Ontology of Folk Songs in the Greater Mekong Subregion (GMS)†

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Abstract: This research aims to develop an ontology of the GMS folk songs for further utility in the areas of knowledge discovery and research pertaining to the humanities and social sciences domains. Ontology development processes are comprised of three phases: 1) analysis of existing metadata schema for folk songs; 2) content analysis of GMS folk songs from key resources; and, 3) ontology development, which consists of five processes: 1) defining the scope of folksongs ontology; 2) investigating the existing ontologies and plan for reuse; 3) defining terms and its relations; 4) create instances; and, 5) implementation and evaluation. The research outcome is the domain ontology of GMS folk songs, wherein 125 concepts of folk songs on GMS have been identified, defined and classified into classes and sub-classes. This classification presents an inclusion of some necessary scope notes and relationships of the topics, for example, the concepts on genres, the purpose of creation, moods, features, occasions, languages, ethnic groups, and place of origins. The ontology was developed by using the Hozo Ontology Editor. This study aspires that the consequently developed ontology will serve to be highly useful for the development of semantic knowledge-based search of GMS folk songs in the subsequent research.

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1.0 Introduction

By definition, the term folk song pertains to the songs that people in a community usually sing during their routine or social activities. An essential aspect of the folk song is that it constitutes a part of the oral culture, wherein the melodies and texts are learned and transferred by imitation and participation rather than from books. In the course of this oral transmission, it has been observed that the melodies undergo alterations overtime, and the resulting set of variants of a song are called "tune family." In alignment, several folk songs have been recorded on tapes or transcribed on papers by field workers, thereby making them available for research (Kranenburg et al. 2007).

The contents of folk songs or the lyrics, usually express stories about people and the important issues in

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their lives. Therefore, these folk songs describe the stories about history, ways of life, traditions, cultures, places, events, or even the social-economic and political situations of the country or community (Leopenwong 2009). According to UNESCO (2016), folk song is an intangible cultural heritage (ICH), which is classified in the "oral traditions and expressions domain." In this respect, UNESCO explains that oral traditions and expressions are used to pass on knowledge, cultural and social values and collective memory. In addition, they play a crucial role in the sustenance of a culture, with the progress of time. However, these oral traditions are threatened by the concepts of rapid urbanization, large-scale migration, industrialization and environmental change.

Specific to the current study, "The Greater Mekong Subregion (GMS) is a natural economic area bound together by the Mekong River, covering 2.6 million square kilometers with a combined population of approximately 326 million" (Asian Development Bank 2017).

> The Mekong River flows through regions of enormous ethnic and cultural diversity on its journey from the Tibetan Plateau, in China's Qinghai Province, to the Pacific Ocean in southern Vietnam. It traverses through Myanmar (Burma), Laos, Thailand and Cambodia, and passes through steep mountain gorges, daunting rapids and immense alluvial plains in six nations. Congruently, the music of the more than sixty million people who live in the Mekong Basin reflects this vast diversity (Smithsonian Institution 2017).

Moreover, the distinct characteristic of the GMS being inhabited by people from diverse ethnic backgrounds and different nations accords it the status and traits of a multicultural region. The folk songs in GMS inherited from the past, with a continual impact on the lives of people, constitute an important area for research and study. Based on the literature reviews, various resources for folk songs exploration in the GMS are available. Undoubtedly, folk songs have been an essential resource for the researchers studying folklore studies, sociology and anthropology to explore the historical development and traditional culture of a society (Kaewboonma and Tuamsuk 2016).

Moreover, as a knowledge organization system, ontology can be regarded as the classification of knowledge that provides the scope, concept and structure of the GMS folk songs, which in turn, will be useful for understanding and searching folk songs information. This research aims to develop an ontology of the GMS folk songs for further use in the areas of knowledge discovery and research in the humanities and social sciences domains.

2.0 Literature Review

Traditionally, it has been observed that in cultures around the world, work is often accompanied by song. Americans have developed work songs for many occupations, from agricultural jobs, such as picking cotton, to industrial ones, such as driving railroad spikes. Also, well known American figures such as cowboys had their own work songs, as did sailors, whose songs ensured smooth working on tall ships throughout the age of sail. Correspondingly, the work songs are typically sung for two reasons: 1) to ensure coordinated and organized working of a labor group, towards improvement in work efficiency; and, 2) to relieve the boredom of a tedious job, towards improvement in lives of the workers (The Library of Congress 2017).

Emphasizing the cultural significance, reports say that similar to "the Yangtze, the Nile, and the Mississippi, the Mekong River in Southeast Asia is a giver of life; countless communities depend on it for their existence. Like these other rivers as well, the Mekong River means more than environmental and economic stability—it has taken on a cultural significance in each of the areas it touches and has inspired a dazzling array of ritual, musical, and artistic expressions" (Smithsonian Institution 2017).

It is common knowledge that analogous to the world wide web, the growth of the semantic web will be driven by applications utilizing the semantic web. Correspondingly, semantic search is an application of the semantic web, which is one of the most popular applications presenting significant room for improvement. Furthermore, we believe that the addition of explicit semantics, the search function can be significantly improved. A semantic search attempts to augment and improve traditional search results (based on information retrieval technology) by using data from the semantic web. Traditional information retrieval technology is based almost purely on the occurrence of words in documents. Congruently, the advanced online search engines such as Google, augment this in the context of the web with information about the hyperlink structure of the web. The availability of expansive, structured, machine-understandable information pertaining to a wide range of objects on the semantic web provides ample opportunities for traditional search improvement (Guha, McCool and Miller 2003).

It has been observed that ontologies play a key role in this kind of search. An ontology, by definition, represents a formal model of the common interpretation of the entities and relationships in a domain of interest. Therefore, it is imperative that ontologies are widely used in digital library systems, towards optimization of processes. In particular, three types of ontologies have been identified as applicable to semantic digital libraries: 1) bibliographic ontologies; 2) ontologies for content structures (or subject

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ontologies, according to the term used in this paper); and, 3) community-aware ontologies. Subject ontologies are useful in providing support to the semantic annotation for all types of library resources. In addition, they play the role of knowledge sources, which define the meaning of most domain concepts, their hierarchy, properties and relationships (Guha, McCool and Miller 2003, Nisheva-Pavlova and Pavlov 2012).

Campos and Gomes (2017, 178) wrote:

> However, ontologies may be considered as knowledge organization systems due to the presenting interaction of the elements in a consistent conceptual structure. Moreover, theories pertaining to the representation of knowledge domains produce models that include a definition, representation units and semantic relationships essential for structuring such domain models. Congruently, scholars state that a realist viewpoint is proposed to enhance domain ontologies, as definitions provide a structure that reveals not only ontological commitment but also relationships between unit representations.

The folk song domain, as a part of the music domain, is vast in scope and divergent in terms of concepts and conceptual relations. Abrahamsen (2003) stated that the domain of music can be regarded as something that intersects with other domains such as education (teaching music), philosophy (thinking about music in philosophical ways), business (selling music) and information science (organizing and retrieving music, etc.). Therefore, the multi-disciplinary attribute, makes it challenging to create a folk song knowledge structure and define its representation. Smiraglia (2001) also stated that semiotic analysis of musical works indicates a variety of cultural and social roles. Thus, the domain of music is subject to cultural, temporal, geographic and sociological factors. Hence, it can be envisaged and visualized by one or a combination of perspectives. Correspondingly, Debaecker and Hadi (2011) examined the elements of musical information indexing and retrieval to determine how users find it practical to index music information. The results of the study showed that by tagging the various websites, users are allowed to enrich music metadata. Therefore, combining social driven metadata with mainstream data can form a basis for indexing music information.

Furthermore, studies on the organization of music knowledge with the use of metadata have created various metadata frameworks or schema. Corthaut et al. (2008) proposed a semi-automatic approach for generating music metadata. His findings suggested that the music metadata generation framework was composed of two aspects: 1) the desired application domains (e.g., music library/encyclopedia, music recommendation, music retrieval and music notation); and, 2) the metadata formats (e.g., MARC, MODS, ID3, Dublin core, music vocabulary, music ontology and MPEG-7). Similarly, Tian et al. (2013) provided an overview of the metadata schema for Chinese traditional music, such as the Dublin Core Metadata Initiative, the Metadata Object Description Schema, the Encoded Archival Description Schemes, MPEG-7, MusicXML, the Music Encoding Initiative, ID3 and AES-60. An examination of these metadata schemas in the context of Chinese traditional music revealed the current absence of certain essential concepts. This absence can primarily be attributed to the disparity in importance—or biases in different social and cultural concepts—between western and Chinese musical traditions.

The other forms of knowledge organization that show the use of classification approach are knowledge vocabulary, the thesaurus, taxonomy and ontology. In several cases, knowledge vocabulary and taxonomy are utilized for the creation of knowledge structure, and correspondingly, the terms or keywords in the vocabulary or taxonomy are used for ontology development. The research on the taxonomy of folktale for GMS by Tuamsuk et al. (2016) was an example of creating a knowledge structure using taxonomy and subsequent development of an ontology based on the taxonomy. Likewise, Kanzaki (2007) created music vocabulary to describe classical music and performances. Similarly, classes (categories) for musical works, events, instruments and performers, as well as related properties, are defined to distinguish musical works (e.g., Opera) from performance events (Opera_Event), or works (String_Quartette) from performers (StringQuartetEnsemble in this vocab), whose natural language terms present an interchangeable use. The current version of music vocabulary creates a more precise model to describe a musical work, its representations (performances, scores, etc.) and a musical event to present a representation (a concert). Specifically, the vocabulary consists of 112 classes, thirty-four properties, and thirty individuals.

Noy and McGuinness (2001) explained that "An ontology defines a common vocabulary for researchers who need to share information in a domain." An ontology consists of a set of objects divided into classes, concepts, properties (such as slots or roles) and the restrictions of the roles. Also, a hierarchy can be created, through establishing an association between the main and more specialized classes to an ontology. Additionally, the so-called instances of the classes represent individual objects of the selected domain. Previous literature reviews, correspondingly shows that studies on the development of music or song ontology were mainly aimed for web-based information retrieval. Likewise, Raimond et al. (2007) devel-

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oped the "Music Ontology" to link all the information about musical artists, albums and tracks together, from MusicBrainz to MySpace. The goal of these studies is to express all relations between musical information in order to help people find anything about music and musicians. Thus, it shows a resemblance and is based on the concept of machine-readable information provided by any website or web service on the web. Music ontology is divided into several levels of expressiveness: 1) the first level only addresses purely editorial information; 2) the second level introduces the event concept. This concept can be used to describe a work flow involving the composition of a musical work, an arrangement of this work, a performance of this arrangement and a recording of this performance; and, 3) the third level introduces event decomposition and builds on four main ontologies: 1) *FOAF*, a vocabulary for describing people, groups of people and organizations; 2) *The Event Ontology*, a vocabulary for describing events, from "this performance occurred on that date" to "this is the chorus of that song;" 3) *The Timeline Ontology*, a vocabulary for describing time intervals and instants on multiple (possibly related) timelines, e.g., an audio signal's timeline; and, 4) *The FRBR Ontology*, a vocabulary for describing works, expressions, manifestations and items and their inter-relationships, as defined by the Functional Requirements for Bibliographic Records.

More examples of research on music ontology include the study of Goienetxea et al. (2012) focusing on the ontologies for representation of folk song metadata, based on the Web Ontology Language (OWL) and implementation of the CIDOC Conceptual Reference Model. The main objective of the research was to organize the metadata of songs in a hierarchical way, through the structuring of the Basque Folk Song collections from the Euskal Herria territories located in France. The research results produced nine domains of the songs including "place," "borders with," "is identified by," "CRM entity," "appellation," "falls within," "contains," "place appellation" and "title."

Similarly, a study by Nisheva-Pavlova and Pavlov (2012) focused on developing technologies for the digitization of Bulgarian folk music and building a semantic digital library (named DjDL) with Bulgarian folk songs including their sound recordings, lyrics, as well as notation of more than 1,000 Bulgarian folk songs and tools for various types of search and analysis of the available resources. The study revealed DjDL to present the typical architecture of an academic digital library with heterogeneous resources. Its functional structure was found to include six main components: 1) metadata catalogue; 2) repository; 3) subject ontology; 4) search engine; 5) module implementing the library functionality; and, 6) interface module. The system as studied is found to contain heterogeneous resources of four types: 1) lyrics of songs (in PDF format); 2) notation of songs (in LilyPond format); 3) musical (MP3); and, 4)musical (MIDI) and subject ontology. In addition, the subject ontology was found to be developed especially for the following occasions: 1) ontology of folk songs—includes various genre classifications of folk songs (by their thematic focus—historical, mythical, etc.; by the context of performance—Christmas folk songs, harvest songs, etc.; by their cultural functions—blessing, oath, wooing, etc.); 2) ontology of family and manner of life; 3) ontology of impressive events and natural phenomena; 4) ontology of social phenomena and relationships; 5) ontology of historical events; 6) ontology of disasters; 7) ontology of feasts; 8) ontology of traditions and rites; 9) ontology of blessings and curses; 10) ontology of mythical creatures and demons; and, 11) ontology of administrative division.

Lastly, the study of Madalli, Balaji and Sarangi (2015) presented a principled approach towards the analysis of music as a domain and explained the resulting concept scheme. It was arranged by facets at a higher level of abstraction and each facet consisted of concepts with shared features displaying increasing intention of scope in the hierarchies. Building upon S.R. Ranganathan's faceted theory, the research addressed the faceted classification approach applied to build domain ontologies. The process of facetizing the domain of music was determined in alignment with facetization postulates. Furthermore, music ontology was developed with the top classes of the theory, persons, instruments, kinds, forms and works.

3.0 Materials and Methods

3.1 Materials

The researchers reviewed the existing resources on GMS folk songs, folk song classifications, folk song metadata and folk song ontologies. The key resources, which were selected for all study purposes included 1) Fabian (2007); Thai Junior Encyclopedia Project (1999); Samson (2012); Donaldson (2011); Leopenwong (2009), and Tian et al. (2013); 2) existing resources on folk song classification or categorization, such as the works of Dundes (1965) and Sujachaya (2002); 3) internet resources providing GMS folk song contents; 4) the existing ontology in the previous ontology-related projects including Raimond et al. (2007; 2013); 5) Nisheva-Pavlova and Pavlov (2012); 6) Goienetxea et al. (2012); and, 7) Kanzaki (2007)

3.2 Methods

This section describes the development and interaction of ontology with a knowledge management system. In

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their study, Kayed and Colomb (2001) summarized the methodologies for developing ontologies around three major stages of the ontology life cycle, i.e., building, manipulating and maintaining. The study evidences that these three stages overlap in the building process, which affects and is affected by the manipulating stages. This intersect is also true between the manipulating-maintaining and building-maintaining stages and hence, the relation between stages in the ontology life cycle is necessary for an evolutionary approach.

In this research, we adopted an ontology life cycle framework from Kayed and Colomb (2001) and Li, Hsieh and Sun (2003) to develop the ontology for the GMS folk songs. The architecture of the framework consisted of four major stages, i.e., concerting, developing, manipulating and maintaining (Figure 1).

In the "concerting stage," a qualitative research method was applied in the following steps: 1) analysis of existing metadata schema for folk songs; and, 2) content analysis of GMS Folk songs from key resources.

In the "developing stage," ontology development was composed of five steps: 1) defining scope of the Folk Song ontology; 2) investigating the existing ontologies and plan for reuse; 3) defining terms and its relations; 4) create instances; and, 5) implementation and evaluation. Based on the content analysis and the domain experts, the ontology can be divided into two domains of "Folk Song (Domain) ontology" and "Information ontology." The Folk Song ontology consists of the concepts, attributes and instances of folk songs. The objective of the Folk Song ontology is the achievement of a semantic match during the searching of knowledge objects. The Information ontology is a metamodel that describes knowledge objects and contains generic concepts and attributes of all information about the knowledge objects, such as "title," "subject," "identifier," "albums," "tracks," "formats," "artists," "date of creation" and other related information.

In the "manipulation stage," an ontology query language should be provided for browsing and searching, efficient lattice operation and domain-specific operations. Finally, in the "maintenance stage," ontology engineers should be able to syntactically and lexically analyze the ontology by adding, removing or modifying definitions, as well as translate from one language to another.

4.0 Results

In the study, the GMS Folk Song ontology was developed using Hozo, which is an ontology editor environment. Congruently, the scope of the ontology development was

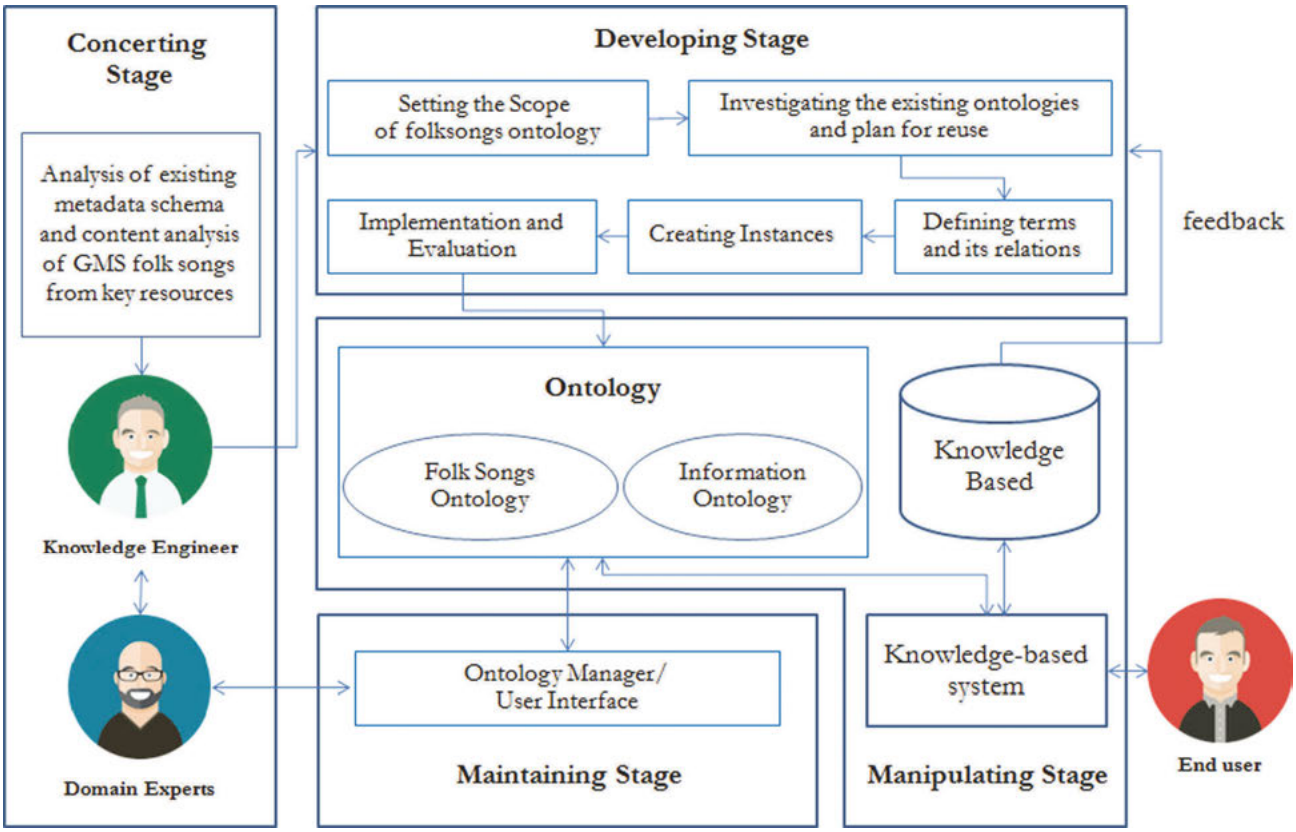

Figure 1. The framework of ontology modeling for GMS Folk Songs (Adopted from Kayed and Colomb (2001); Li, Hsien and Sun (2003).

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focused on GMS folk song data and knowledge on GMS folk songs.

According to a study by Kaewboonma and Tuamsuk (2016) focusing on the knowledge organization of the GMS folk songs for ontology development, the knowledge on GMS folk songs can be divided into eight concepts. These include "genres," "purpose of creations," "moods," "features," "occasions," "languages," "ethnic groups" and "place of origins." Also, one interesting aspect of the "folklore" class hierarchy (Figure 2) is the "is-a" relation of three important sub-class ("verbal," "non-verbal" and "hybrid").

The relations are found to consist of several types, including hierarchical relations such as "is-a," "part-of" and "attribute-of." We specifically address these three formal relations in the study to indicate the specialization of the concept and sub-concept. For example, forEntertainment, forEducation, forExpression, forPlayingGames and forSleepingChild are sub-classes of the "purpose of creations" class (Figure 3).

The GMS Folk Song ontology was revealed in the study to consist of classes and properties that describe "genres," "purpose of creations," "moods," "features," "occasions," "languages," "ethnic groups" and "place of origins" (Table 1).

In addition, a class of "FolkSong" (Figure 4) is defined as a main class in the GMS ontology with defined properties, i.e., "title," "subject," "identifier," "albums," "tracks," "formats," "artists," "date of creation," "time of origin," "other names," "lyrics," "length," "related work," "related artists" and "file description." Other main classes, as revealed in the study include the "PlaceOfOrigins," "Purpose OfCreations," "Occasions," "Languages," "Genre," "Mood," "Feature" and "EthnicGroups" classes, which show an association with the "FolkSong" class.

In this research, we used application-based ontology evaluation to conduct the GMS Folk Song ontology assessment. Correspondingly, the ontology can be evaluated using what is known in information retrieval as precision, recall and the F-measure. We evaluated the system performance by calculating: 1) the precision value, which is the total matched terms divided by the total found terms; 2) the recall value, which is the total matched terms divided by the total terms found manually; and, 3) the F-measure using an equation. The results of the knowledge retrieval were shown in the semantic search application to be effective as regards the values of precision, recall and F-measure, which were 90.00%, 78.00%, and 83.00%, respectively (Table 2).

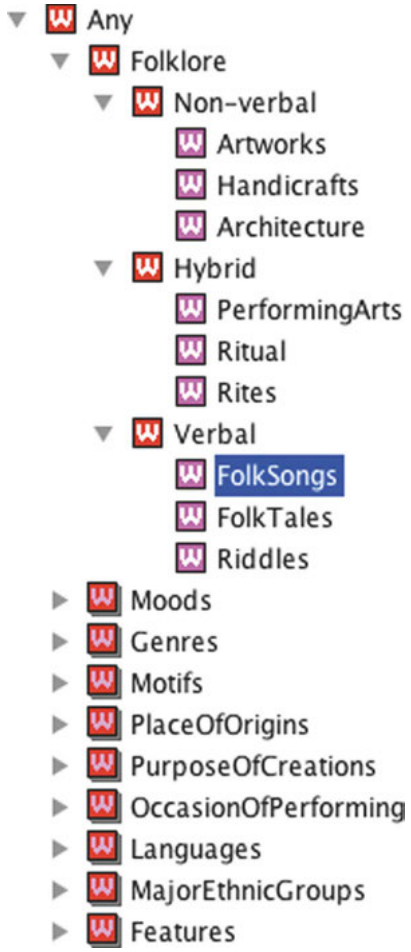

Figure 2. Concepts of GMS Folk Song classes.

Term Name	Type	Definition
Genres	Class	Types of folk songs
Purpose of creations	Class	Purpose of the creation of the folk song, which can be identified from the meaning of the songs.
Moods	Class	The emotion expressed in the folk songs.
Features	Class	The features represent the components of the folk songs.
Occasions	Class	The occasions of folk song performances.
Languages	Class	The languages of the folk songs.
Ethnic groups	Class	The ethnic groups who created the folk songs.
Place of origins	Class	The countries of origin of the folk songs.

Table 1. Summary of terms.

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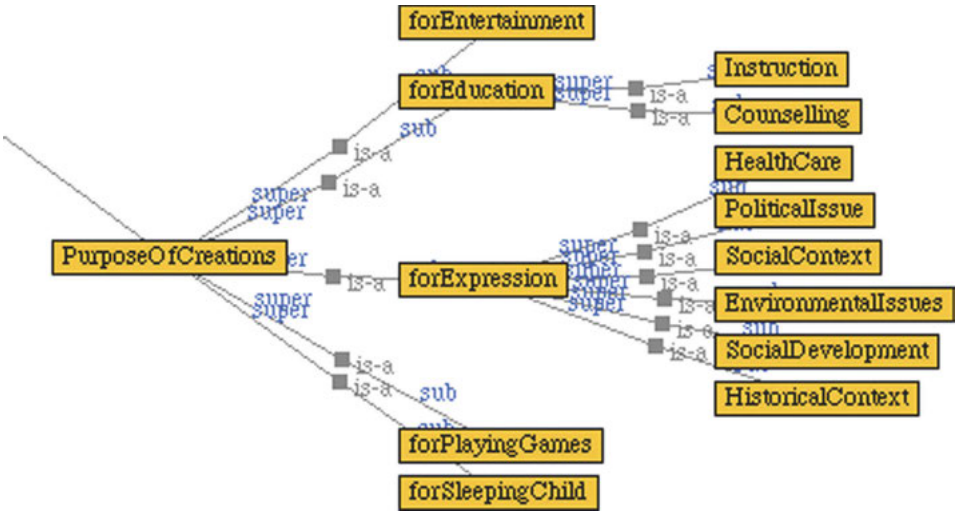

Figure 3. Class hierarchy of the PurposeOfCreations class.

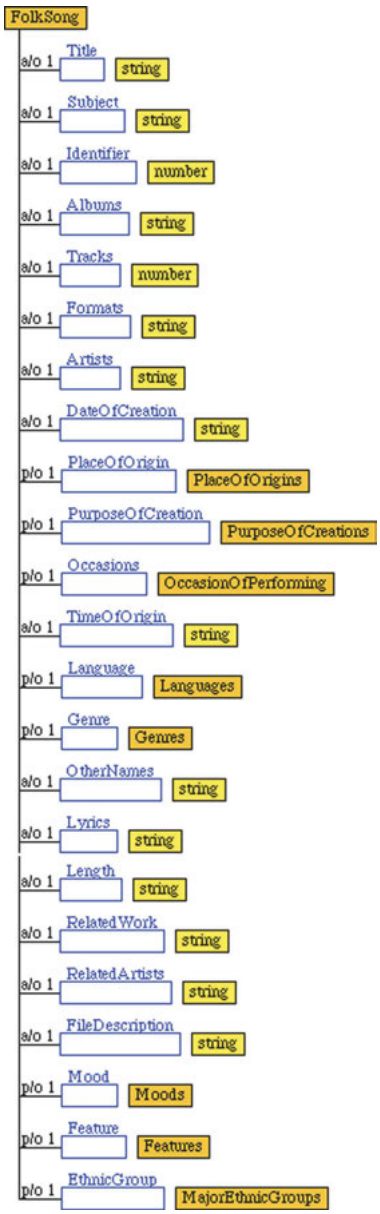

Figure 4. Properties of 'Folk Song' class.

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Query Category	Queries				Total			Precision	Recall	F-Measure
	Yes/No	List	Quantity	Total	Terms Manually	Found Terms	Matched Terms			
Folklore	10	10	10	30	18	15	13	0.87	0.72	0.79
Moods	10	10	10	30	40	38	37	0.97	0.93	0.95
Genres	10	10	10	30	14	12	10	0.83	0.71	0.77
Motifs	10	10	10	30	8	6	5	0.83	0.63	0.71
Place of Origins	10	10	10	30	14	12	11	0.92	0.79	0.85
Purpose of Creations	10	10	10	30	24	22	21	0.95	0.88	0.91
Occasion of Performing	10	10	10	30	6	5	4	0.80	0.67	0.73
Languages	10	10	10	30	30	28	27	0.96	0.90	0.93
Major Ethnic Groups	10	10	10	30	50	45	44	0.98	0.88	0.93
Features	10	10	10	30	10	8	7	0.88	0.70	0.78
Total	100	100	100	300	214	191	179			
Average								0.90	0.78	0.83

Table 2. The collected queries and performance categories and distribution of the knowledge retrieval.

5.0 Discussion and Conclusions

We examined existing metadata standards to present a relevant academic discussion on music-related information in the context of GMS folk songs and thus aimed to develop an ontology for the GMS folk songs for publishing music-related information on the semantic web.

The work of Tian et al. (2013) examined existing metadata standards for describing music-related information in the context of the Chinese music tradition. The prominent schema includes accepted or de-facto standards,as well as semantic web ontologies. Standards including DCMI, MODS, EAD, MPEG-7, MusicXML, MEI, ID3, The EBUCore and Music ontology, were selected for comparison. They found that western-centric metadata schema demonstrates a lack of some crucial terms in specifying featured elements of the Chinese music tradition, including social context or performing skills. However, the current study revealed that the properties of "Folk Song" in GMS were adopted from Music Ontology (Figure 4) and created new featured elements including "mood (displeasure and pleasure)" and "feature (form, melody, rhythm, sounds and texture)."

The work of Tai, Rau and Yang (2008) described the Yami Ontology in traditional songs by employing Protégé software. They found that Yami people employ the conceptual metaphor of "fishing" in traditional songs when parsing the host's diligence in a ceremony, which celebrates the completion of a workhouse. This was corroborated in the current study, which revealed that thee folk songs in GMS also have developed work songs for many agricultural jobs such as a song about rice planting and harvesting in Thailand, Laos and Vietnam.

In conclusion, we present our GMS Folk Song ontology, specifically focused on the ontology development process. Ontology can be developed based on four main stages: concerting, developing, manipulating and maintaining. In the "developing stage," ontology development is composed of five steps: 1) defining scope of folk song ontology; 2) investigating the existing ontologies and plan for reuse; 3) defining terms and its relations; 4) create instances; and, 5) implementation and evaluation. The ontology was developed with the use of Hozo Ontology Editor. In the future, we plan to develop a semantic knowledge-based search system of GMS folk songs.

The results of our research, when compared to the previous studies found that the top classes of GMS Folk Song ontology comprised eight classes, while the other music ontologies, vocabulary and thesaurus, comprised four to six classes. This disparity in the results can be attributed to the difference of the current research focusing on folk songs, which has a narrower knowledge scope than previous studies. Therefore, in the current study, the content is more explicit and can be divided into specific top classes' characteristics of folk songs in the GMS, such as "languages," "ethnic groups" and "place of origins" (Table 3).

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The Music Ontology (Raimond*et al.*, 2007)	Music Vocabulary (Kanzaki, 2007)	Musical Thesaurus (Leach, 1976)	Music Ontology (Madalli*et al.*, 2015)	GMS Folk Songs
Performance	Works	Theory	Theory	Genres
Instrument	Events	Persons	Person	Purpose of creation
Genre	Instruments	Forms	Instrument	Moods
Social networking information	Performers	Genres	Kind	Features
Features		Themes	Form	Occasions
			Work	Languages
				Ethnic groups
				Place of origins

Table 3. Comparison of top classes (categories) of music and GMS Folk Song ontology.

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