

# **A Complete System for Publishing Music-related ETDs: Technology Development and Publishing Model**

## **Abstract**

### **Purpose**

There is no proposed solution to address the unresolved issues of publishing music-related electronic theses and dissertations (ETDs) pertaining to technology availability, copyright, and preservation. This article proposes a complete system, including technology development and publishing model, which addresses the existing issues of publishing music-related ETDs. The article shares the practice of utilizing the system developed by Texas Tech University Libraries known as Streaming Audio & Video Experience (SAVE), and proposes it as a solution for other multimedia collections.

### **Design**

The proposed system includes a technology solution and a publishing model. The technology solution, SAVE, contains an authenticated streaming multimedia player, a responsive-design user interface, and a web-based submission and management system. The publishing model combines a DSpace-based institutional repository (IR) with SAVE and preservation strategies.

### **Findings**

The integrated system of SAVE and DSpace-based IR expands the access of music-related ETDs and other multimedia collections to patrons, benefits the distance education students as well as the local students, facilitates professors' classroom teaching, and helps to preserve physical multimedia items by avoiding check-outs.

### **Value**

The SAVE solution resolves issues of publishing music-related ETDs, fulfills the local needs of publishing hundreds of music-related ETDs from the College of Visual and Performing Arts, and supports the publishing of other multimedia collections. The software will be released open source to the public for other universities' use. The publishing model is also useful for those universities that intend to integrate an IR with the streaming player platform.

*KEYWORDS: Electronic Theses and Dissertations, ETDs, Music-related ETDs, Multimedia Files, Multimedia Player, Digital Repository, Institutional Repository, Music Recitals, Music School, SAVE, Streaming Audio & Video Experience*

## Introduction

Current literature has vigorously discussed various aspects of ETDs, including but not limited to: collaboration and submission, system development, metadata, discovery, and long-term preservation strategies. However, very little literature is found discussing music-related ETDs. The main challenges of publishing music-related ETDs are the integration of a variety of music formats and software, as well as the appropriate use of copyrighted music materials. In the past decade, the published music-related ETDs merely include multimedia supplements by attaching original audio files, allowing free access to download copyrighted and archival performances. No integrated solution is proposed in the literature to address the concerns of multimedia publishing in music-related ETDs.

Realizing the current concerns and unresolved issues that are still existing in music-related ETDs, Texas Tech University Libraries proposes a comprehensive system and presents it as a solution to the publishing and curating of music-related ETDs. This integrated system is a combination of the technology solution SAVE, a DSpace-based IR publishing model, and a dark archive preservation strategy. SAVE includes an authenticated streaming multimedia player, a responsive-designed user interface, and a submission and management system. The system helps resolve the conflict between copyrighted performing works and open access of metadata records, and it helps to facilitate publication, dissemination, and preservation of music-related ETDs. Using the system, Texas Tech University Libraries is able to process the backlogs of several hundred music-related ETDs and will be extending the use to other copyrighted performing art works.

## Literature Review

Methods of dissemination of theses and dissertations have been evolving along with the rapid development of information technology since the early 20th century when microfilm was used for storage and distribution (Clement & Rascoe, 2013). Starting in 1987 when the concept of ETDs was formed, theoretical literature and technological development began to speed up with the advancement of Internet technology and online search engines (Fineman, 2004). Scholars of library and information science have widely and deeply discussed issues regarding ETD collaboration, discovery, metadata, system improvement, and preservation strategies (Janick & McLaughlin, 2006; Song, 2007; Yiotis, 2008; Lippincott & Lynch, 2010; Early & Taber, 2010; MuCutcheon, 2011; Stewart, 2012; Perrin *et al.*, 2015). However, only a little literature has discussed music-related ETDs, mainly because the concept of ETDs, according to Fineman, is generally “limited to providing better access to information, but not additional or better information” (2004, p.898)

Many academic libraries have implemented ETD submissions through the collaboration between graduate schools and the university libraries, mandating graduate students to submit

ETDs into the institutional repositories (Fox *et al.*, 1996; Fineman, 2003; Yiotis, 2008; Swain, 2010). Fineman (2004) noted that the fundamental technology supporting most ETDs has been PDF files for more than a decade, while music-related ETDs merely include multimedia supplements in the format of attached audio files. Thus, graduate students preparing musical ETDs face additional challenges and problems of integrating music formats and software with text documents, as well as the appropriate use of copyrighted materials of music (Fineman, 2004). Similar issues were also mentioned by Lippincott and Lynch (2010), reporting that the particular issues of multimedia associated ETDs have been raised about copyrights and online access.

Dougan's current study found that music-related ETDs are still using the publishing model of attaching original multimedia files, allowing free downloads of copyrighted works (2011). Some ETD repositories and ProQuest allow students to deposit supplemental digital files, including audio and video recordings. However, issues related to preservation, copyright, and multimedia components such as audio and video have yet to see standard resolution in ETDs (Dougan, 2011).

Researchers studying music-related ETDs pointed out the direction of future research, hoping to address the existing issues of music-related ETDs. Fineman (2004) emphasized the availability of software and development of applications, stating that technology development is needed to ensure future access to the contents of music-related ETDs. Fineman proposed an idea of bundling archival copies with corresponding media files on the host server, based on a solution to resolve copyright issues.

Dougan (2011) wondered how the continued use of ETDs as the standard format of deposit would affect the mechanics of official recording. Since the National Association of Schools of Music (2010) requires music schools to keep the final products of a degree as part of their certifications, Dougan asked that, if students are not able to deposit supplemental media materials with ETDs to ProQuest or local repositories, in what formats will these recordings remain accessible. Dougan claimed that ETDs cannot be a permanent record of graduate work if they do not integrate all of the elements created by the students. Future research is therefore needed to determine how the barriers pertaining to media, copyright, and preservation can be addressed in both local and global ETD repositories (Dougan, 2011).

## **Problem Statement**

The literature has discussed all aspects of ETDs except for the music-related ones. The traditional digital repository systems are developed to support the dissemination and preservation of PDF files, the dominant format of ETDs. Thus, they are not able to address issues associated with multimedia files. However, since graduate students of music schools are required, just like other graduate students, to submit their ETDs to the IR, they face additional challenges. The most obvious challenges are submitting and disseminating their graduation projects while being

mindful of audio player software and of the appropriate use of copyrighted works. Scholars in this field have realized this problem and called for a standard solution to handle music-related ETDs (Fineman, 2004; Dougan, 2011). Because of the lack of a solution, Texas Tech University Libraries is unable to process the backlogs of music-related ETDs and other multimedia digital items.

To resolve the issues of publishing, disseminating, and preserving copyrighted music-related ETDs, the ideal technological solution must be able to accommodate online access of associated multimedia files, supplemented with metadata records and PDF files, if any. In the publishing model, metadata records of music-related ETDs should be made available to the public, while the multimedia files should require appropriate authentication and be played via streaming media. In order to protect copyrighted performing works, both the publishing copy and the archival copy of multimedia files should be stored on the institutional server instead of other third-party servers. In other words, the ideal system, associated with a publishing model, needs to accommodate the public access of metadata records and the authenticated access of multimedia files, all while protecting copyrighted performing works from unauthorized downloading and third-party storage.

### **Technology Solution**

With the publishing model and dissemination challenge clearly defined, Texas Tech University Libraries development team and metadata librarians set out to create the Streaming Audio & Video Experience (SAVE) system. The total time spent developing this project is two person-years of programming and design.

The SAVE system begins with a web-based administrative interface for librarians to add materials to collections (See Figure 1). After an initial, automated import of the existing collections, librarians are able to maintain the collections by manually adding each year's audio and video ETDs. Using this interface, librarians can enter all the metadata associated with each ETD, upload audio and video files, and provide a link to the DSpace listing of the item (See Figure 2). The internal web interface submission system also includes multiple file upload functionality and delimits the file names accordingly.

[Figure 1 Administrative Interface of SAVE]

[Figure 2 Item Uploading & Editing Interface of SAVE]

SAVE is written to favor commonly used metadata for audio and video items, with fields such as title, composer, performer, original format, and so forth. The software was written by the programmers at Texas Tech University Libraries using tools including Adobe Dreamweaver, Microsoft SQL Server, PHP, JavaScript, Bootstrap, jQuery, and the jQuery DataTable library ColVis. The administrative interface took one developer approximately six months to create, and it was written after the basic functionality for public users searching and browsing collections.

The Microsoft SQL Server database which stores the audio and video special collections was designed for speed and ease of use rather than completely thorough metadata with inevitably empty fields. For example, if a collection item contains more than one audio/video file, the file names are delimited by the vertical bar or pipe (|) character in a single field rather than placing each name in its own field. The lean selection of fields also includes: an automatically incremented ID number, the item's call number, title, track names, names of the performer and contributors, instruments, degree and department, original format, description, creation date and performance date, DSpace URI, and collection. This data is also indexed by call number for fast access. A table containing records for each collection (ID, name, and description) completes the foundation of the system.

The folder structure of the application reflects the data design as well. Each digitized collection item contains a folder with the same name as the call number. The call number is also the unique identifier in the database. All media files associated with the item are copied to the respective folder.

The development team took steps to ensure the security of audio and video files in the collection, as it is common for items to be embargoed or restricted by some policy. Access to the media file server is restricted by IP address, with public access allowed only to the web application server. This limitation guarantees that only the web application can directly access media files of any item in the collection. The player itself adds another layer of security by disallowing direct download of the media files, which are instead streamed to the user.

The browse, search, and player interface combine to create the user interface portion of the SAVE system. This entire system can only be accessed after authenticating with the campus single sign-on system at Texas Tech University. Other institutions can substitute their own single sign-on authentication instead. Placing the entire system behind single sign-on authentication is essential for protecting copyright and various item-specific restrictions.

The browse and search features of the SAVE system were the original impetus for the project and are some of the most distinctive features of the finished product. The goal of the browse interface is to provide Netflix-like endless scrolling carousels of items represented by thumbnail images, which are retrieved from the database along with the item metadata (See Figure 3). These images are grouped and sorted by various criteria, such as date, performer, instrument, etc. This browse interface is created with Bootstrap for a responsive design, so it renders appropriately on any size device such as PCs, tablets, and phones. The player is responsive as well and shrinks or expands as needed.

### [Figure 3 User Interface of SAVE]

A content area to the left of the player completes the browse interface. SAVE displays a PDF document associated with the media items, such as a recital program or a theatrical performance program. Standard embedded PDF controls are available: save, print, etc.

The search interface enhances the user interaction with each collection by providing the traditional set of search tools expected by users. The primary search option is a simple search box in the header of the application that searches all fields for the keywords provided. This simple interface meets internet user expectations. An advanced search allows users to specify which fields will be searched. Additionally, multiple collections can be accessed through a dropdown menu.

The SAVE player has standard music player controls such as play, pause, previous, next, volume, current time, total time, repeat, and shuffle. JPlayer is the free and open source software selected for the player, in order to support more devices. JPlayer is powered by HTML5 and jQuery, which are universally supported by modern browsers on any contemporary device.

Each item in a collection has a unique URL associated with it. This was an essential feature of SAVE so that items could link directly from other interfaces such as DSpace. The call number parameter of the URL query string for each item is dynamically updated by jQuery when carousel items are clicked.

### **Publishing Model**

Texas Tech University Libraries uses DSpace as the main repository system for the IR. Graduate students are mandated to submit an electronic copy of their thesis or dissertation to the university libraries. However, they are also allowed to select five embargo options, which include: unrestricted access, restricted for a period, authenticated access to the university community, restricted to physical copy only, and restricted indefinitely. Based on the student-selected embargo option, librarians then implement complete metadata for each ETD and publish them in the IR.

The music-related ETDs are all treated as normal ETDs in IR. This treatment is implemented with complete metadata of Dublin Core and supplemented with PDF files of recital programs, but not any multimedia files. Both the metadata record and the recital program in PDF are open access to the public, and they can also facilitate the indexing and discovery of published items by online search engines, such as Google and Google Scholar. In doing so, the ETD collection in IR functions as the main portal for all landing traffic of the music-related ETDs (See Figure 4).

[Figure 4 Main Portal of DSpace-based IR]

The archival WAV files of the music-related ETDs are all converted to MP3 format for publishing purposes. The MP3 files are assigned call numbers and uploaded to the server of authenticated streaming player. Each MP3 file uploaded to the player server also generates a corresponding URL with its call number. After uploading, the SAVE administration interface allows metadata librarians to implement and modify metadata for each uploaded MP3 file. This metadata guarantees that accurate information is displayed when the music is played. The DSpace handles of ETD items in IR are also added to the corresponding music files on the player.

After adding the information to SAVE, the unique corresponding URLs of multimedia files in SAVE are added as a “dc.relation.uri” field to the same ETD items in the IR (See Figure 5). In addition, the corresponding URLs are also saved as HTML files and uploaded as supplemental files to the ETD items (See Figure 4). When opening the associated HTML files or clicking the “dc.relation.uri” links, patrons will be prompted with a log-in page to get access to the specific music files on the streaming player.

[Figure 5 Music ETD Item Published in DSpace-based IR]

### **Preservation Strategies**

All original music files in cassettes, reels, CDs, and DVDs have been converted to WAV files for preservation purposes. For the born digital ETDs, students are required to submit both WAV and MP3 files the libraries. In the dark archive, each published item is assigned a folder, where the archival WAV files are stored. Both the archival WAV files and folders are assigned the same call numbers used for the SAVE streaming player. For the filing structure of preservation, please see Figure 6.

[Figure 6 Filing Structure of Preservation]

For administrative purposes, information of all music-related ETDs is documented in a manifest, an Excel sheet that contains all basic information for every published item, including file names, titles, authors, corresponding URLs in the SAVE, and handles in the IR. The manifest allows librarians to locate any file in the future, even when having only a piece of valid information.

The dark archive and the SAVE search interface and streaming player are supported by two separate servers, one of which is on campus while the other is at a geographically separate location from the main server. Texas Tech University Libraries is using Microsoft Robocopy to replicate all files on the remote server daily.

## **Conclusion**

Regarding the publication of music related ETDs in either local or global ETD repositories, the current literature does not provide a solution to address the barriers pertaining to media, copyright, and preservation. In order to fulfill the needs of the College of Visual and Performing Arts, Texas Tech University Libraries has developed SAVE: a platform that incorporates an authenticated streaming multimedia player, a responsive-designed user interface, and a submission and management system. Texas Tech University Libraries integrates SAVE with the DSpace-based IR to create a publishing model which addresses the copyright issues of music-related ETDs along with other copyrighted multimedia collections on campus.

The proposed integrated system – including both the technology solution and the publishing model – overcomes physical and technological limits while expanding access to music-related ETDs and other multimedia collections to patrons from any computer with an Internet connection. Through the SAVE system, distance education students have the same access to multimedia collections as local students do. Also, these multimedia collections can be made available for use in networked classroom and course management systems across campus. Professors are able to use these collections in their lessons without having to check out the physical copies from the library. By offering this online accessible system, physical multimedia files avoid substantial amount of future damage caused by heavy use and frequent check-outs.

The submission and management interface of SAVE are currently for administrator use only; librarians are able to upload music files, edit metadata, and remove files with this interface. The SAVE administrative system could be improved by integrating it with popular submission systems of regular PDF ETDs and similar collections. Another possible enhancement would be to allow administrators to specify keywords to boost search engine optimization for each item in a collection. In order to discover what can be further improved, user study is needed to determine if the current set-up of the publishing model and the streaming player interface meets the needs and expectations of patrons. Google Analytics has also been deployed in both SAVE and DSpace. After each full semester of use, analysis of the whole system is needed to assess the usage of music-related ETDs, to study user behavior, to evaluate the effects of search engine indexing, and to analyze traffic sources to the collection.

Texas Tech University Libraries plans to release the SAVE technology as open source software to benefit the universities that have similar needs. Therefore, an easy installation package will be desirable and customization features need to be provided for the SAVE system. Texas Tech University Libraries also seeks collaborative opportunities with other institutions and

associations, such as the U.S. Electronic Theses and Dissertation Association, the National Association of Schools of Music, or the Music Library Association, to make further improvements on the SAVE system.

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