

Ontology Modeling for Provision of Semantic based Open API Information

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Abstract— As According as the web technology rapidly advances, web services are taking a step further up to the era of Web 2.0 which goes beyond the existing closed web services and enables ones to open and share information freely. In addition, with the rapid distribution of mobile terminals such as smart phone, web services are available in various environments such as while on the move, not only at a certain place, which arouses more interests on web services. Web services are usually provided in the form of Open APIs (Application Programming Interface). Since the current Open API search is performed only by key words, numerous unnecessary Open APIs are retrieved along with the desired Open API, which makes it difficult for users to find desired Open APIs readily and swiftly. It is necessary, therefore, to provide the right information that users need so that they can readily and promptly use the collected Open API information. Thus, this study presents the semantic annotation methods on acquired Open API data from target web-sites, home and abroad, based on the data-mining technology. And, the annotated information is built into the OWL-based ontology, and the interface is embodied by means of the Jena ontology inference engine. Unlike the existing information searching methods, proposed method helps users acquire Open API information readily and promptly.

Keywords— Ontology, Semantic, Open API, Semantic Web Service, OWL

I. INTRODUCTION

Recently, web-based service is going through a new change. While existing web services were broken-off and closed, Web 2.0, which emerged recently, is contributing to service openness and user participation. This trend is in relation to the distribution of mobile devices such as smart phone, tablet pc, etc, which are attracting much attention, and this has made users too interested and they even want to participate in the process of service production personally. Accordingly, their interest in Open API is increasing as well. Users may readily create and share a new web service by means of Open API from a web service provider, which is an open application programming interface. In addition, the composition of several different Open APIs creates a new type of service, which is called, 'Mashup services,' and this is explosively increasing in Web 2.0 environment.

Domestically, however, there is no web services that provide information on Open APIs. Although information on Open APIs is provided in a form of portal service in other countries, it is too complicated for users to use such Open

APIs and the information system is too difficult to utilize. In this study, therefore, we presents the semantic ontology based provision method of Open API information by adopting the annotation technique, a base technology of a semantic web, after collecting Open API information through the Web Crawler.[1]

This study includes the following contents: Chapter 2 addresses semantic web service and its base technology. Chapter 3 points out the methods of existing target sites to provide Open API information in examination of existing studies. In addition, it explains the semantic annotation method based on Open API information, which is newly suggested in this study. Chapter 4 states the establishment of the ontology of annotated Open API data and the interface for semantic Open API searching tools, designed by means of the Jena[2] ontology inference engine open source. Lastly, Chapter 6 concludes this study.

II. SEMANTIC WEB SERVICE

Existing web services made the Internet available widely by providing simple methods for expressing and delivering information. As accumulated information in the Internet becomes massive, however, the current access methods to accumulated data only by means of key words leads to the flooding of unnecessary data in the searching process. To solve this problem, studies on semantic web services are increasing. Unlike the current web, where people work on computers to search for desired information by means of a mouse or keyboard and thereby see and understand the information, 'Semantic Web' provides the environment where computers understand the user's intention, sentences, and words. In other words, this is an intelligent web that enables systems to communicate in a new language that computers understand, which is different from the current web system designed for persons to be able to read and interpret readily.

The semantic web proposed by Tim Berners Lee is a dense, gigantic information structure for knowledge based web automation. Accordingly, it aims to create an intelligent web where computers can understand and infer the meaning of resources. W3C, for example, which is a leading organization for world wide web standardization, presents as a standard the semantic web stack shown in Figure 1 for the basic expression, data storage, management, and inference on the semantic web. The semantic web service, based on the semantic web stack, consists of semantic annotation technology, semantic

searching technology, semantic ontology technology, and semantic composition technology.

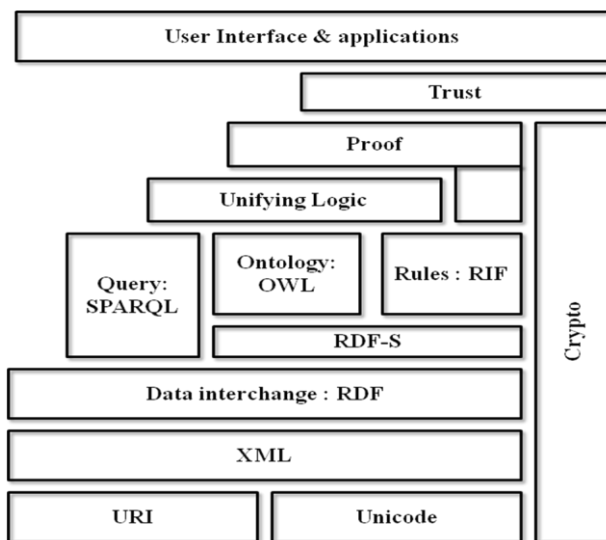


Figure 1. Semantic Web Stack

A. Semantic Annotation Technology

Semantic annotation is a technology, which adds functional and non-functional information of ontology-based services to the standard statement, because WSDL documents stating only the interface and input/output data are not enough for semantic interpretation. The added information is utilized for the semantic searching and composition, and thus annotation technology can be regarded as the most fundamental among all semantic web service technologies.

B. Semantic Searching Technology

Semantic searching technology is used for semantic web service searching on the ontology based web service specification, in which semantic information has been added. Figure 1 shows that 'SPARQL' is frequently used as a semantic inquiry tool. Semantic searching technology provides various searching services from keyword matching to natural language inquiry.

C. Semantic Ontology Technology

Semantic ontology technology is to express semantic information necessary for search, mediation, and composition of semantic web services. This is a useful technology to find the meaning in various relations between data sets by specifying the various relations between them. Some of the ontology technology models include RDF(Resource Description Framework) and WSML suggested by ESSI WSML(Web Service Modeling Language) working group and OWL(Web Ontology Language), which are presented in Figure 1.[3][4][5]

D. Semantic Composition Technology

As the demands of Internet users are diversified, composition or mashup of a variety of new services by combining the existing several web services to satisfy specific

demands of users in terms of reuse and efficiency is preferred to designing one single new service to satisfy all simultaneously. Composition of semantic services is to divide requirements into sub-sections by analyzing them semantically, and to create the order and logic of service implementation by searching web services that meet each requirement. Since this technology takes advantage of semantic annotation, semantic searching, and semantic mediation technology, it is regarded as the ultimate goal of semantic web service technologies. This study applies semantic annotation technology, a basic technology among semantic web service technologies, to Open API based on XML(Extensible Markup Language) and OWL, an ontology language.

III. SEMANTIC ANNOTATION FOR PROVISION OF SEMANTIC BASED OPEN API INFORMATION

This section outlines the main contents of previous studies on semantic web based Open API information, and suggests the semantic annotation in complement of the former studies.

A. Analysis of Target Sites for Semantic based Open API Information

For semantic annotation of Open APIs, it is necessary to analyze the existing methods to search Open API information. Thus, former study analyzed web-sites, home and abroad, that provided Open API information, and then the loyalty of such data elements based on Dublin Core, a meta data format.[1] As a result of analysis in former study, it turned out that the data elements from the sites were not enough to grasp the characteristics of Open APIs, and that there is a need to classify data elements for each function in order to readily grasp Open API characteristics as well as additional data elements.[1]

B. Definition of Semantic based Open API Information

This study classifies Open API information for semantic annotation into the three elements as in Table 1 - semantic element, functional semantic element, and non-functional semantic element - in complement of former study. This classification is to acquire Open API information through diversified approaches and to help users acquire information readily by reducing the exposure of unnecessary data sets other than the desired information. As for data semantics, defined were methods that users might use by analyzing WSDL files. Users may look through methods and learn functions of the Open API that they want to use. As for functional semantic elements and non-functional semantic elements, they are classified based on the functional and non-functional characteristics of WSMO(Web Service Modeling Ontology) and OWL-S, the base language for semantic web services. The functional semantic elements are a group that users classify to distinguish the characteristics of Open APIs for proper selection.

In addition, functional semantic elements are absolutely essential when users decide to select and use certain Open APIs. On the other hand, non-functional semantic elements provide additional information on Open APIs that users have

selected. When users create web services or mashup services by means of Open APIs, they may refer to QoS, other users' evaluation, and accessibility of Open APIs to judge whether the Open APIs are suitable for the purpose, which is the role of non-functional semantic elements as a supplementary means.

TABLE 1. SEMANTIC ELEMENTS FOR OPEN API INFORMATION

	Field	Programmableweb	Seekda
Data Semantic	Input/Output	In/Output of WSDL	In/Output of WSDL
	Method Name		
	Parameter Name		
Functional Semantic	Service Name	API name	Title
	Service Category	Category	Query
	Service Provider	Provider	Provider
	Service URL	API home	WSDL File
	Effect	Tag	Tag
	Country	X	Country
	Description	Summary	Description
Non-Functional Semantic	Protocol	Protocol	Protocol
	Reliability	X	Availability
	Security	Security	X
	Rating	User Rating	User Rating

C. Semantic Annotator based on Open API Information

This study embodies the semantic annotator for the automatic semantic annotation of Open API information acquired through web crawling.

```

<?xml version="1.0" encoding="UTF-8">
<SemanticInformation>
  <DataSemantics>
    <input name="GetWeatherSoapIn" type="string" />
    <output name="GetWeatherSoapOut" type="string" />
    <input name="GetCitiesByCountrySoapIn" type="string" />
    <output name="GetCitiesByCountrySoapOut" type="string" />
    <input name="GetWeatherHttpGetIn" type="string" />
    <output name="GetWeatherHttpGetOut" type="string" />
    <input name="GetCitiesByCountryHttpGetIn" type="string" />
    <output name="GetCitiesByCountryHttpGetOut" type="string" />
    <input name="GetCitiesByCountryHttpPostIn" type="string" />
    <output name="GetCitiesByCountryHttpPostOut" type="string" />
  </DataSemantics>
  <FunctionalSemantics>
    <serviceName>GlobalWeather</serviceName>
    <serviceCategory>weather</serviceCategory>
    <serviceProvider />
    <serviceURL>http://www.websvcex.com/globalweather.asmx?WSDL</serviceURL>
    <country>United States</country>
    <effect>aviation, free, condition, global, company, current, weather, get city name using country's name, mywebsvcex, worldwide, MyWeather, city</effect>
    <serviceDescription>This free Web Service provides the current weather and along with additional information for major cities (with airport) around the world. More details are available on the providers web page: http://www.websvcex.net/WCF/ServiceDetails.aspx?SID=48</serviceDescription>
  </FunctionalSemantics>
  <NonFunctionalSemantics>
    <protocol>SOAP</protocol>
    <availability>93.04%(within WSDL)</availability>
    <security />
    <rating>3.5</rating>
  </NonFunctionalSemantics>
</SemanticInformation>
</xml>

```

Figure 2. XML Format of Open API Information

This semantic annotator imports Open API databases that web crawlers have acquired from target sites such as programmable web sites and Seekda, and transforms them into a XML format as in Figure 2 based on the classification in Section 3.1, presented in Table 1. Details on semantic annotator designing will be published in a separate paper.

IV. OPEN API INFORMATION ONTOLOGY

This section presents the Open API information ontology map for semantic web services based on the annotated Open API information as stated in Section 3. The ontology production tool used in establishing the ontology is Protégé, an open source ontology tool. The ontology was established by means of OWL(Web Ontology Language), an ontology language that can express the relations between data sets most clearly among various ontology languages. The ontology map is presented in Figure 3, Figure 4.

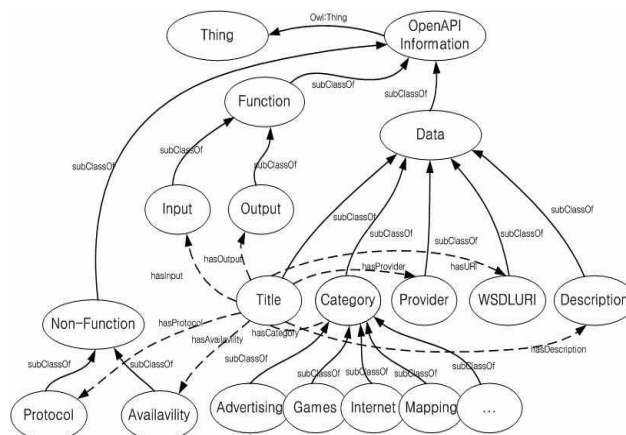


Figure 3. Ontology of Open API Information

The factors classified above such as data semantic element, functional semantic element, and non-functional semantic element are set as part of the upper node while elements that describe Open API information as part of the lower node. The correlation between individual nodes is also expressed.

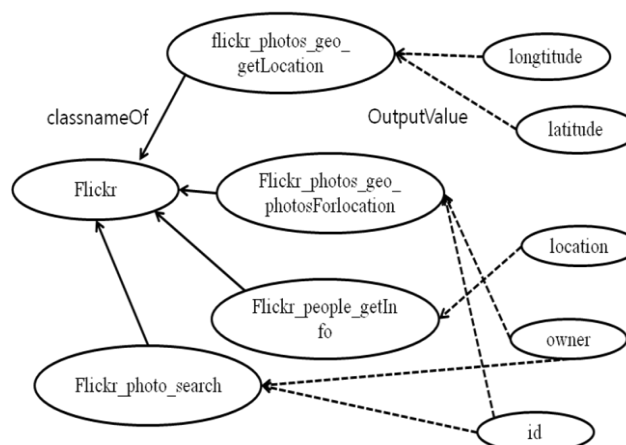


Figure 4. Example Ontology of Flickr API

A. Provision of Semantic based Open API Information

This section addresses the semantic web based interface to present Open API information in utilization of OWL ontology inference engine open source, which is called Jena, and the ontology established earlier. Figure 5 shows the embodied interface. Once the user types in the key word that he is looking for in the searching box, the searching begins based on the key words while it is inferring data in relation to the searched information automatically.

In addition, this enables the user to check the data around the node too when he clicks on a certain node. To overcome the disadvantages of the existing searching methods such as scrolling and page-by-page method, other information sets are also accessible through nodes within one page.

For instance, existing searching methods may search for Open APIs with the keyword, 'advertising,' to acquire the information on the Open API provider. Thereafter, the user has to search by using the same keyword to acquire other information on the Open API of the same provider. In contrast, the interface suggested in this study overcomes such problems as above through the user-centered interface, through which users may acquire Open API information readily and promptly.

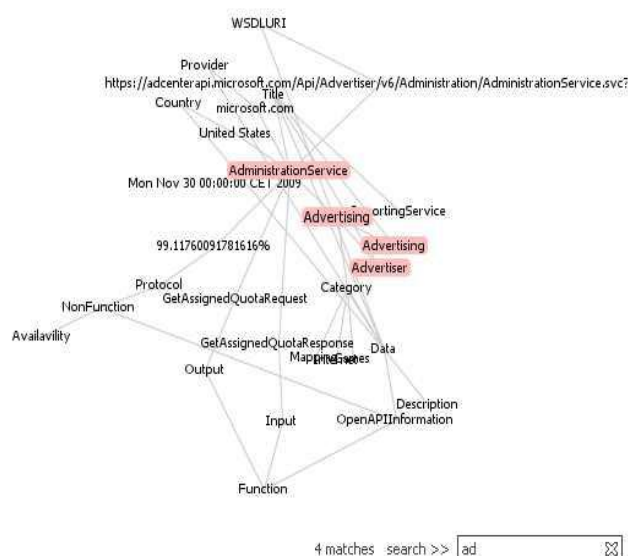


Figure 5. Result of Open API Search

V. CONCLUSION

This study is to come up with an Open API annotator based on the semantic web technology. Existing Open API information that is provided by portal web sites may help users readily grasp the general features of an Open API, but the information the user may acquire through key word searching is insufficient and it takes long time. Thus, this study defines and outlines the types of Open API information by means of the semantic annotation technology so that users may acquire Open API information readily and promptly. Specifically, this study classifies a large amount of Open API

information acquired by means of a web crawler into data semantic element, functional semantic element, and non-functional semantic element, and then transforms them into XML/OWL formats. Then the OWL-based ontology is established, and the interface is embodied by means of the Jena ontology inference engine so that users can acquire Open API information far more easily and promptly than existing searching methods.

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