

Development of a Semantic Web Based Mobile Local Search System

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ABSTRACT

This paper describes the development of a semantic web and ontology based local search system that can be used in wireless mobile communication services.

Categories and Subject Descriptors

H.3.3 [Information Storage and Retrieval]: Information Search and Retrieval – *Retrieval models*.

General Terms: Performance, Design.

Keywords: Semantic Web, Ontology, Mobile Web Search.

1. INTRODUCTION

Semantic web makes it possible for users or specific devices to search for information existing on the web and performs semantics based searches that find results according to user needs, which differs from the existing web environment [1]. In addition, it plays a vital role in the next generation web technology that makes it possible to provide services automatically instead of users interacting directly with other users and devices, or devices interacting with other devices. Furthermore, it is possible to establish a basic semantic web structure in which a machine recognizes semantics by configuring an ontology based semantic system in the existing web page that provides simple information regarding links [2].

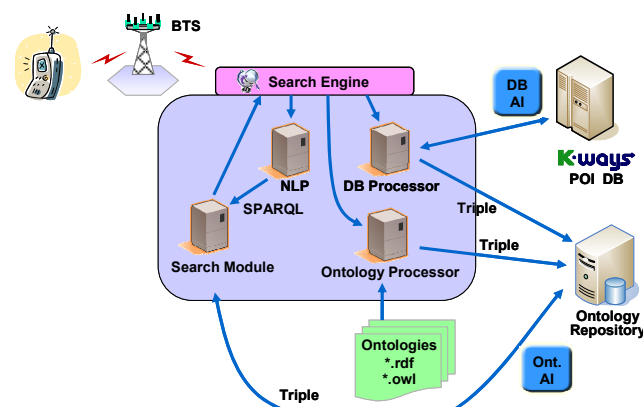
Mobile search services become a blue ocean that has spread throughout wireless mobile communication markets in recent years. Three major companies, such as Google, Yahoo, and Micro Soft, have already crushed the competition to achieve their goals. It is expected that semantic web technology can develop into high value added services for wireless mobile communication markets.

This paper describes the development of a semantic web based mobile local search system. It illustrates the first application of semantic web technology in mobile communication. The semantic web based mobile local search system described in this paper established the ontology for 13 fields, which represents user inquiries. The ontology for these 13 fields consists of 1,715 classes and 898,400 individuals. Finally, it provides a movement service for reaching the Point Of Interest in the shortest time by downloading geographic information through the navigation

service based on a local search service. This system becomes very attractive and provides the fastest most optimal movement path to the user because the downloaded geographic information includes real-time traffic information.

2. SYSTEM ARCHITECTURE

Most search systems used in recent years have been relational database systems. For instance, in the case of Oracle and Microsoft SQL Server, data is stored and managed in the form of tables and provide queries and answers using an artificial query language called SQL (Structured Query Language) in which it is necessary to configure pattern matching between the keyword written in the SQL and the field name in the table [3]. As previously mentioned, the present computer system that processes knowledge, information, and data including searching is based on the similarity of structures and mechanisms including a high rate of errors. Semantic web technology is introduced to overcome such technical limitations, provide intelligence to a computer in order to understand semantics, and process knowledge, information, and data.



NLP: Natural Language Processor, SPARQL: Protocol And RDF Query Language
DB AI: DB Administrator Interface, Ont. AI: Ontology Administrator Interface

Fig. 1 System configuration for a semantic web based mobile local search system.

Fig. 1 illustrates the configuration of the system for semantic web based mobile local search services (K-ways) that performs local searches based on the semantic web and ontology in wireless mobile communication networks. If a query that is applied to search a Point Of Interest using a user's cell phone is transmitted through a wireless mobile communication network, a server

system analyzes the transmitted data and queries it to a database containing information regarding the Point Of Interest that was established using the ontology. The searched data obtained by the query is then calculated as distance and location information and applied to a process that provides search data for the Point Of Interest. Finally, space information that reflects the requirements of such queries is applied.

Fig. 2 illustrates an example to search the Point Of Interest by processing a concept search. When the word set “Seoul airport spaghetti” was input as a query through a user’s cell phone, the query was analyzed by a search engine through a wireless mobile network. Then, the search engine passed the query along to the OWL ontology (Step 1). The word “spaghetti” was included in the lower menu of the Italian restaurant class of the restaurant OWL ontology. Therefore, “spaghetti” could be searched as a category of “Italian Restaurant” through the concept search (Step 2). The engine inquired again the extracted “Italian restaurant” to the restaurant OWL ontology. Then, individuals for the Italian restaurant were searched (Step 3). A spatial search was applied for “Seoul airport” through a spatial search module from the query of “Seoul airport spaghetti” in which the module calculated and searched Italian restaurants nearest the Seoul airport among the searched individuals in Step 3. The spatial search was performed using the location information contained in the RDF triple (Step 4). The final Point Of Interest was obtained by searching the individual ID that was the searched Point Of Interest with the spatial search to the RDF triple (Step 5).

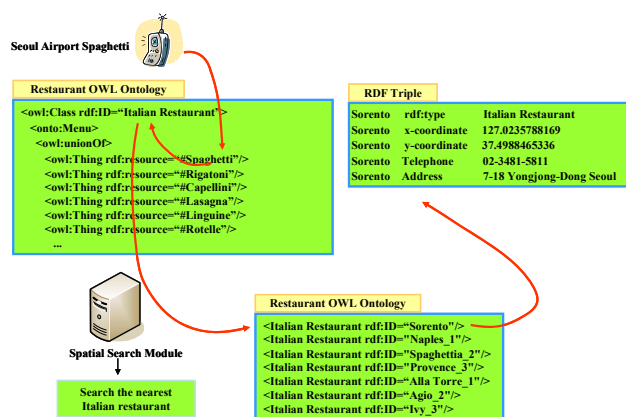


Fig. 2 Example of a concept search process.

As mentioned above, the semantic web and ontology based search system introduced in this study developed the next generation in search services, such as flexible name search, intelligence sentence search, concept search, and similarity search, by applying the query to a Point Of Interest search system in wireless mobile communication systems.

3. ONTOLOGY DATABASE

The ontology database used in the local search service proposed in this study was established by transforming it into an RDF triple using an N3 (Notation 3) method of W3C with a legacy database. The N3 method made it possible to automatically transform the table of the related database system to a 'record-field-data' and triple format of 'Subject-Predicate-Object'. This method not only guarantees the automatic generation of database instances but also integrity because the data stored in existing relational database systems is only a part of the detailed information comprising

ontology. The field (column), record, and data used in a conventional database are mapped into triple predicates (Property, Predicate), Subject, and Object, respectively.

4. EVALUATION RESULTS

According to the performance evaluation of a semantic web based mobile local search system, the number of words was the factor with the greatest impact on system performance. This was because increases in the number of words during the transformation of user input queries into SPARQL decreased the precision of transformation. Fig. 3 shows the relationship between the number of words in the query and the precision of SPARQL transformation.

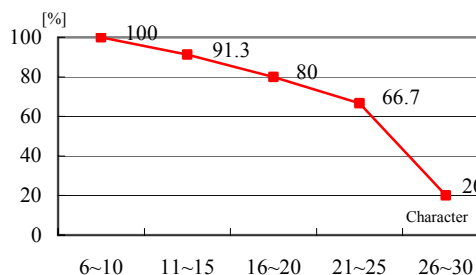


Fig. 3 Relationship between the number of words in the query and the precision of SPARQL transformation.

This study tested the success rate of searches using the data recorded in a system that was used in a conventional local search. When searching a name, the success rate of the conventional system was approximately 70.49%. Meanwhile, the semantic web based mobile local search system proposed in this study demonstrated approximately a 90.92% success rate. In addition, the success rate for the conventional and proposed method in the concept search were 25.72% and 89%, respectively.

5. CONCLUSIONS

The semantic web based mobile local search system proposed in this study reduced search time and provided precise information by applying semantic web and ontology technology to wireless mobile communication services. When this system was compared to conventional local search services, there was a more than 20% improvement in the search process. In addition, this system processed natural language and inference functions making it possible to provide next generation services, such as flexible name search, intelligence sentence search, concept search, and similarity search. Future studies intend to extend the results of this study to e-commerce and multimedia search service.

6. REFERENCES

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