MODULO7 : A FULL STACK MUSIC INFORMATION RETRIEVAL AND STRUCTURED QUERYING ENGINE

First Author
Affiliation1
author@ismir.edu

Second Author
Retain these fake authors in submission to preserve the formatting

Third Author
Affiliation3
author3@ismir.edu

ABSTRACT

This paper describes a novel Music Information Retrieval and Structured Querying framework named Modulo7. Modulo7 is a full stack implementation (both client and server side software) which facilitates indexing variegated sources of music (midi, mp3, music xml and digitized sheet music files). Modulo7 implements a similarity search engine based on customized vector space representations of songs, an efficient indexing and persistent storage mechanism and an interface for querying attributes based on SQL(Structured Querying Language) like principles. The papers describes the implementation details and outlines speed up and scale up results over input sources and other MIR frameworks.

Keywords : MIDI, Music XML, MP3, Music Retrieval, SQL

1. INTRODUCTION

Given the explosive growth of Music Information Retrieval research, several approaches and software suits have been designed to tackle generic problems such as efficient indexing, similarity searches, archival methods, structured and un-structured querying ,feature extraction, audio and digital signal processing. A vast majority of the MIR frameworks in academia tend to approach very specific problems and does not support scalability as a significant end goal in itself [3]. Moreover, industry applications predominantly treat MIR applications based on collaborative filtering approaches [7] and/or manual annotation [4] instead of structural analysis of music sources yet scales very well to large datasets.

Modulo7 is an attempt to capture the best features of both worlds. Modulo7 converts different music sources (midi, musicxml files, sheet music png/jpeg files and mp3) into a single unified symbolic representation. It indexes songs on global properties (artist, key signature, time signature etc) and provides a vector space implementation for similarity searches and querying based on the similie [6] platform and extended to include chords and polyphony. As a consequence, Modulo7 acts as an end to end software suite for Music Information Retrieval including client side querying, searching, indexing and persistent store mechanism.

2. RELEVANT WORK

Music Information Retrieval is a vast and interdisciplinary body of work. In order to facilitate research in MIR, several software suits and frameworks have been developed in the past. Notable amongst them are software suits like jMIR [9] for automatic feature extraction from audio and midi sources, marsyas [11] and essentia [1] for audio processing, humdrum [2] for automated musicological research, gamera [5] for optical music recognition and symbol identification,

3. SOFTWARE ARCHITECTURE AND DESIGN

This section details the software architecture of the Modulo7. The Modulo7 architecture can be visualized as 2 and is broadly divided into the following components

1. **Music Parsers:** Components that individually parse different music sources into a unified symbolic representation. as described in 1. This object can be stored in memory or in a persistent serialized state via Apache Avro. Depending on the source of the file, the parser utilizes a different approach.For mp3 files, the input is parsed into chromagrams using echonest API and then converted into symbolic format using the KKTonality profiles algorithm [8]. Similarly for

2. **Music theory Models:** Modulo7 implements vector space models described in [6] with extensions to polyphonic music and chords using a template matching algorithm described in [10]. This forms a mathematical formulation of music sources described in detail in 4 which is leveraged for querying and similarity searches.

3. **Client side Querying:** Modulo7 implements a client side abstraction that exposes two modes of information retrieval.

   (a) **Structured Querying:**

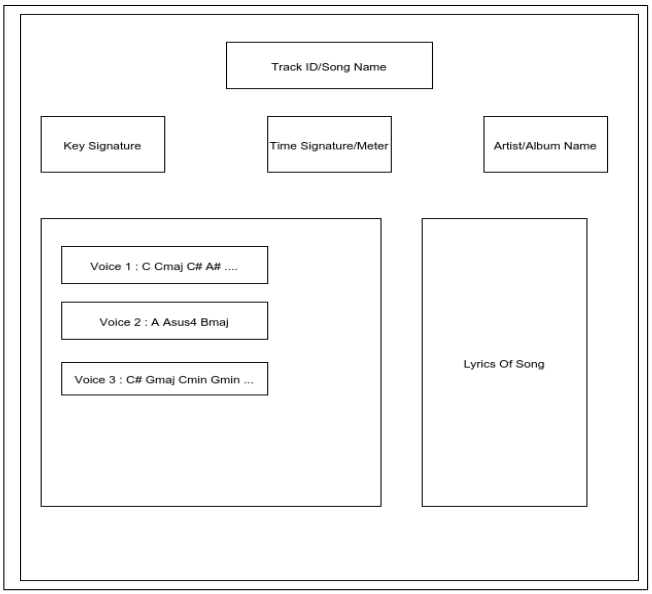

Figure 1. Modulo7 internal representation.

4. **Auxiliary Models:**

Modulo7 also

4. VECTOR SPACE MODEL REPRESENTATION OF MUSIC SOURCES

5. MODULO7 QUERYING SYNTAX AND SIMILARITY SEARCH

6. EXPERIMENTAL EVALUATION

7. CONCLUSION AND FUTURE WORK

8. REFERENCES

[1] *ESSENTIA: an Audio Analysis Library for Music Information Retrieval*.

[2] Anon. The humdrum toolkit: Reference manual. menlo park, california: Center for computer assisted research in the humanities, 552 pages, isbn 0-936943-10-6.

[3] Donald Byrd and Tim Crawford. Problems of music information retrieval in the real world. *Inf. Process. Manage.*, 38(2):249–272, March 2002.

[4] W.T. Glaser, T.B. Westergren, J.P. Stearns, and J.M. Kraft. Consumer item matching method and system, February 21 2006. US Patent 7,003,515.

[5] Ichiro Fuginaga Karl MacMillan, Micheal Droettboom. Gamera: Optical music recogntion in a new shell.

[6] Daniel Mllensiefen Klaus Frieler. The simile algorthms for melodic similarity.

[7] Greg Linden, Brent Smith, and Jeremy York. Amazon.com recommendations: Item-to-item collaborative filtering. *IEEE Internet Computing*, 7(1):76–80, January 2003.

Figure 2. A block diagram of the Modulo7 Architecture.

[8] Sren Tjagvad Madsen, Gerhard Widmer, and Johannes Kepler. Key-finding with interval profiles.

[9] Cory Mckay. Automatic music classification with jmir, 2010.

[10] Adam M. Stark and Mark D. Plumbley. Real-time chord recognition for live performance. 2009.

[11] George Tzanetakis and Perry Cook. Marsyas: A framework for audio analysis. *Org. Sound*, 4(3):169–175, December 1999.