DESIGN OF THE MUSIC SCORE WEB ONTOLOGY USING ARC2 FRAMEWORK

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Abstract

The objectives of this paper are 1) to construct the design of the web ontology of the Music Scores using Arc2 Framework that will be used to create the music scores web ontology of Jose Maceda Compositions and 2) to introduce another model and process of representation of music-related data and metadata schemata for storage and retrieval system. This also includes research and exploration on comparative evaluation for the framework and systems available for the web representing an ontology across digital repositories and collections.

Web ontology of music score is linked to Music Ontology in several ways. The RDF framework is flexible that supports different informational object types like Class: mo:Score, or Class: mo:PublishedScore or Property: foaf:maker and etc which serves as extensions by the music score to Music Ontology. Interoperability on the other hand is the focus of our future research for the results show that MARC, AACR2 and LCSH are the most widely used among digital repositories and collection in metadata description and construction. They are confined with the Library foundational operations and looking into new approach is considered. Furthermore Jose Maceda Music Score Web Ontology establishes an opportunity for collaborative codification by diverse groups opening other metadata schemata representation, data storage model and retrieval system and resolutions to reuse and interoperability issues and some other knowledge representation challenges.

Keywords: Web Ontology, Music Ontology, Ontology, RDF, RDF/XML, Music Score, SPARQL

INTRODUCTION

This paper is a part of a project on Building the Ontology of Jose Maceda Collections of the Center of Ethnomusicology, College of Music of the University of the Philippines. The paper focuses mainly with the representation of the music score of Jose Maceda compositions. The Center which houses Jose Maceda Collections has an ongoing digitalization wherefore needs a structural framework to organize and classify digitally converted collections. Web Ontology as a knowledge representation for authoring knowledge databases is a known semantic for the web. Its concept has been an IT niche for quite a while now because it provides a machine readable vocabulary that allows compatibility with the World Wide Web (WWW) architecture. Thus this study constructed an ontology to represent and express music-related information in the WEB. Currently there is no extension module yet available for Music Score in the Music Ontology and therefore this study creates one and makes it available to the community, capturing features of the Music Scores of Jose Maceda Compositions.

MOTIVATION

This is the first leg of the two-part paper entitled, "Music Score Web Ontology of Jose Maceda Compositions Using Dublin Core". This paper aims to construct a web ontology to represent the musical scores of Jose Maceda Compositions using Dublin Core. Some parts of the Jose Maceda collection has been cataloged to Marc 21 format which can be mapped to Dublin Core. For this, the ontology can be created through the use of crosswalk. However this paper aims to construct for part of collections that has no crosswalk (Marc 21 to Dublin Core) like the Music Scores. In this study, the design is going to be developed using Arc2 Framework, a lightweight RDF library and system for parsing and serializing RDF/XML files, that will eventually be extended to developing Dublin Core Metadata.

MUSIC ONTOLOGY DESIGN

Music Ontology is an online community effort collaborating to express music-related information in the Semantic Web. As an active community, it is designed to allow simultaneous deployment and extension to scalable Music vocabularies and terminologies. Moreover as a framework, it has a namespace document specification

"Music Ontology"

- Provides the terms, Resource Description Framework (RDF) classes and properties that semantic web applications use in a variety of RDF-compatible document and formats.

- Is identified by the namespace URI : *'http://purl.org/ontology/mo/'.*

- Uses RDF Music-Ontology-based description that allows integration to other RDF vocabulary.

- Music Ontology RDF/XML Ontology namespaces referenced allows reuse of other ontologies.

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● Allows also other ontologies to be plugged on top of Music Ontology namespaces referenced, a way to extend the ontology

Music Ontology RDF/XML

Music Ontology RDF provides the description of the main concept and properties of music related terms on the web. Latest version is available at: *http://motools.sourceforge.net/doc/musicontology.rdfs*

Figure 1. Music Ontology RDF

Figure 2. shows the overview of the Music Ontology in class diagram representation. Also refer to Appendix A for the summary of terms that defines 54 classes and 153 properties of Music Ontology [*http://purl.org/ontology/mo/*].

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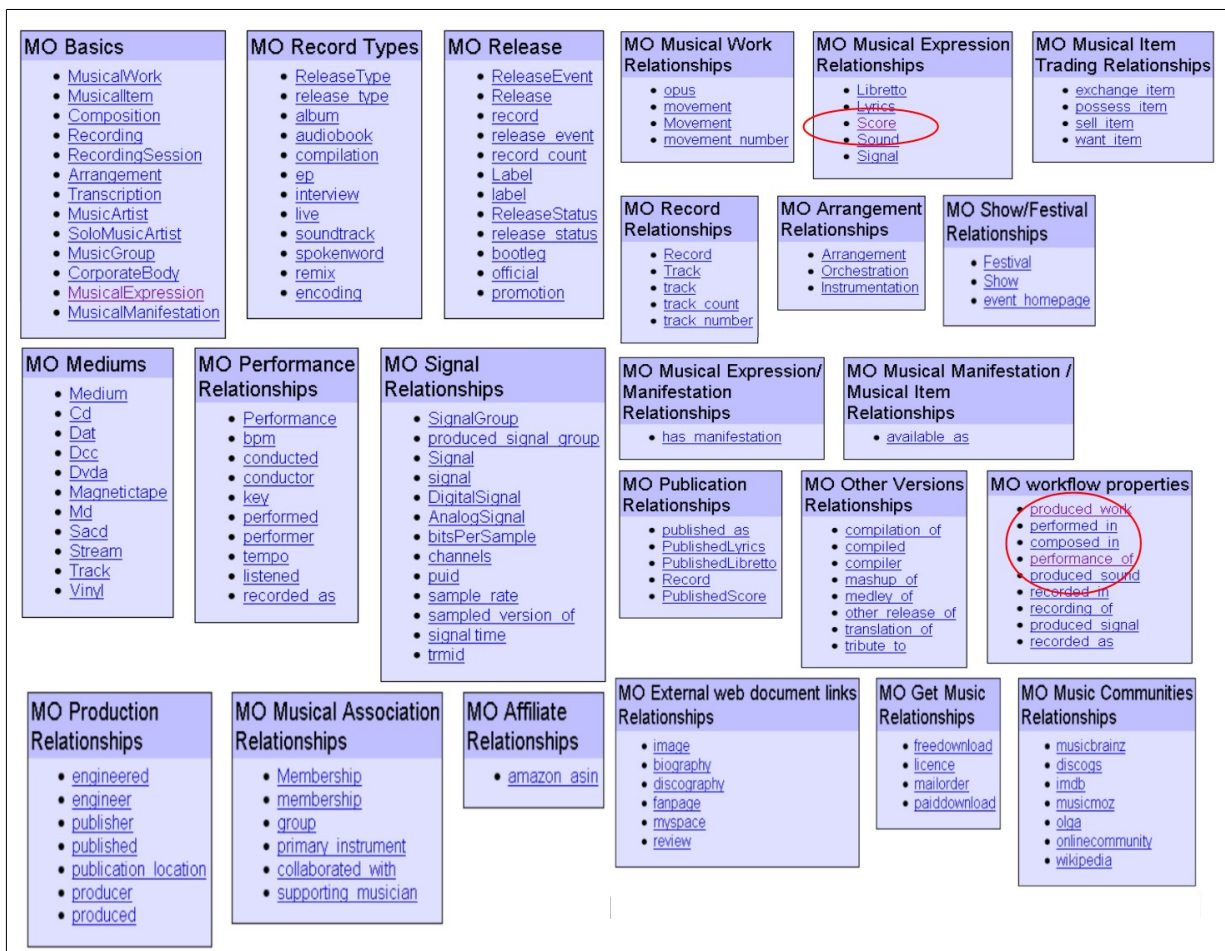
Figure 2. Music Ontology Overview (Gangler. T, Giasson. F., et al. 2010b)

Music Ontology Extension Module

Below is the current list of available Extension Module that Music Ontology has:

1. Music Features Ontology

2. Instrument Taxonomy

3. Similarity Ontology

4. Play Back Ontology

5. Association Ontology Music Ontology Modules

Based on the list above, there is no extension yet created for MUSIC SCORE, and this is the purpose of this study.

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DESIGN OF THE MUSIC SCORE WEB ONTOLOGY

Enumerated below are the approaches this research has taken to construct Music Score Web Ontology anchoring from the existing Music Ontology.

1. Music Score can be extended to Music Ontology in several ways.

See design framework of classes for extension.

– score as an informational object
Class: mo:Score
– published_score is an object published score
Class: mo:PublishedScore
– published_as associates published score to a Record
Property: mo:published_as
– composed_in associates a score event to a composition
Inverse-of:mo:composed_in
– created_by associates a score event to the maker
Property:mo:created_by
– Foaf:maker associates a score event to the other contributor to create it
Property: foaf:maker
– produced_score associates an arrangement event to a Score
Property: mo:produced_score
– Performed_by associates a composition event to the performer of a performance
Property:mo:performed_by
– Foaf:maker associates a composition event to the other contributor who creates it
Property: foaf:maker

2. Music Score can be integrated in the existing Music Ontology workflow.

See Figure 4. for the Music Ontology workflow with Music Score Ontology.

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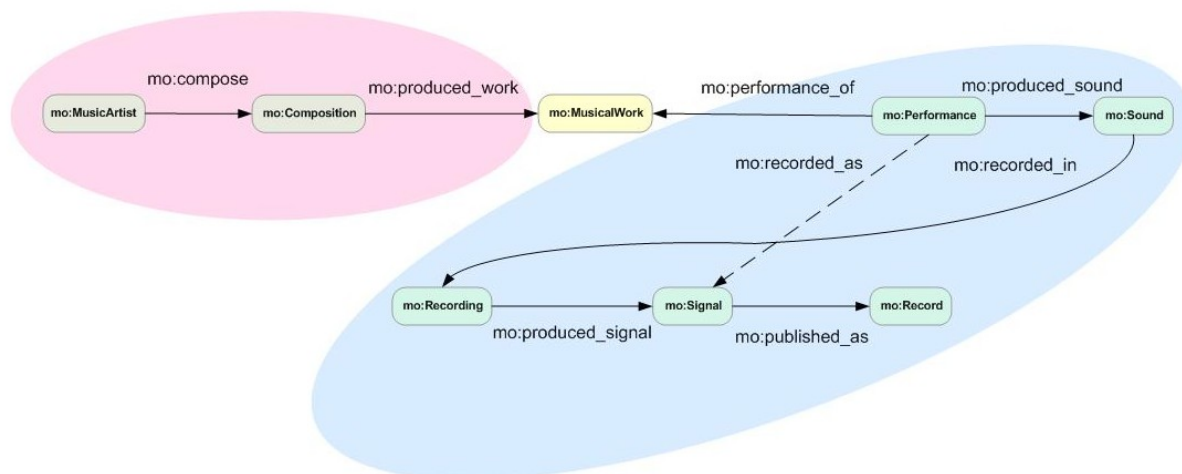
Figure 3. Music Ontology Workflow (http://musicontology.com)
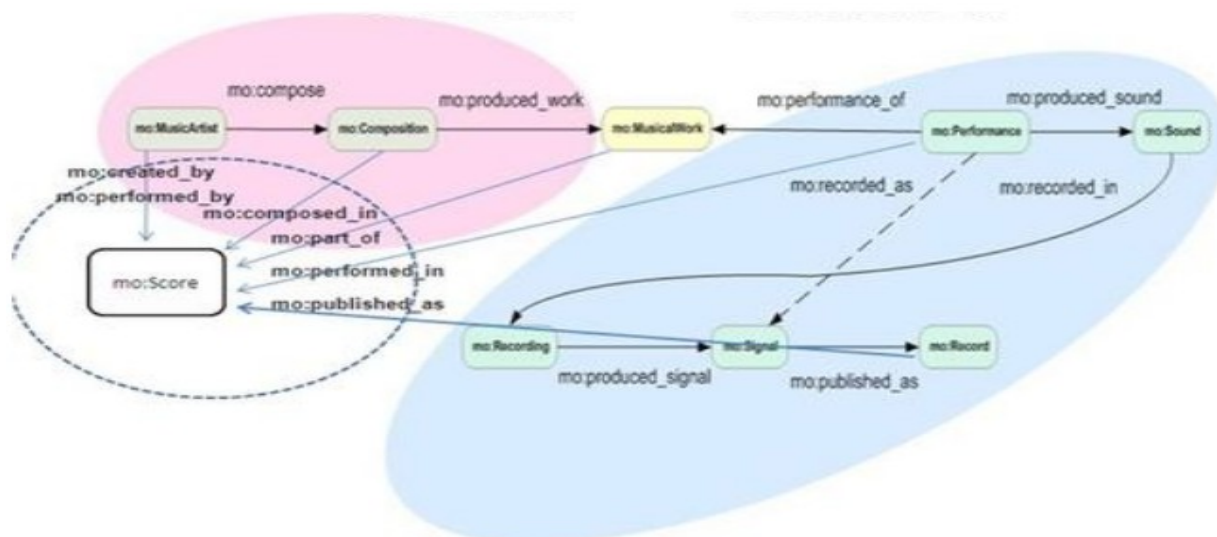
Figure 4. Music Score Web Ontology Workflow (http://musicontology.com)

3. Conceptual Design of the Music Score Web Ontology

        Figure 5. depicts the relationships between the classes and properties building the knowledge models of the Music Score Web Ontology. Namespace given is *http://purl.org/ontology/mo* that serves as the domain for all sets of vocabularies and facets for their relationships. Qname, qualified name, mo is the XML Namespace element that gives the value used as URI references. It works as a valid identifier to be referenced for elements or attributes with in the knowledge base.

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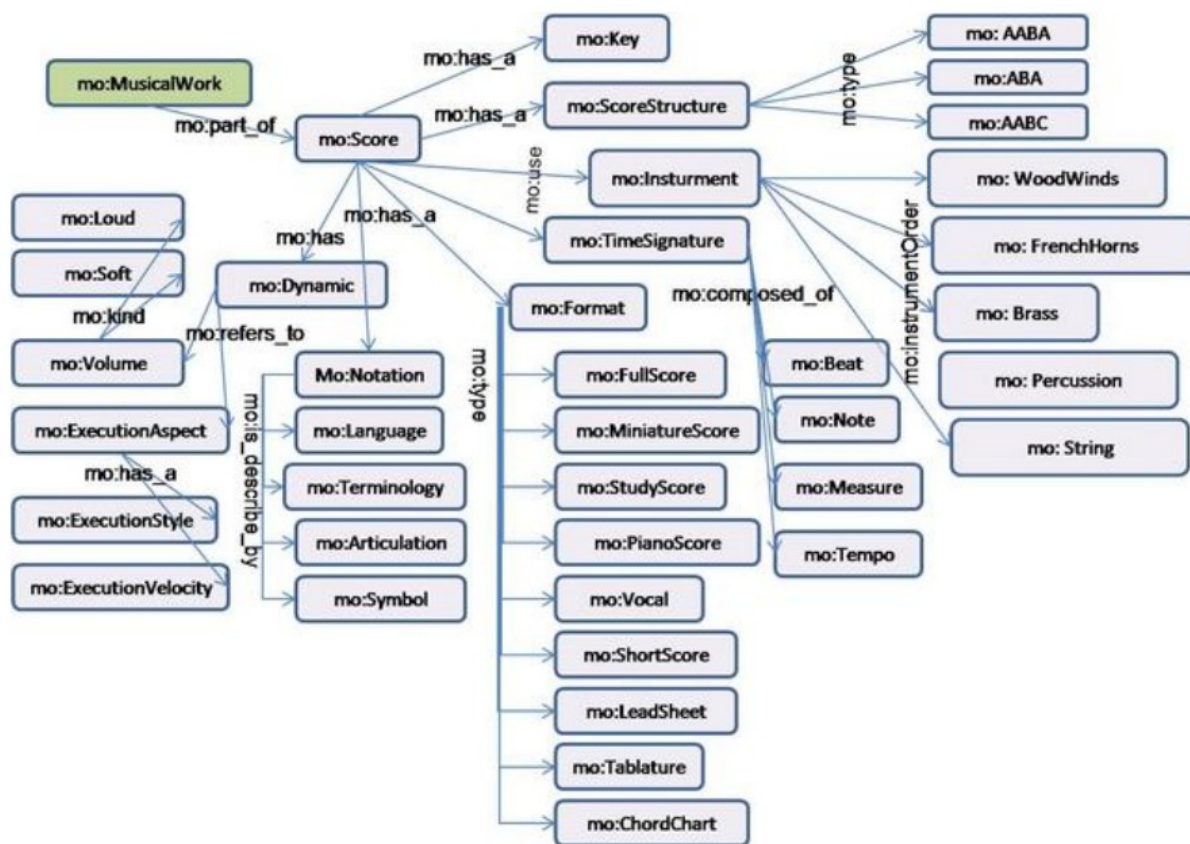
Figure 5. Concept Map of Music Score Web Ontology

4. Logical Design of the Music Score Web Ontology

RDF concept uses RDF databases to implement the schema. RDF stores are typically what are queried in the Web fitting its service architecture. In comparison to SQL, implementation of RDF and Simple Protocol and RDF Query Language (SPARQL) has a higher level of standardization especially in the use of query languages. Tables 1 to 3 are the Triples Model Design for MSWO.

Subject	Predicate	Object
Score	has	Key
Score	has	ScoreStructure
Score	has	Instrument
Score	has	TimeSignature
Score	has	Format
Score	has	Notation
Score	has	Dynamics

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AABA	type	ScoreStructure
ABA	type	ScoreStructure
AABC	type	ScoreStructure
Instrument	instrumentOrder	Woodwind
Instrument	instrumentOrder	French Horn
Instrument	instrumentOrder	Brass
Instrument	instrumentOrder	Percussion
Instrument	instrumentOrder	String
TimeSignature	composedOf	Beat
TimeSignature	composedOf	Note
TimeSignature	composedOf	Measure
TimeSignature	composedOf	Tempo
Full Score	type	Format
Miniature Score	type	Format
Study Score	type	Format
Piano Score	type	Format
Vocal	type	Format
Short Score	type	Format
Lead Sheet	type	Format
Tablature	type	Format
Chord Chart	type	Format
Notation	described By	Language
Notation	described By	Terminology
Notation	described By	Articulation
Notation	described By	Symbol
Volume	refers To	Dynamics
Execution Aspect	refers To	Dynamics
Execution Aspect	has	Execution Style
Execution Aspect	has	Velocity
Loud	type	Volume
Soft	type	Volume

Table 1. Triples Model

Subject	Predicate	Object
mo:Score	mo:has	mo:Key
mo:Score	mo:has	mo:ScoreStructure
mo:Score	mo:has	mo:Instrument
mo:Score	mo:has	mo:TimeSignature

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mo:Score	mo:has	mo:Format
mo:Score	mo:has	mo:Notation
mo:Score	mo:has	mo:Dynamics
mo:AABA	rdf:type	mo:ScoreStructure
mo:ABA	rdf:type	mo:ScoreStructure
mo:AABC	rdf:type	mo:ScoreStructure
mo:Instrument	mo:instrumentOrder	mo:Woodwind
mo:Instrument	mo:instrumentOrder	mo:FrenchHorn
mo:Instrument	mo:instrumentOrder	mo:Brass
mo:Instrument	mo:instrumentOrder	mo:Percussion
mo:Instrument	mo:instrumentOrder	mo:String
mo:TimeSignature	mo:composedOf	mo:Beat
mo:TimeSignature	mo:composedOf	mo:Note
mo:TimeSignature	mo:composedOf	mo:Measure
mo:TimeSignature	mo:composedOf	mo:Tempo
mo:FullScore	rdf:type	mo:Format
mo:MiniatureScore	rdf:type	mo:Format
mo:StudyScore	rdf:type	mo:Format
mo:PianoScore	rdf:type	mo:Format
mo:Vocal	rdf:type	mo:Format
mo:ShortScore	rdf:type	mo:Format
mo:LeadSheet	rdf:type	mo:Format
mo:Tablature	rdf:type	mo:Format
mo:ChordChart	rdf:type	mo:Format
mo:Notation	mo:describedBy	mo:Language
mo:Notation	mo:describedBy	mo:Terminology
mo:Notation	mo:describedBy	mo:Articulation
mo:Notation	mo:describedBy	mo:Symbol
mo:Volume	mo:refersTo	mo:Dynamics
mo:Execution-Aspect	mo:refersTo	mo:Dynamics
mo:Execution-Aspect	mo:has	mo:ExecutionStyle
mo:Execution-Aspect	mo:has	mo:Velocity
mo:Loud	rdf:type	mo:Volume
mo:Soft	rdf:type	mo:Volume

Table 2. Triples Model: Table with qnames

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Subject	Predicate	Object
mo:has	rdf:type	rdf:Property
mo:instrumentOrder	rdf:type	rdf:Property
mo:composedOf	rdf:type	rdf:Property
mo:describedby	rdf:type	rdf:Property
mo:composedOf	rdf:type	rdf:Property

Table 3. Triples Model RDF: Property Assertion Table

5. Design Schema for the Music Score Web Ontology in N-Triples Model

N-triples format is known for storing and transmitting data for RDF. It is a line-based for parsing RDF/XML and is what this study uses to generate the schema of the web ontology. N-3 Triples are also provided. They are used for applications to easily parse and generate the code. See Tables 4.0 – 6.0 for the schema of the MSWO.

<http://purl.org/ontology/mo.rdf#Score>	<http://purl.org/ontology/mo.rdf#Tempo>
<http://purl.org/ontology/mo.rdf#has>	<http://purl.org/ontology/mo.rdf#FullScore>
<http://purl.org/ontology/mo.rdf#Key>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://purl.org/ontology/mo.rdf#Score>	<http://purl.org/ontology/mo.rdf#Format>
<http://purl.org/ontology/mo.rdf#has>	<http://purl.org/ontology/mo.rdf#MiniatureScore>
<http://purl.org/ontology/mo.rdf#ScoreStructure>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://purl.org/ontology/mo.rdf#Score>	<http://purl.org/ontology/mo.rdf#Format>
<http://purl.org/ontology/mo.rdf#has>	<http://purl.org/ontology/mo.rdf#StudyScore>
<http://purl.org/ontology/mo.rdf#Instrument>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://purl.org/ontology/mo.rdf#Score>	<http://purl.org/ontology/mo.rdf#Format>
<http://purl.org/ontology/mo.rdf#has>	<http://purl.org/ontology/mo.rdf#PianoScore>
<http://purl.org/ontology/mo.rdf#TimeSignature>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://purl.org/ontology/mo.rdf#Score>	<http://purl.org/ontology/mo.rdf#Format>
<http://purl.org/ontology/mo.rdf#has>	<http://purl.org/ontology/mo.rdf#Vocal>
<http://purl.org/ontology/mo.rdf#Format>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://purl.org/ontology/mo.rdf#Score>	<http://purl.org/ontology/mo.rdf#Format>
<http://purl.org/ontology/mo.rdf#has>	<http://purl.org/ontology/mo.rdf#ShortScore>
<http://purl.org/ontology/mo.rdf#Notation>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://purl.org/ontology/mo.rdf#Score>	<http://purl.org/ontology/mo.rdf#Format>
<http://purl.org/ontology/mo.rdf#has>	<http://purl.org/ontology/mo.rdf#LeadSheet>
<http://purl.org/ontology/mo.rdf#Dynamics>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://purl.org/ontology/mo.rdf#AABA>	<http://purl.org/ontology/mo.rdf#Format>
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>	<http://purl.org/ontology/mo.rdf#Tabliature>
<http://purl.org/ontology/mo.rdf#ScoreStructure>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://purl.org/ontology/mo.rdf#ABA>	<http://purl.org/ontology/mo.rdf#Format>
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>	<http://purl.org/ontology/mo.rdf#ChordChart>
<http://purl.org/ontology/mo.rdf#ScoreStructure>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>

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<http://purl.org/ontology/mo.rdf#AABC>	<http://purl.org/ontology/mo.rdf#Format>
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>	<http://purl.org/ontology/mo.rdf#Notation>
<http://purl.org/ontology/mo.rdf#ScoreStructure>	<http://purl.org/ontology/mo.rdf#describedBy>
<http://purl.org/ontology/mo.rdf#Instrument>	<http://purl.org/ontology/mo.rdf#Language>
<http://purl.org/ontology/mo.rdf#instrumentOrder>	<http://purl.org/ontology/mo.rdf#Notation>
<http://purl.org/ontology/mo.rdf#Woodwind>	<http://purl.org/ontology/mo.rdf#describedBy>
<http://purl.org/ontology/mo.rdf#Instrument>	<http://purl.org/ontology/mo.rdf#Terminology>
<http://purl.org/ontology/mo.rdf#instrumentOrder>	<http://purl.org/ontology/mo.rdf#Notation>
<http://purl.org/ontology/mo.rdf#FrenchHorn>	<http://purl.org/ontology/mo.rdf#describedBy>
<http://purl.org/ontology/mo.rdf#Instrument>	<http://purl.org/ontology/mo.rdf#Articulation>
<http://purl.org/ontology/mo.rdf#instrumentOrder>	<http://purl.org/ontology/mo.rdf#Notation>
<http://purl.org/ontology/mo.rdf#Brass>	<http://purl.org/ontology/mo.rdf#describedBy>
<http://purl.org/ontology/mo.rdf#Instrument>	<http://purl.org/ontology/mo.rdf#Symbol>
<http://purl.org/ontology/mo.rdf#instrumentOrder>	<http://purl.org/ontology/mo.rdf#Volume>
<http://purl.org/ontology/mo.rdf#Percussion>	<http://purl.org/ontology/mo.rdf#refersTo>
<http://purl.org/ontology/mo.rdf#Instrument>	<http://purl.org/ontology/mo.rdf#Dynamics>
<http://purl.org/ontology/mo.rdf#instrumentOrder>	<http://purl.org/ontology/mo.rdf#ExecutionAspect>
<http://purl.org/ontology/mo.rdf#String>	<http://purl.org/ontology/mo.rdf#refersTo>
<http://purl.org/ontology/mo.rdf#TimeSignature>	<http://purl.org/ontology/mo.rdf#Dynamics>
<http://purl.org/ontology/mo.rdf#composedOf>	<http://purl.org/ontology/mo.rdf#ExecutionAspect>
<http://purl.org/ontology/mo.rdf#Beat>	<http://purl.org/ontology/mo.rdf#has>
<http://purl.org/ontology/mo.rdf#TimeSignature>	<http://purl.org/ontology/mo.rdf#ExecutionStyle>
<http://purl.org/ontology/mo.rdf#composedOf>	<http://purl.org/ontology/mo.rdf#ExecutionAspect>
<http://purl.org/ontology/mo.rdf#Note>	<http://purl.org/ontology/mo.rdf#has>
<http://purl.org/ontology/mo.rdf#TimeSignature>	<http://purl.org/ontology/mo.rdf#Veloctiy>
<http://purl.org/ontology/mo.rdf#composedOf>	<http://purl.org/ontology/mo.rdf#Loud>
<http://purl.org/ontology/mo.rdf#Measure>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://purl.org/ontology/mo.rdf#TimeSignature>	<http://purl.org/ontology/mo.rdf#Volume>
<http://purl.org/ontology/mo.rdf#composedOf>	<http://purl.org/ontology/mo.rdf#Soft>

Table 4. N-Triples Model

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@prefix mo: <http://purl.org/ontology/mo.rdf#>
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
mo:Score mo:has mo:Key
mo:Score mo:has mo:ScoreStructure
mo:Score mo:has mo:Instrument
mo:Scire mo:has mo:TimeSignature
mo:Score mo:has mo:Format
mo:Score mo:has mo:Notation
mo:Score mo:has mo:Dynamics
mo:AABA rdf:type mo:ScoreStructure
mo:ABA rdf:type mo:ScoreStructure
mo:AABC rdf:type mo:ScoreStructure
mo:Instrument mo:instrumentOrder mo:Woodwind
mo:Instrument mo:instrumentOrder mo:FrenchHorn
mo:Instrument mo:instrumentOrder mo:Brass
mo:Instrument mo:instrumentOrder mo:Percussion
mo:Instrument mo:instrumentOrder mo:String
mo:TimeSignature mo:composedOf mo:Beat
mo:TimeSignature mo:composedOf mo:Note
mo:TimeSignature mo:composedOf mo:Measure
mo:TimeSignature mo:composedOf mo:Tempo
mo:FullScore rdf:type mo:Format
mo:MiniatureScore rdf:type mo:Format
mo:StudyScore rdf:type mo:Format
mo:PianoScore rdf:type mo:Format
mo:Vocal rdf:type mo:Format
mo:ShortScore rdf:type mo:Format
mo:LeadSheet rdf:type mo:Format
mo:Tablature rdf:type mo:Format
mo:ChordChart rdf:type mo:Format
mo:Notation mo:describedBy mo:Language
mo:Notation mo:describedBy mo:Terminology
mo:Notation mo:describedBy mo:Articulation
mo:Notation mo:describedBy mo:Symbol
mo:Volume mo:refersTo mo:Dynamics
mo:ExecutionAspect mo:refersTo mo:Dynamics
mo:ExecutionAspect mo:has mo:ExecutionStyle
mo:ExecutionAspect mo:has mo:Velocity
mo:Loud rdf:type mo:Volume

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mo:Soft rdf:type mo:Volume

Table 5. N3 – Triples Model

@prefix mo: <http://purl.org/ontology/mo.rdf#>
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
mo:Score mo:has mo:Key;
mo:ScoreStructure;
mo:Instrument;
mo:TimeSignature;
mo:Format;
mo:Notation;
mo:Dynamics;
mo:AABA a mo:ScoreStructure
mo:ABA a mo:ScoreStructure
mo:AABC a mo:ScoreStructure
mo:Instrument mo:instrumentOrder (mo:Woodwind mo:FrenchHorn mo:Brass mo:Percussion mo:String).
mo:TimeSignature mo:composedOf mo:Beat;
mo:Note;
mo:Measure;
mo:Tempo;
mo:FullScore a mo:Format
mo:MiniatureScore a mo:Format
mo:StudyScore a mo:Format
mo:PianoScore a mo:Format
mo:Vocal a mo:Format
mo:ShortScore a mo:Format
mo:LeadSheet a mo:Format
mo:Tablature a mo:Format
mo:ChordChart a mo:Format
mo:Notation mo:describedBy mo:Language;
mo:Terminology;
mo:Articulation;
mo:Symbol;
mo:Volume mo:refersTo mo:Dynamics
mo:ExecutionAspect mo:refersTo mo:Dynamics
mo:ExecutionAspect mo:has mo:ExecutionStyle;
mo:Velocity;
mo:Loud a mo:Volume

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mo:Soft a mo:Volume

Table 6. N-3 Tripples Model (with binding)

IMPLEMENTATION OF THE DESIGN TO A SAMPLE DATA SET

Below are the outputs of the implementation of the design constructed to a sample data set.

1. Table of sample data

Music Score	Format
Halleljah	Piano Score
Hungarian	Vocal Score
Here Comes my Wife	Choral Score

Table 7. Sample Data

2. Triple Model: Table

Subject	Predicate	Object
Music Score	has	Title
Music Score	has	Format
Title	type	Hallelujah
Title	type	Hungarian
Title	type	Here Comes my Wife
Format	type	Piano Score
Format	type	Vocal Score
Format	type	Choral Score
Hallelujah	has	Piano Score
Hungarian	has	Vocal Score
Here Comes my Wife	has	Choral Score

Table 8. Triple Model of the Sample Data

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3. N-Triples Model

Number	Subject	Predicate	Object
1	genid:UMusicScore	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://localhost/arc2-starter-pack/sonia2.html/MusicScore
2	http://localhost/arc2-starter-pack/sonia2.html/MusicScore	http://localhost/arc2-starter-pack/MusicScore.rdf#has	"Title"
3	http://localhost/arc2-starter-pack/sonia2.html/MusicScore	http://localhost/arc2-starter-pack/MusicScore.rdf#has	"Format"
4	http://localhost/arc2-starter-pack/sonia2.html/Title	http://localhost/arc2-starter-pack/MusicScore.rdf#format	genid:UMusicScore
5	genid:A2305	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Bag
6	http://localhost/arc2-starter-pack/sonia2.html/Title	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	genid:A2305
7	genid:A2305	http://www.w3.org/1999/02/22-rdf-syntax-ns#_1	"Hallelujah"
8	genid:A2305	http://www.w3.org/1999/02/22-rdf-syntax-ns#_2	"Hungarian"
9	genid:A2305	http://www.w3.org/1999/02/22-rdf-syntax-ns#_3	"Here Comes My Wife"
10	http://localhost/arc2-starter-pack/sonia2.html/Format	http://localhost/arc2-starter-pack/MusicScore.rdf#format	genid:UMusicScore
11	genid:A2307	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Alt
12	http://localhost/arc2-starter-pack/sonia2.html/Format	http://localhost/arc2-starter-pack/MusicScore.rdf#type	genid:A2307
13	genid:A2307	http://www.w3.org/1999/02/22-rdf-syntax-ns#_1	"PianoScore"
14	genid:A2307	http://www.w3.org/1999/02/22-rdf-syntax-ns#_2	"VocalScore"
15	genid:A2307	http://www.w3.org/1999/02/22-rdf-syntax-ns#_3	"ChoralScore"
16	http://localhost/arc2-starter-pack/sonia2.html/Hallelujah	http://localhost/arc2-starter-pack/MusicScore.rdf#title	genid:UMusicScore
17	http://localhost/arc2-starter-pack/sonia2.html/Hallelujah	http://localhost/arc2-starter-pack/MusicScore.rdf#has	"PianoScore"
18	http://localhost/arc2-starter-pack/sonia2.html/Hungarian	http://localhost/arc2-starter-pack/MusicScore.rdf#title	genid:UMusicScore
19	http://localhost/arc2-starter-pack/sonia2.html/Hungarian	http://localhost/arc2-starter-pack/MusicScore.rdf#has	"ChoralScore"
20	http://localhost/arc2-starter-pack/sonia2.html/Here Comes My Wife	http://localhost/arc2-starter-pack/MusicScore.rdf#title	genid:UMusicScore
21	http://localhost/arc2-starter-pack/sonia2.html/Here Comes My Wife	http://localhost/arc2-starter-pack/MusicScore.rdf#has	"VocalScore"

Table 9. N-Triples Model of the Sample Data

4. Inferences for the Sample Data

1. ?Title ms:has PianoScore
Sparql result ?Title= Hallelujah
2. ?Format ms:has Hallelujah
Sparql result ?Format= PianoScore
3. ?MusicScore rdf:type Title
Sparql result ?MusicScore= Hallelujah
?MusicScore= Hungarian
?MusicScore= Here Comes my Wife
4. ?MusicScore rdf:type Format
Sparql result ?MusicScore= PianoScore
?MusicScore= VocalScore

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?MusicScore= ChoralScore

5. XML Format of the Music Score Web Ontology for the Sample Data

```
[[#1]]: <?xml version="1.0" encoding="utf-8"?>
[[#2]]:
[[#3]]: <rdf:RDF
[[#4]]: xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
[[#5]]: xmlns:ms="http://localhost/arc2-starter-pack/MusicScore.rdf#">
[[#6]]:
[[#7]]: <rdf:Description rdf:nodeID="MusicScore">
[[#8]]: <rdf:type rdf:resource="http://localhost/arc2-starter-pack/sonia2.html/MusicScore" />
[[#9]]: </rdf:Description>
[[#10]]:
[[#11]]: <rdf:Description
[[#12]]: rdf:about="http://localhost/arc2-starter-pack/sonia2.html/MusicScore">
[[#13]]: <ms:has>Title</ms:has>
[[#14]]: <ms:has>Format</ms:has>
[[#15]]: </rdf:Description>
[[#16]]:
[[#17]]: <rdf:Description
[[#18]]: rdf:about="http://localhost/arc2-starter-pack/sonia2.html/Title">
[[#19]]: <ms:format rdf:nodeID="MusicScore"/>
[[#20]]: <rdf:type>
[[#21]]: <rdf:Bag>
[[#22]]: <rdf:li>Hallelujah</rdf:li>
[[#23]]: <rdf:li>Hungarian</rdf:li>
[[#24]]: <rdf:li>Here Comes My Wife</rdf:li>
[[#25]]: </rdf:Bag>
[[#26]]: </rdf:type>
[[#27]]: </rdf:Description>
[[#28]]:
[[#29]]: <rdf:Description
[[#30]]: rdf:about="http://localhost/arc2-starter-pack/sonia2.html/Format">
```

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```
[[#31]]: <ms:format rdf:nodeID="MusicScore"/>
[[#32]]: <ms:type>
[[#33]]: <rdf:Alt>
[[#34]]: <rdf:li>PianoScore</rdf:li>
[[#35]]: <rdf:li>VocalScore</rdf:li>
[[#36]]: <rdf:li>ChoralScore</rdf:li>
[[#37]]: </rdf:Alt>
[[#38]]: </ms:type>
[[#39]]: </rdf:Description>
[[#40]]:
[[#41]]: <rdf:Description
[[#42]]: rdf:about="http://localhost/arc2-starter-pack/sonia2.html/Hallelujah">
[[#43]]: <ms:title rdf:nodeID="MusicScore" />
[[#44]]: <ms:has>PianoScore</ms:has>
[[#45]]: </rdf:Description>
[[#46]]:
[[#47]]: <rdf:Description
[[#48]]: rdf:about="http://localhost/arc2-starter-pack/sonia2.html/Hungarian">
[[#49]]: <ms:title rdf:nodeID="MusicScore" />
[[#50]]: <ms:has>ChoralScore</ms:has>
[[#51]]: </rdf:Description>
[[#52]]:
[[#53]]: <rdf:Description
[[#54]]: rdf:about="http://localhost/arc2-starter-pack/sonia2.html/Here Comes My Wife">
[[#55]]: <ms:title rdf:nodeID="MusicScore" />
[[#56]]: <ms:has>VocalScore</ms:has>
[[#57]]: </rdf:Description>
[[#58]]:
[[#59]]: </rdf:RDF>
[[#60]]:
```

Figure 6. XML Formats of the Sample Data

IMPLEMENTATION OF THE DESIGN USING ARC2 FRAMEWORK

1. Set up

1.1. Download and Install the new version of XAMPP 1.7.3 (for Windows) at *http://www.apachefriends.org/en/xampp-windows.html,* including:

- Apache 2.2.14 (IPv6 enabled) + OpenSSL 0.9.8l

- MySQL 5.1.41 + PBXT engine

- PHP 5.3.1

- phpMyAdmin 3.2.4

1.2. Download arc2-starter-pack for semantic web at *http://arc.semsol.org/download*.

• Unzip the file

• Load the extracted files to the htdocs of xampp which is located at *C:xampp/htdocs*
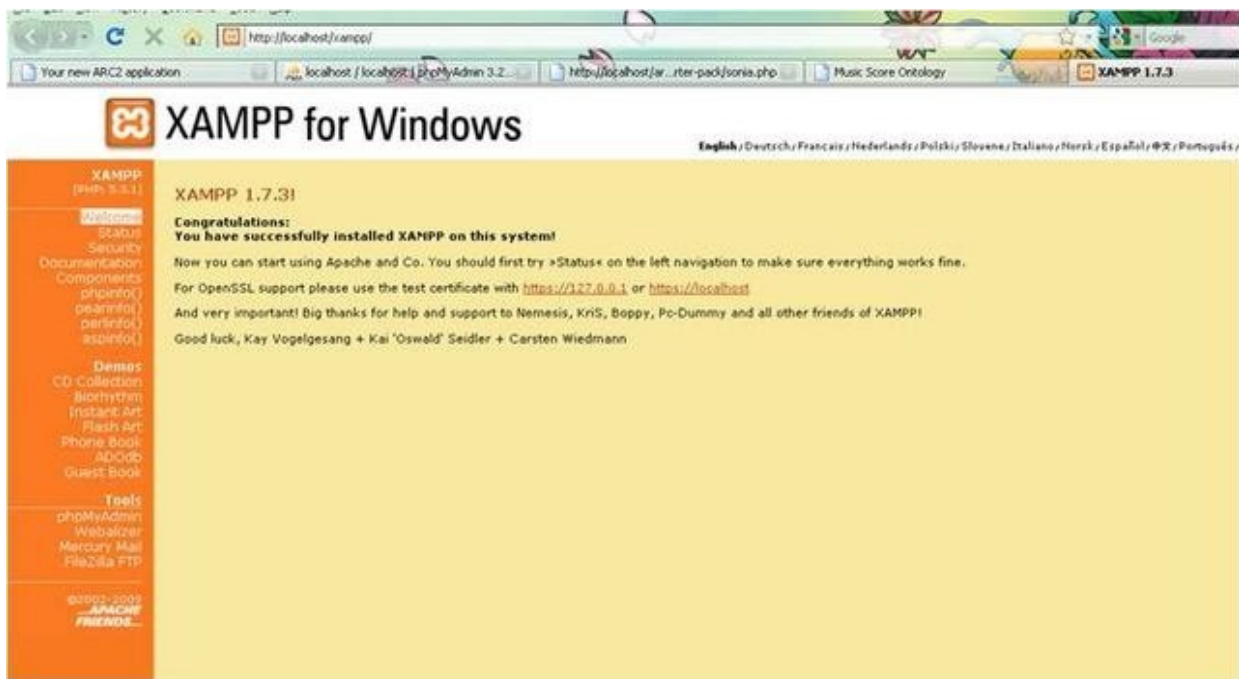
2. Configuration

2.1. Open browser and open *http://localhost/xampp*

Figure 7. XAMPP Screenshot

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2.2. At the Security tab at the right, secure the database by configuring user name and password.

Figure 8. Security Tab Screenshot

2.3. Click *phpMyAdmin* tab at the right pane to log in to your account

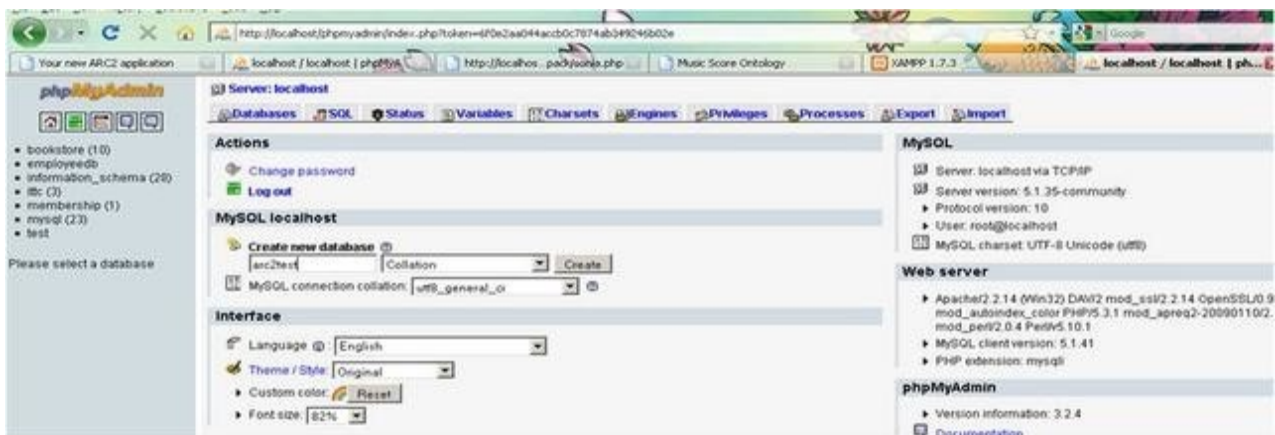*Figure 9. phpMyAdmin Log in Screenshot*

2.4. Create your datastore.

Figure 10. phpMyAdmin Datastore Screenshot

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3. Coding

3.1. Configure your *config.php* with your user name, password, dbname and datastore name.

```
<?php
include_once(dirname(FILE).'/arc/ARC2.php'); path to the file ARC2.php
SQL database configuration for storing the postings:
$arc_config = array(
/* MySQL database settings */
'db_host' => 'localhost',
'db_user' => 'root',
'db_pwd' => 'admin',
'db_name' => 'arc2test',
/* ARC2 store settings */
'store_name' => 'sandbox',
/* SPARQL endpoint settings */
'endpoint_features' => array(
'select', 'construct', 'ask', 'describe', allow read
'load', 'insert', 'delete', allow update
'dump' allow backup
),
'endpoint_timeout' => 60, /* not implemented in ARC2 preview */
'endpoint_read_key' => '', /* optional */
'endpoint_write_key' => '', /* optional */
'endpoint_max_limit' => 250, /* optional */
);
```

3.2. Create php application to load rdf's (.rdf) to data store.

```
<html>
<h1 align=center>My Music Score Ontology</h1>
<br>
<p>A collection of Music Scores of great composers from classical to modern
that accounts all scores propertiesand attributes.
<p>Take a look on each Scores as they are grouped into TYPES, FORMATS,
TEMPOS, GENRES, INSTRUMENT and KEYS.
</p>
<?php
```

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```
include_once("/arc/ARC2.php");
$config = array(
/* db */
'db_name' => 'arc2test',
'db_user' => 'root',
'db_pwd' => 'admin',
/* store */
'store_name' => 'sandbox',
/* stop after 100 errors */
'max_errors' => 100,
);
$store = ARC2::getStore($config);
if (!$store->isSetUp()) {
$store->setUp();
}
/* LOAD will call the Web reader, which will call the
format detector, which in turn triggers the inclusion of an
appropriate parser, etc. until the triples end up in the store. */
$store->query('LOAD <http://localhost/arc2-starter-pack/rdf.rdf>');
?>
</html>
```

3.3. Load your rdf (.rdf) to htdocs of xampp

```
<?xml version="1.0" encoding="utf-8"?>
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:ms="http://localhost/arc2-starter-pack/MusicScore.rdf#">
<rdf:Description rdf:nodeID="MusicScore">
<rdf:type rdf:resource="http://localhost/arc2-starter-
pack/sonia2.html/MusicScore" />
</rdf:Description>
<rdf:Description
rdf:about="http://localhost/arc2-starter-pack/sonia2.html/MusicScore">
<ms:has>Title</ms:has>
<ms:has>Format</ms:has>
</rdf:Description>
<rdf:Description
rdf:about="http://localhost/arc2-starter-pack/sonia2.html/Title">
<ms:format rdf:nodeID="MusicScore"/>
```

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```
<rdf:type>
<rdf:Bag>
<rdf:li>Hallelujah</rdf:li>
<rdf:li>Hungarian</rdf:li>
<rdf:li>Here Comes My Wife</rdf:li>
</rdf:Bag>
</rdf:type>
</rdf:Description>
<rdf:Description
rdf:about="http://localhost/arc2-starter-pack/sonia2.html/Format">
<ms:format rdf:nodeID="MusicScore"/>
<ms:type>
<rdf:Alt>
<rdf:li>PianoScore</rdf:li>
<rdf:li>VocalScore</rdf:li>
<rdf:li>ChoralScore</rdf:li>
</rdf:Alt>
</ms:type>
</rdf:Description>
<rdf:Description
rdf:about="http://localhost/arc2-starter-pack/sonia2.html/Hallelujah">
<ms:title rdf:nodeID="MusicScore" />
<ms:has>PianoScore</ms:has>
</rdf:Description>
<rdf:Description
rdf:about="http://localhost/arc2-starter-pack/sonia2.html/Hungarian">
<ms:title rdf:nodeID="MusicScore" />
<ms:has>ChoralScore</ms:has>
</rdf:Description>
<rdf:Description
rdf:about="http://localhost/arc2-starter-pack/sonia2.html/Here Comes My
Wife">
<ms:title rdf:nodeID="MusicScore" />
<ms:has>VocalScore</ms:has>
</rdf:Description>
</rdf:RDF>
```

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3.4. Run php application to query for extraction of data.

```
<!DOCTYPE html PUBLIC "-W3CDTD XHTML+RDFa 1.0//EN"
"http://www.w3.org/MarkUp
/DTD/xhtml-rdfa-1.dtd">
<htmlxmlns="http://www.w3.org/1999/xhtml"
xmlns:xsd ="http://www.w3.org/2001/XMLSchema#"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:foaf="http://xmlns.com/foaf/0.1/"
xmlns:vcard="http://www.w3.org/2006/vcard/ns#"
xmlns:owl="http://www.w3.org/2002/07/owl#"
xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
<head>
<title>Music Score Ontology</title>
</head>
<body>
<h1>Music Score Ontology of Sample Data</h1>
<h2>Below is the tabular sample data </h2>
<table border=1>
<tr>
<th>Music Score</th>
<th>Format</th>
</tr>
<tr>
<td>Hallelujah</td>
<td>Piano Score</td>
</tr>
<tr>
<td>Hungarian</td>
<td>Vocal Score</td>
</tr>
<tr>
<td>Here Comes my Wife</td>
<td>Choral Score</td>
</tr>
<tr>
</tr>
</table>
<h2>Triple Model Table</h2>
```

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```
<table border=1>
<tr>
<th>Subject</th>
<th>Predicate</th>
<th>Object</th>
</tr>
<tr>
<td>Music Score</td>
<td>has</td>
<td>Title</td>
</tr>
<tr>
<td>Music Score</td>
<td>has</td>
<td>Format</td>
</tr>
<tr>
<td>Title</td>
<td>type</td>
<td>Hallelujah</td>
</tr>
<tr>
<td>Title</td>
<td>type</td>
<td>Hungarian</td>
</tr>
<tr>
<td>Title</td>
<td>type</td>
<td>Here Comes my Wife</td>
</tr>
<tr>
<td>Format</td>
<td>type</td>
<td>Piano Score</td>
</tr>
<tr>
<td>Format</td>
<td>type</td>
```

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```
<td>Vocal Score</td>
</tr>
<tr>
<td>Format</td>
<td>type</td>
<td>Choral Score</td>
</tr>
<tr>
<td>Hallelujah</td>
<td>has</td>
<td>Piano Score</td>
</tr>
<tr>
<td>Hungarian</td>
<td>has</td>
<td>Vocal Score</td>
</tr>
<tr>
<td>Here Comes my Wife</td>
<td>has</td>
<td>Choral Score</td>
</tr>
<tr>
</tr>
</table>
<h2>After loading the Music Score Ontology RDF to my data store,</h2>
<em>The Arc2 application can output the specific triple store for the subjects,
predicates and objects as shown below:</em>
<?php
print "<em>Running PHP code...</em>";
print "<br>";
print "<br>";
include_once(dirname(FILE).'/config.php');
/* store instantiation */
$store = ARC2::getStore($arc_config);
if (!$store->isSetUp()) {
$store->setUp(); /* create MySQL tables */
}
/* LOAD will call the Web reader, which will call the
```

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```php
format detector, which in turn triggers the inclusion of an
appropriate parser, etc. until the triples end up in the store. */
$store->query('LOAD <http://localhost/arc2-starter-pack/MusicScore.rdf>');
$result2 = $store->query("SELECT DISTINCT ?subject WHERE { ?subject ?
property ?object . }");
$rows = $result2["result"]["rows"];
if ($rows) {
print "<table border='1'>\n";
print "<tr><th>Subjects currently in use in the triple store</th></tr>\n";
foreach ($rows as $row) {
$item = $row["subject"];
if (strpos($item, "http://www.w3.org/1999/02/22-rdf-syntax-ns#_") !== 0) {
print "<tr><td>" . htmlspecialchars($item) . "</td></tr>\n";
}
}
print "</table>\n";
} else {
print "<strong>The ARC2 triple store is currently empty.\n";
print "Please load some data first.</strong>";
}
print "<br>";
print "<br>";
print "<hr>";
$result = $store->query("SELECT DISTINCT ?property WHERE { ?subject ?
property ?object . }");
$rows = $result["result"]["rows"];
if ($rows) {
print "<table border='1'>\n";
print "<tr><th>Properties currently in use in the triple store</th></tr>\n";
foreach ($rows as $row) {
$item = $row["property"];
if (strpos($item, "http://www.w3.org/1999/02/22-rdf-syntax-ns#_") !== 0) {
print "<tr><td>" . htmlspecialchars($item) . "</td></tr>\n";
}
}
print "</table>\n";
} else {
print "<strong>The ARC2 triple store is currently empty.\n";
print "Please load some data first.</strong>";
```

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```
}
print "<br>";
print "<br>";
print "<hr>";
$result3 = $store->query("SELECT DISTINCT ?object WHERE { ?subject ?
property ?object . }");
$rows = $result3["result"]["rows"];
if ($rows) {
print "<table border='1'>\n";
print "<tr><th>Objects currently in use in the triple store</th></tr>\n";
foreach ($rows as $row) {
$item = $row["object"];
if (strpos($item, "http://www.w3.org/1999/02/22-rdf-syntax-ns#_") !== 0) {
print "<tr><td>" . htmlspecialchars($item) . "</td></tr>\n";
}
}
print "</table>\n";
} else {
print "<strong>The ARC2 triple store is currently empty.\n";
print "Please load some data first.</strong>";
}
?>
</body>
</html>
```

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4. Screenshots

4.1. The application had no data from data store after running once maybe because the datastore has not created.

Figure 11. Sample Data Screenshot

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4.2. Application displaying queries after the data store has created:

Figure 12. Sample Data Screenshot

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CONCLUSIONS

Web ontology of music score is linked to Music Ontology in several ways. The RDF framework is flexible that supports different informational object types like Class: mo:Score, or Class: mo:PublishedScore or Property: foaf:maker and etc which serve as extensions by the music score to Music Ontology. Interoperability on the other hand is the focus of our future research for the results show that MARC, AACR2 and LCSH are the most widely used among digital repositories and collection in metadata description and construction.They are confined with the Library foundational operations and looking into new approach is considered. Furthermore Jose Maceda Music Score Ontology establishes an opportunity for collaborative codification by diverse groups opening other metadata schemata representation, data storage model and retrieval system and resolutions to reuse and interoperability issues and some other knowledge representation challenges.

REFERENCES

A Journal Article Bibliographic Citation Dublin Core Structured Value. Retrieved from *http://dublincore.org/usage/meetings/2002/05/citdcsv.html*

Berners-Lee, T., et al. (1998). Uniform Resource Identifiers (URI): Generic Syntax. RFC 2396, Internet Engineering Task Force. Retrieved from *http://www.ietf.org/ rfc/rfc2396.txt*

Bradner, S. Key words for use in RFCs to Indicate Requirement Levels. RFC 2119, Harvard University. March 1997. Retrieved from *http://www.ietf.org/rfc/rfc2119.txt*

Brigitte, Jörg, et al. CERIF 1.3 Full Data Model (FDM). Introduction and Specification. Retrieved from *http://www.eurocris.org/Uploads/Web%20pages/CERIF1.3/ Specifications/CERIF1.3_FDM.pdf*

Dutta, Biswanath. Cataloguing Web Documents using Dublin Core, MARC 21. Retrieved from *http://www.glib.hcmuns.edu.vn/hiep/knowledge/C_Webcat_bisu.pdf*

International Federation of Library Associations and Institutions. (1998). Functional Requirements for Bibliographic Records - Final Report. Retrieved from *http://www.ifla.org/VII/s13/frbr/frbr.htm*

MARC21 – format for bibliographic data. Retrieved from *http://www.loc.gov/marc/ bibliographic/*

MARC standards. Retrieved from *http://en.wikipedia.org/wiki/MARC_standards*

MARC to Dublin Core Crosswalk. Retrieved from *http://www.loc.gov/marc/marc2dc.html*

Music Ontology RDF. Retrieved from *http://musicontology.com*

Pascua, S.M. (2014). Design of the Music Score Web Ontology Using Arc2 Framework. *Journal of Philippine Librarianship*, 34, pp. 14-44.

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Slovak Centre of Scientific and Technical Information. Online Catalog. Retrieved from *http://katalog.cvtisr.sk/opacfn=*searchform&pg=2&fs=7D85F1F227CB4A1B82FDD2 7096C54A73*

Using Dublin Core . Retrieved from *http://dublincore.org/documents/usageguide/*

Using Dublin Core - Dublin Core Qualifiers. Retrieved from *http://dublincore.org/documents/ usageguide/qualifiers.shtml*

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