The proposal for the Digital Music Library project summarizes the work to be completed as follows:

1. To establish a Digital Music Library (DML) testbed system, using IU's highly successful VARIATIONS digital library application as a foundation, greatly expanding it with additional representations of music in other media, additional metadata and new software tools for enhanced intellectual access and navigation, and by providing and demonstrating new capabilities for remote network access.

2. To develop applications for education and research in the field of music that are based on the evolving collections and functions of the DML.

3. To use the DML for digital library research in these key areas: usability and instruction, and intellectual property implications for various representations of music.

This document focuses on the first two points, providing a basic outline of the testbed system and applications to be developed as part of the DML project. Some text in this document has been adapted from the original project proposal.

Summary

The Digital Music Library (DML) testbed system will provide users with access to a collection of music in several formats from a range of musical styles and types. Users will listen to sound recordings of musical performances; browse and display images of published scores; view and manipulate encoded score notation files; have notation translated into MIDI format for audio playback; retrieve documents and text files that relate to musical works (possible); read historical, biographical, and critical essays (possible); and make use of active links that connect a musical work in one format to a representation in a different format.

The DML system will provide navigation, search, and retrieval functions for this large and diverse information space. This will include search based on descriptive metadata; retrieval and synchronized playback of recorded music, MIDI files and encoded music notation files; access to structural metadata for manipulation of and navigation within individual recordings or other music representations; access control and authentication services; and administrative metadata for rights management.

The DML system will provide a software framework to make digital music objects (music sound recordings, score notation files, text files, etc.) accessible to music instructors and application developers, using a component-based programming architecture. This framework will serve as the foundation for developing and delivering software applications that integrate the collections of the DML into teaching and research in the field of music.

No other digital library system currently offers such capabilities for search, retrieval, and navigation of musical content.

Content

The testbed system will contain musical information in the following content formats:

- Audio
- Musical score images
- Musical score notation

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An existing set of audio files (6000+ titles) and score image files in VARIATIONS will be drawn upon to populate the DML’s audio and image collections, with selections based on user need and intellectual property restrictions. In the case of notation and MIDI formats, we do not plan to encode a large body of music, but to incorporate existing collections when possible.

**Metadata**

Metadata will be developed to enable the following functions:

- Greatly improved search functionality for music over that possible in traditional MARC-based library catalog systems, including search based on characteristics such as style, genre, instrumentation, date of composition/performance, and others which are not easily searchable using current systems.
- Navigation to specifically defined locations within a sound file, score image file set, or score notation file (i.e., tracks on a recording, movements within a score).
- Relation of multiple representations (e.g. sound files, score images, notation files) of the same work. When a user is accessing one version of a work, links will be available to the other representations.
- Association of multiple representations of the same work by linking particular locations, i.e., the opening passage of the second movement of Mozart's Symphony No. 40 on a recording will be linked to the same passage in a score image or notation file.
- Association of multiple representations of the same work with greater specificity by linking them together at the measure or note level.
- Control of access to content, based on legal requirements defined as part of the project.

Note: Not all musical works in the DML will contain the same degree of structural information. Only a small fraction will likely be linked at the measure or note level, but for those that are, applications will be able to use of this structural metadata to synchronize playback of multiple linked representations such as a sound file and score.

**Network**

The testbed system will be developed to support network delivery of library content (including audio and possibly video) over a wide range of network architectures, including LAN, WAN, and remote access technologies. Evaluation of network delivery of content over traditional and high-performance wide area and international networks will be conducted with the assistance of “satellite sites” in the United States, Japan, and the United Kingdom.

**Architecture**

One of the greatest differences between the current VARIATIONS system and the DML testbed system will be that of system architecture. The DML will contain a layered architecture of repository services, access components, and user interface components, designed to allow the system to be adapted over time to accommodate changes in technology and provide new functionality.
There will not necessarily be a single user interface to the system. The access components and user interface components are intended to be used to bring DML functionality into new applications developed to meet needs of particular user communities. User interface components to be developed include:

- Audio player
- MIDI player
- Score image display
- Score notation input/editor
- Score notation player
- Digital Timeliner (bubble chart)
- Text display
- Score notation / image / audio synchronization

Applications

As many as three possible user interface front-end applications are envisioned for development within the context of this project, using the user interface components defined above:

- A general purpose library application
- An authoring / class presentation / lesson delivery application for music theory instruction (MMTT: Multimedia Music Theory Teaching)
- Integration of DML services into the existing OnCourse web instructional application

The general purpose application will support searching based on descriptive metadata, and retrieval/playback of content using the components listed above (including synchronized playback and navigation). In addition, it should support bookmarking of content by users to aid in future access.

An authoring environment will be developed for use by faculty and instructional developers in creating classroom presentations and independent exercises which incorporate use of DML content. This environment will allow music theory instructors to construct their own multimedia documents by assembling application components through which they can play music selections, view scores, and assess students’ abilities to hear, understand, and categorize music.

Mechanisms for linking between OnCourse and DML content will be developed to allow instructors using OnCourse to incorporate digital music content into entirely web-based courses as well as online supplemental materials for traditional classroom-based courses. The main requirement is simply the ability to link to the DML’s content display/playback mechanisms using a URL.

Platform support

Both Windows and Macintosh platforms will be supported by DML client software, given the extensive use of both for music applications. The following specific operating system versions have tentatively been selected for support: Windows NT, Windows 2000, and MacOS X. Server platform is to be determined.