Adding Content-Based Searching to a Traditional Music Library Catalogue Server

Matthew J. Dovey
Visiting Research Fellow, OMRAS Project
Dept. of Computer Science, Kings College, London
Tel: +44 1865 278272   E-mail: matthew.dovey@las.ox.ac.uk

ABSTRACT
Most online music library catalogues can only be searched by textual metadata. Whilst highly effective - since the rules for maintaining consistency have been refined over many years - this does not allow searching by musical content. Many music librarians are familiar with users humming their enquiries. Most systems providing a “query by humming” interface tend to run independently of music library catalogue systems and not offer similar textual metadata searching. This paper discusses the ongoing investigative work on integrating these two types of system conducted as part of the NSF/JISC funded OMRAS project (http://www.omras.org).

Categories and Subject Descriptors

General Terms
Algorithms; Design

Keywords
Music Information Retrieval; Z39.50

1. INTRODUCTION
OMRAS (Online Music Retrieval And Searching) is a three-year collaborative project between Kings College London and the Center for Intelligent Information Retrieval, University of Massachusetts. One of its aims is to look at issues surrounding content-based searching of polyphonic music; current research in content-based music searching has tended to concentrate on monophonic music, i.e. music consisting of a single melodic line, ignoring the complexities in more complex music textures such as those found in, say, an orchestral symphony.

However, a key mission statement of the joint JISC/NSF International Digital Library Initiative, which is funding the OMRAS work, is to make existing digital collections more accessible. We intend that the work of OMRAS will achieve this for music collections by making content-based searching possible as well as standard metadata searching such as by composer or title. This paper outlines some collaborative work with JAFER, another JISC funded project in the UK, to provide a prototype applying the searching technologies developed in OMRAS to enhance an existing online music library catalogue.

2. The OMRAS Test Framework
The OMRAS project has developed a Java based framework to test the performance of various search algorithms and techniques. The framework is currently command-line driven and not aimed at novice users. We can load music files (in different formats), different algorithms and different user-interface components (for displaying and editing queries and results) into the system. We can then experiment with and compare different algorithms and representations for music.

The framework takes advantage of Java’s object-oriented nature: all components such as file-format modules, user-interface elements and search algorithms are implemented as independent java objects. These are manipulated in the framework using a scripting interface such as BeanShell¹, but selected components can be used in other software. At the moment, we have modules for handling a small number of file formats (including MIDI) and are working on others. The user-interface components are based on piano-roll type displays, but we are planning to incorporate better music-score display software soon. With this framework we have devised a number of algorithms for searching musical content, described elsewhere [1][2].

3. INTEGRATING MUSIC SEARCHING WITH LIBRARY SYSTEMS
3.1 Z39.50 and Library Systems
Many music libraries will already have an electronic catalogue of their collections. Typically systems contain a database of records in a cataloguing format called MARC² (an established standard for library catalogue systems) and follow established cataloguing practices such as AACR2 [3]. Many systems allow querying using a protocol called Z39.50 (ISO 23950)³. This is fairly rich in functionality; it allows a third-party system to query an external database as shown in Figure 1. The client, possibly a dedicated client such as EndNote or a web gateway, sends a query to the library system. The library server then returns the records.

A major strength of Z39.50 is that the query uses abstract search points such as “author” and “title”, and requires no knowledge of the underlying database structure of the server. In 1998, I successfully proposed adding “musical phrase” to the standard as a potential search point⁴. This allows a music library catalogue to...

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¹ http://www.beanshell.org
² http://www.loc.gov/marc
³ http://www.loc.gov/z3950/agency
⁴ http://lcweb.loc.gov/z3950/agency/defns/bib1.html#music
respond to queries which include traditional textual search terms as well as a query by musical content. Most library systems at present cannot cope with queries which include music content. Although some systems do provide music content query, e.g. the MELDEX system\(^3\), these typically do not have rich metadata or detailed holding/circulation information as in library systems.

3.2 A Z39.50 Proxy Solution

It is possible to put a Z39.50 proxy server in the system to do additional processing. Figure 2 illustrates how such a proxy could add music content searching to an existing library catalogue without modifying the existing system. The query consisting of textual metadata (e.g. composer and title details) and a musical phrase is sent to the proxy server. The proxy passes the textual part of the query to the music library catalogue and receives the appropriate results. The proxy then filters these results by performing a music content query on its own database of musical scores. Each record on the library catalogue has a unique identifier with which the corresponding score in the proxy's database can be tagged. These identifiers are used to determine the records to be returned to the user. The end-user sees a system that can take combined textual and music based queries.

There is a slight difference if the user only submits a music query as shown in figure 3. Here the music search is carried out first, giving the proxy a list of potential matches. The identifiers returned from this search are sent to the music library catalogue in order to retrieve full details of the item (including location and circulation details) for the user.

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3 http://www.nzdl.org/musiclib

4. The OMRAS/JAFER Prototype

The JAFER project\(^6\) is a JISC funded project based at Oxford University which is developing Java based Z39.50 tools. Part of the toolkit allows the building of Z39.50 proxies. The modular nature of the OMRAS test-bed framework means we could take the java objects for the search and indexing algorithms and plug them into the JAFER toolkit’s Z39.50 proxy to produce a proxy as described above. This prototype is still very much proof of concept but it has been demonstrated against the library systems at Kings College London, Oxford University and University of Massachusetts at Amherst. The proxy also modifies the returned records to add a pointer to a MIDI file for the work.

5. FUTURE RESEARCH

We are continuing to develop our algorithms to cope with more complex representations of music. We are also looking at methods for ranking the result lists in order of relevance \([4]\). There are other questions concerning the user interface both in how users should enter musical queries and how the results should be displayed which are being addressed within OMRAS.

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7. REFERENCES


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6 http://www.lib.ox.ac.uk/jafer