# Maximizing Equitable Reach and Accessibility of ETDs

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## ABSTRACT

This poster addresses accessibility issues of electronic theses and dissertations (ETDs) in digital libraries (DLs). ETDs are available primarily as PDF files, which present barriers to equitable access, especially for users with visual impairments, cognitive or learning disabilities, or for anyone needing more efficient and effective ways of finding relevant information within these long documents. We propose using AI techniques, including natural language processing (NLP), computer vision, and text analysis, to convert PDFs into machine-readable HTML documents with semantic tags and structure, extracting figures and tables, and generating summaries and keywords. Our goal is to increase the accessibility of ETDs and to make this important scholarship available to a wider audience.

#### CCS CONCEPTS

• Applied computing  $\rightarrow$  Digital libraries and archives; Document management and text processing; • Information systems  $\rightarrow$  Document representation; • Human-centered computing  $\rightarrow$  Accessibility.

#### **KEYWORDS**

digital libraries, electronic theses and dissertations, accessibility

### **1** INTRODUCTION

University-based institutional repositories are DL systems used to manage, preserve, and distribute intellectual output from faculty, staff, and students. They often contain a significant number of ETDs, the final product of graduate students' research, which are typically long, book-length documents. The most common format for ETDs is the Portable Document Format (PDF), which is widely used as it preserves the visual formatting and layout of the document and is compatible with most computer systems. PDFs have many advantages for scholarly work, but their lack of machine readability and broad accessibility through assistive devices is a significant limitation.

The first ETDs were created around 1988 as Standard Generalized Markup Language (SGML) documents. However, widespread adoption of ETDs did not occur until the introduction of PDF and the release of Adobe's Acrobat tool in the early 1990s. Before the release of the first version of PDF and Adobe Acrobat in 1993, the ETD team at Virginia Tech, through a partnership with Adobe, was able to evaluate a pre-release version of the software to explore its potential for ETDs [6]. Their efforts helped lay the foundation for ETDs and aided the widespread adoption of PDF for the dissemination of scholarly work. ETDs are often only available as PDFs, which typically lack machine readability, semantic structure, and

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machine readable and accessible through the use of tools such as PDF-to-HTML conversion, summarization, and keyword extraction. Advances in machine learning, deep learning, and NLP can improve the accessibility of ETDs, and increase and broaden their usefulness.

#### 2 RELATED WORK

Iris Xie and her collaborators have written extensively on the usability of DLs (e.g., [14, 15]). Her recent focus on the needs of blind and visually impaired users [17] led to the development of the Digital Library Accessibility and Usability Guidelines (DLAUG) in 2021 [16]. Some of the guidelines address problems with accessing PDFs, particularly scanned PDFs, and recommend several techniques to make PDF files more accessible to blind and visually impaired users. These include inserting PDF tags and using OCR software for scanned documents. The guidelines also recommend providing users with document summaries, keywords, and relevant document snippets. However, adherence to these guidelines is time consuming and typically involves manual work by the authors.

Usability advocate Jakob Nielsen has written for more than 25 years about problems PDF files cause online readers [10, 11]. For long documents, Nielsen recommends generating two versions: one optimized for online viewing (HTML) and one optimized for printing (PDF)—but urges that PDF files should *never* be read online [10]. Nielsen advises designers to avoid PDFs unless a printable PDF is necessary. In these cases, he suggests creating a gateway page that summarizes key components and critical information from the document with the option to download the full PDF [11].

A framework for improving the accessibility of articles submitted to the arXiv.org preprint repository was recently published in 2022 [3]. The paper proposes that arXiv should offer an HTML version alongside the PDF and TeX formats currently offered. According to the article, 90% of the submissions to arXiv are provided as TeX, but the conversion from TeX to HTML cannot be fully automated. Authors will need to adjust their workflows in order to create properly formatted HTML versions of their papers. Many efforts are being made to overcome the limitations of scholarly PDFs through the use of AI. AllenAI's SciA11y project aims to increase the accessibility of scientific documents by using AI and NLP techniques to extract and convert the semantic content of scientific PDFs into accessible HTML [13]. Our work is closely related. However, while it is possible that their system could be applied to ETDs, the focus of their work is on improving access to scientific papers (e.g., for conferences and journals), which are shorter and structured differently than theses and dissertations.

### **3 PRELIMINARY WORK**

Our team compiled a research corpus of more than 500,000 full text ETDs and metadata collected from 40+ institutional repositories of universities throughout the United States [12]. The corpus is widely diverse in terms of the departments and academic disciplines it represents. By training models on a diverse corpus, we expose them to a wider range of writing styles, subject matter, and discourse conventions. Our aim is to increase the generalizability and adaptability of our models, making them better suited for working with a variety of ETDs from different fields and disciplines. Additionally, the inclusion of ETDs from multiple disciplines can help identify commonalities in the structure and content of ETDs in general, which could further improve the performance of our models. In multiple studies, we trained models for various tasks with the goal of improving accessibility. These tasks include metadata extraction [4, 5], figure and table extraction [9], summarization [7], keyword generation [8], topic modeling [2], and PDF-to-XML conversion [1]. By converting the PDF to XML, we capture the semantic structure of the document. The XML is converted to HTML or ePub for humans to read online, and it can be easily converted to other XML formats, such as the JATS format used by PubMed and others, to increase the interoperability and discoverability of the ETD, and allow for more efficient indexing, searching, and retrieval of content by other systems. By combining these techniques, we aim to create a more accessible, navigable, and machine-readable DL for ETDs.

#### **4 DISCUSSION AND FUTURE WORK**

We investigate using AI to convert PDF ETDs to machine-readable HTML documents with semantic tags, extracted figures and tables, and generated summaries and keywords, with the aim of making them machine-readable and more accessible to a wider audience. More research is underway to assess the impact of the proposed techniques on the accessibility and usability of ETDs through user studies involving a diverse group of participants, including those with visual impairments and cognitive or learning disabilities.

As ETDs are complex book-length documents, creating one long HTML representation might not be the best way to present them. More research is needed to determine how users can navigate and consume information in an ETD in the most effective and efficient way. ETDs differ from other academic writing in their length and format and contain a diverse range of content, including text, images, tables, equations, and references. A combination of approaches, including structured navigation, adaptive interfaces, and summarization, may be needed to support users in finding and understanding the content buried in these rich scholarly documents.

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