

OntoQuer: A Tool for Building SPARQL Query Automatically Applying with Our Ontologies

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Abstract—The aim of this paper is to retrieve results efficiently from 3 related ontologies using a new tool based on SPARQL: “OntoQuer”. OntoQuer consists of 6 menus designed to cover all searches from users. The highlight of OntoQuer is that users can obtain results without any background in SPARQL syntax. OntoQuer compiles at each step in a simple way. The outstanding advantages of OntoQuer are the system can automatically create SPARQL query to find the results and able to validate the correction of syntax. OntoQuer simply proceeds the data in Resource Description Framework (RDF) and the Web Ontology Language (OWL). In addition, the current search with Thai-English transliterated words does not support foreign tourists. The existence of OntoQuer can solve the mentioned problem. The implementation of OntoQuer was designed with 3 newly-developed ontologies (Tourism ontology, Language ontology and UserProfile ontology) to tackle this issue with the case study of Phuket tourism. The ontological knowledge was required in order to improve search effectiveness using ontological data in SPARQL query. The combination of OntoQuer with 3 ontologies has offered a powerful search tool with high efficiency and greater flexibility to users.

Index Terms—SPARQL, RDF, URI, Ontology, OntoQuer

I. INTRODUCTION

In the globalization era, the large amount of information is available on the internet and increasing in number exponentially. Keywords search has several disadvantages; long retrieval time, low accuracy, inability to evaluate the meaning of the user’s query etc., especially, lack of support in transliterated word searching. Tourists may not find suitable and accurate information of touristic attractions on the internet without some help from a personal travel guide or native speakers.

In order to overcome these limitations, semantic web technology is necessary. The Semantic Web is a common

framework used to store, presented the structure contents and classified data relationships. It provides the ability to understand meta-data, standard markup language such as RDF or using ontologies and define relations for interoperability [1]. Ontology is a semantic web tool that is being increasingly used for create the applications for the specific domain. Most used ontologies describe individuals (instances), classes (concepts), attributes and relations. Defining ontology in RDF form makes the search system be able to understand the meaning of the information’s efficiency; and RDF can gather the knowledge from multiple data sources together.

SPARQL is a popular method for query the relevant records from RDF or OWL file [2]. SPARQL is the W3C candidate recommendation query language for RDF [3]. It is the language that performs fast and efficient search of data. Users must learn SPARQL syntax to query data from ontology. SPARQL contains many capabilities for querying, including express queries across diverse data sources. Moreover, SPARQL has sensitive syntax and difficult to learn in limitation time. Nevertheless, our new tool enhances the effectiveness of query search using SPARQL. OntoQuer will generate SPARQL automatically from keywords. This is a powerful tool which can reduce the search time and provide more flexibility for users.

In summary, the goal of this work is a new tool called “OntoQuer” which can assist users in building their SPARQL queries. OntoQuer with the new three ontologies : Tourism ontology, Language ontology and UserProfile ontology was tested. The results show that OntoQuer offers a simple and user-friendly interface. OntoQuer is easy to use by only entering keywords to create URIs or literal. This system needs users to select URIs or literal into <subject>, <prediction> and <object>. Then the system will automatically create a complete SPARQL syntax and retrieve accurate and relevant results for their queries. This tool can support and apply SPARQL query with all domain ontologies. Thus, the effective query is very high because the data are linked and interrelated.

The following section presents the related work on RDF, OWL, SPARQL and ontology. Then, in the third section, we introduce our 3 ontologies and OntoQuer. After that, we show the results from querying and conclusion.

II. RELATED WORK

Currently, an increasing amount of linked data and the web of data is available [4]. The representation of the knowledge dedicated to represent the information is in a form that computer system can process to compile the complex systems. There are a variety of languages which can be used to represent a conceptual model. RDF (Resource Description Framework), RDFs (RDF Schema) and OWL (Web Ontology Language) are the famous language's representation for the semantic web.

A. RDF and OWL

RDF is a standard data model to represent information about resources in the World Wide Web (i.e. meta data). RDF identifies the relationship between nodes that link the structure of the Web using URI [5].

The Uniform Resource Identifier (URI) is a string of characters that identifies a unique identification for a resource. It allows interacting with the representations of the resource on the internet, typically WWW (World Wide Web) [6]. Ontology is a semantic web tool for interactions in some particular domain of knowledge. Ontologies have several advantages such as interoperability, sharing, reuse...[7]. OWL is a semantic web language that provides syntax and represents the knowledge and the relations between things for the semantic web. It also provides the solution for limitations in terms of identifying the relationships between classes in RDF.

The fundamental build up on each of these languages is the triple. It contains three components : subject, predicate and object. Subject, Predicate and Object must be identified by URIs, or by another Object who can be a constant data value (or literal) instead of a URI. Subject is the resource that described by the statement. Predicate is also known as the property of the triple. Object is the specific value of the property. OWL can be used to mix between RDF and XML (Extensible Markup Language) depending on the methodology and the information that are created in .owl, .rdf and .xml [8].

B. SPARQL(Search Protocol and RDF Query Language)

Using query language can reduce the time obviously for searching and retrieving information. The semantic web ontologies code is based on RDF query language (including RDFs and OWL). There are many existing semantic web query language such as RQL, RDQL, Versa and SPARQL [9]. SPARQL improved searching the data faster and efficient when compared to other

Query language, was presented by [2]. In addition, SPARQL is the query language recommended by W3C (World Wide Web Consortium) currently [3]. SPARQL query is executed and supported by the most RDF triple store [10]. SPARQL works are based on comparison between RDF and query statement. If the statements are matched, the RDF results will be shown.

The principle process has two parts that are SELECT and WHERE. The first part identifies the triple values that will be displayed from searching on the RDF graph. The second part recognizes the results of which conditions matched the RDF datasets. SPARQL has many benefits over the other query languages. For example, SPARQL is an appropriate query language for querying two or more data sources in a single query. SPARQL can query RDF datasets natively. SPARQL can support for querying semi-structured, unpredictable and unreliable structure. It is able to use the various queries to retrieve the output and it can query the RDF graph that consists of various triples. And it helps to reduce time in query language and retrieve fast.

There are several works have proposed for SPARQL queries. Nandish Jayaram et al., [11] created the graphical systems to query the knowledge using GQBE (Graph Query by Example) It can find the best answers with fast query processing. Geraud Fokou et al., [12] constructed graphical tool for SPARQL query too, but this tool can improve to support query-answering technique. In order to make SPARQL queries more easily, [13] proposed a web-based prototype based on the selected SPARQL for users who never used (Visual-OWL) before.

C. Ontology

Ontology constitutes the standard knowledge representation tool for the Semantic Web. It is an efficiency tool for interactions in some particular domain of knowledge. Ontology provides an explicit conceptualization that describes the semantics of the data. Ontology can support the sharing common understanding of the domain and related information among users or software agents. Reusing ontology makes getting new ontologies which are more quality because the reused components have been tested already.

III. CONTRIBUTION

A. Our Platform : WICHAI

WICHAI (WebservICes platform for pHuket tourism bAsed on ontologies) is a platform for searching touristic information (attractions, activities, restaurants, ...) in Phuket based on semantic web technology [14]. There are web-based application, ontology and transliteration (shown in Fig. 1). The main point for this paper is ontology part.

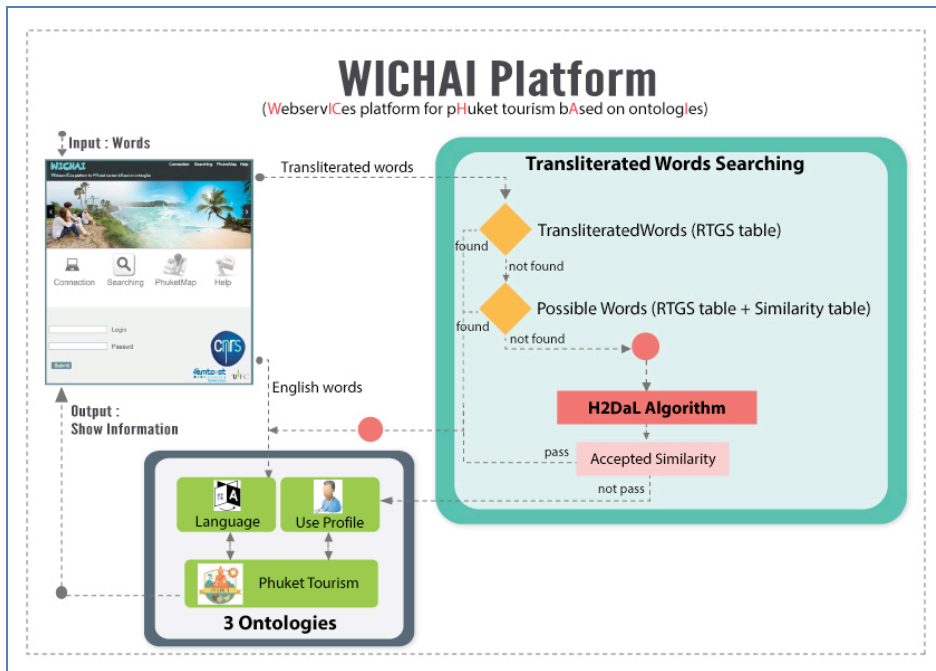


Figure 1. WICHAI Platform.

Ontology development is rapidly evolving in all domains. The obvious advantage of ontologies is supporting the sharing and reusing the knowledge. Applying the reused ontologies helps to save the budget, resource and time. The important reason to apply the reused ontologies because they have been verified and tested. In this work, ontology consists of 3 domains that are Tourism, UserProfile, and Language ontologies. Tourism ontology and UserProfile ontology are created by reusing the existing ontologies and extending some new super-class and sub-class. The last ontology, language ontology, we create the new one because the existing language ontologies are not suitable for Transliterated words in Thailand. These ontologies have already been validated by 3 experts in the field of tourism in Phuket and ontology management from Thailand. Our ontologies are shown in Fig. 2.

Tourism plays an important role in searching information. Currently, The Tourism Authority of

Thailand promotes the “Chom-Chim-Chop” campaign. “Chom” interprets visiting, “Chim” means eating and “Chop” is shopping activity. Thus we create and reuse domain of ontologies based on the government slogans. Tourism ontology is adapted from ETP ontology [15] and OnTour ontology [16]. ETP is a management system of destination for tourism services online such as identifying, classifying, organizing... by the United Nations Conference on Trade and Development e-tourism initiative. OnTour is a Tourism ontology domain using OWL. It is based on the Thesaurus on Tourism and Leisure Activities of the World Tourism Organization. However, existing ontologies do not cover exactly the concepts related to tourism in Phuket, Thailand. This became the motivation for this work: the new one based on ETP ontology and OnTour ontology. Tourism ontology contains eight classes based on “Chom-Chim-Chop” slogans. All classes are created in .owl file.

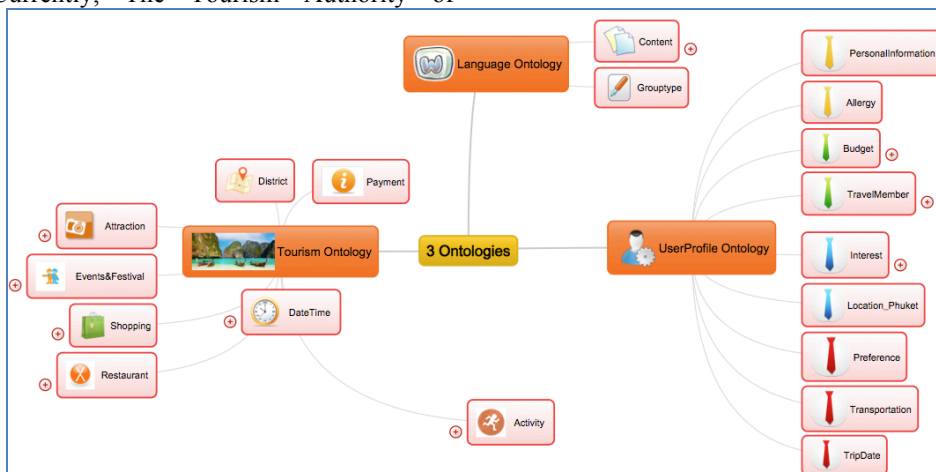


Figure 2. Combination of Ontologies.

The UserProfile ontology aims to facilitate the extraction of the details of the user personal information. This UserProfile ontology is based on Tamilnadu ontology [17] which are Indian scenario (Tamilnadu) tourism. Tamilnadu was created to aid the tourists to plan their trips accurately. User Profile ontology is very important. It is the first step to classify data properties based on user preferences. This ontology collects various details such as preferences, budget, date of the trip... There are total 9 classes and there are object properties, data properties, instances...

The language ontology manages and groups words into English words, Transliterated words and possible words. In addition, this ontology has class for collecting synonym words to provide more powerful searching. Our 3 ontologies are developed using protégé. System based on collaborating 3 ontologies can provide tourism's information that match the user's query based on linguistics and user profile effectively.

From 3 related ontologies, SPARQL query is the important method to retrieve the correct results. But SPARQL has limitations of usage. Thus, we proposed "OntoQuer" to solve this issue.

B. Our Tool: OntoQuer

In order to make SPARQL queries more accessible to users, OntoQuer tool was developed by Java programming language, Swing and AWT libraries using Eclipse. It is suitable for beginner who wants to design, create the SPARQL query without the knowledge of complex syntax and the structure of the ontology. It is the tool to generate URIs and users can select URIs into <subject><prediction><object>. Then, the SPARQL query will be automatically created. This system has various and comprehensive menus such as simple queries lists, lists of entities, classes, ... stored by the user. The user interface consists of 6 main menus are show in Fig. 3.

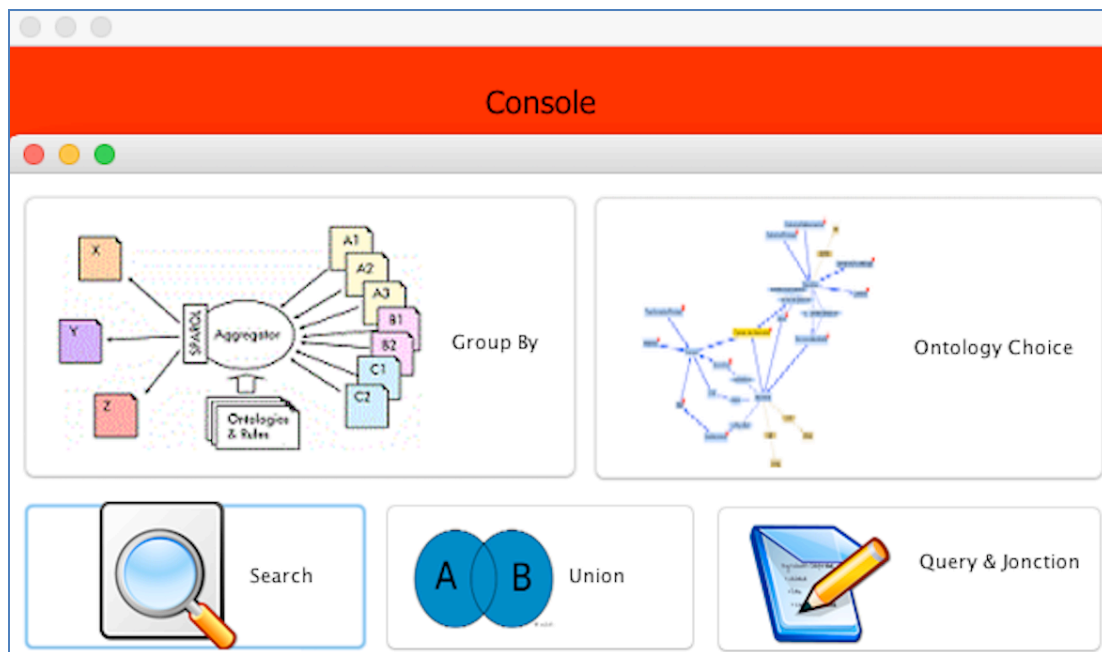


Figure 3. User OntoQuer's User Interface.

The first menu is "Ontology Choice", users can select the ontologies and import the single ontology or multiple ontologies into the system. Next is "Search" function. The users insert the keywords for classes, properties, individual from subject or object part... for simple filtering, and the system will generate URIs automatically. Third is "Query&Inner Join", users can select list of <subject>, <property> and <object>. This process will build the SPARQL query using URIs from search function. Fourth process is union function and next is grouping functions such as sum, count, ... Last is the console window in order to display some messages from

the system such as redirect errors, message for connection ...

OntoQuer is a tool for users creating and reviewing SPARQL query easily. It has various advantages as following: It is user-friendly, even with only one or multiple ontologies. Users do not require the knowledge of SPARQL syntax. This tool allows the users to validate completely or redundancy of ontologies structure. The results are clear visualization, easy to be understood. It can show the details as needed; and it is able to determine the accuracy of the ontology structure. Easy searching process, users can search in each step respectively.

For example, users would like to “search location and opening time for Japanese Restaurant from our ontologies”. Beginning with choosing and importing the ontologies, then selecting the part of triple from class, property, individual, ... for create URIs (Fig. 4a and Fig. 4b). Then, users can insert the keyword from the question or select keywords from the list (Fig. 4c). After that, the system will create URIs and users are able to save each URIs into class, property, individual ... for

next queries (Fig. 4d). Moreover users can select the interested URIs for more information. Then, Query and Inner Join part, users select URIs or literal into <subject><property><object> from combo-list. The system will create and show the SPARQL query automatically (Fig. 4e). After user select “execute query” button, the answers will be displayed from SPARQL query (Fig. 4f).

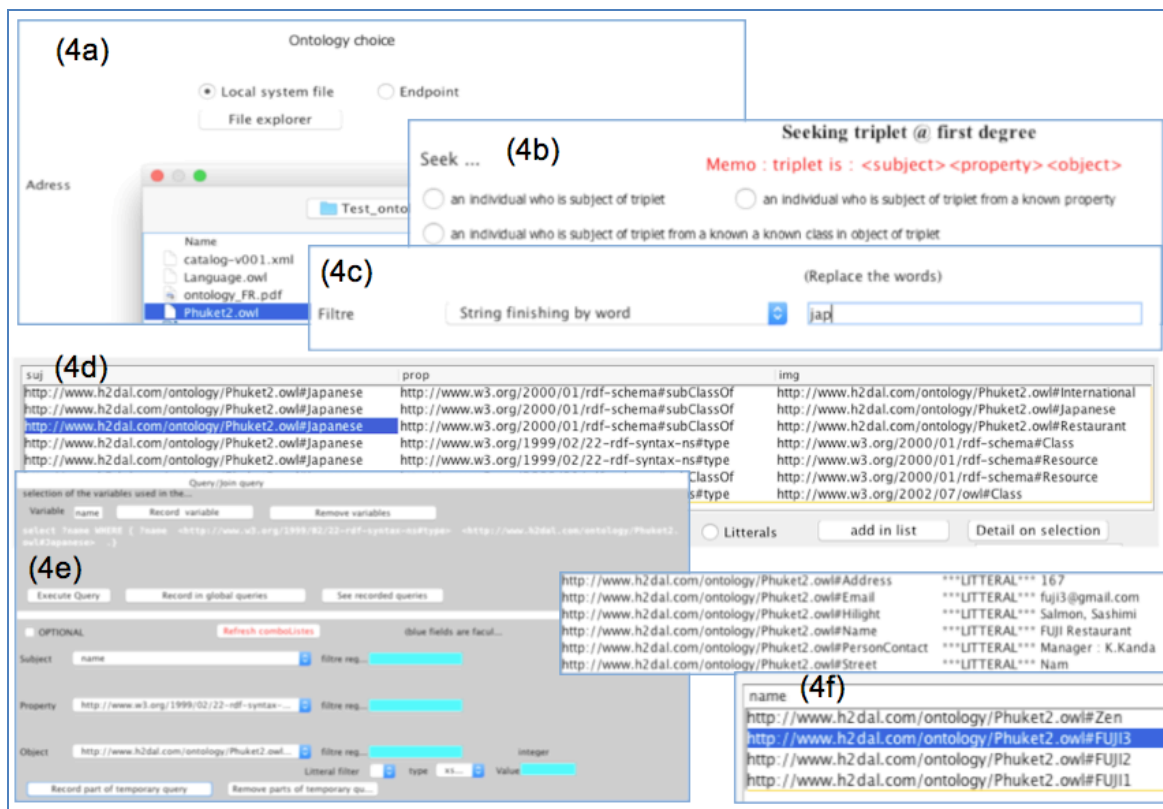


Figure 4. User Interface in Each Step of OntoQuer

IV. RESULTS

OntoQuer was applied with our 3 ontologies. The results clearly show that the structures of those 3 ontologies are correct using SPARQL query generated by OntoQuer. From question in section 3.2, the result of Japanese Restaurant was displayed as shown in Fig. 4. Japanese Restaurant is the subclass of International Restaurant and Restaurant respectively. Users can enter the keyword only “jap”, “japa”, “japanese”, The tool will create the URIs to users automatically. Querying part, users simply select the value or URIs that was recorded previously according to <subject><prediction><object> appropriately. Finally, the system will generate the SPARQL query and offer all Japanese Restaurants from the ontologies. Moreover, users can also get in-depth details such as location, opening hour, ... And users can query with many conditions such as “Where is the places that users can buy the souvenirs on Friday at 9.00 PM?”

The system creates the UNION relationship suitable for the user's requirement.

In addition, supporting for query with various ontologies is another important feature. It connects the data in each domain by using simple SPARQL queries. From Fig. 2, Please retrieve the answer for this question “Who (data from UserProfile ontology) love monkey (data from Tourism ontology)? And please suggest the place whether she should go in English words and Transliterated words (data from Language ontology)”. This question consists of 3 phases, the first step to find the keywords “monkey”. Then, the output shows “Nana” who is the person who love monkey from UserProfile ontology (see Fig. 5(above)). After that, the system will show description about “Zoo” that it is the place for animals from Tourism Ontology. The last step is connecting with Language ontology to show that zoo is “Suansat” or “Sat” in transliterated word. (See Fig. 5(bottom)).

http://www.h2dal.com/ontology/UserProfile.owl#Depart	***LITTERAL*** 2016-04-10T06:00
http://www.h2dal.com/ontology/UserProfile.owl#Dislike	***LITTERAL*** adventure activity
http://www.h2dal.com/ontology/UserProfile.owl#Like	***LITTERAL*** Outdoor activity, monkey
http://www.h2dal.com/ontology/UserProfile.owl#Name	***LITTERAL*** Nana
http://www.h2dal.com/ontology/UserProfile.owl#NumberOfAdult	***LITTERAL*** 2
http://www.h2dal.com/ontology/UserProfile.owl#NumberOfChildren	***LITTERAL*** 1
prop	img
http://www.h2dal.com/ontology/Phuket2.owl#hasGroup	http://www.h2dal.com/ontology/Phuket2.owl#Attraction
http://www.h2dal.com/ontology/Phuket2.owl#words_EN	***LITTERAL*** zoo
http://www.h2dal.com/ontology/Phuket2.owl#words_PO	***LITTERAL*** Suansud, Suansut, Sud, Sut
http://www.h2dal.com/ontology/Phuket2.owl#words_TR	***LITTERAL*** Suansat, sat

Figure 5. User Interface for the Results

Above query results, the users do not require the knowledge of query syntax. Users can search by only putting keywords and understand each step in the searching process. This tool can process the variety of different functions such as grouping and aggregation, union, ... The last advantage of this tool is its suitability for beginners with less knowledge in SPARQL syntax using OntoQuer to confirm the correct syntax.

V. CONCLUSION

Currently, ontology is an important conceptualization covering a variety of information sources. The datasets can group and correlate with the different domain ontology. There are several methods and implementations for query data under RDFs. Using SPARQL to query ontologies and metadata are a popular method. Unfortunately, SPARQL syntax is difficult to learn because it is sensitive and strict. If users type wrongly (even only one alphabet), the results cannot be displayed. Thus, most users avoid using this method. Finally, we propose a new tool for building SPARQL query. It is easily used by users who have low knowledge in syntax of SPARQL. The user interface is simple and easy. It defines the category and supports from various ontologies. When users search the queries from 3 ontologies using OntoQuer by providing only keywords, the results will show the best recommended attractions in Phuket based on user profile.

For the future work, we plan to conduct a recommender system. It integrates a search engine, 3 ontologies being validated by OntoQuer and our algorithm part. Using SPARQL connected with the ontologies via Jena (Java API) will be explored. Then we combine SPARQL query from OntoQuer with the recommender system to get the best results. We will also develop OntoQuer into web-based application in order to have more efficient use. It will be more easily to use OntoQuer directly to searching that gives more accurate and efficient results.

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