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Personalization of Rule-based Web Services

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Abstract: Nowadays Web users have clearly expressed their wishes to receive personalized services directly. Personalization is the way to tailor services directly to the immediate requirements of the user. However, the current Web Services System does not provide any features supporting this such as consideration of personalization of services and intelligent matchmaking. In this research a flexible, personalized Rule-based Web Services System to address these problems and to enable efficient search, discovery and construction across general Web documents and Semantic Web documents in a Web Services System is proposed. This system utilizes matchmaking among service requesters', service providers' and users' preferences using a Rule-based Search Method, and subsequently ranks search results. A prototype of efficient Web Services search and construction for the suggested system is developed based on the current work.

Keywords: Personalization, Web Services, Rule-based Web Services, Semantic Web, Matchmaking Engine

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1. Introduction

Web Services technology is rapidly emerging as a critical solution for information and system integration among departmental systems within an enterprise or between different enterprises. Web Services allow liberal exchange of information among different platforms and applications using open and flexible standards such as SOAP (Simple Object Access Protocol), WSDL (Web Services Description Language) and UDDI (Universal Description, Discovery and Integration). Clustering

Semantic Web Services, which is the method purported to provide services for the convenience of users in the Semantic Web environment, is composed of SOAP, WSDL, UDDI and DAML-S. SOAP, used for calling Web Services, is a quantitative protocol for sending data that is structuralized and standardized using XML. However, it is also a type of message format protocol, which is quite extensive and can actually be applied in many fields other than that of a quantitative protocol. WSDL, used for Web Services description, contains information on the interface provided by the Web Services and the type of data that is to be used through the services. Despite many other related standards such as WSFL or RDF, presently WSDL plays the major role and is highly capable of extensively describing any type of sub-network or messaging protocol. UDDI is a directory service that can be used by an individual or company for registering and searching Web Services. In other words, UDDI allows one to register the service he/she is to provide on the Web and the service user to find the service he/she wants from the registry. DAML-S (Semantic Markup for Web Service) is a key component for implementing Semantic Web Services, and at the same time, the ontology for Web Services. Thus, within the Semantic Web Services, the DAML supporting agent reads the service descriptions in WSDL format, sends the information to DAML and then DAML connects to the appropriate ontology and the information is provided through the search engine. The advantage of this is that the service consumers can search for and link to providers of the desired Web Services through any search engine supporting such a framework and in addition personalization related information and negotiation abilities are allowable. In result, the agent is capable of referring to the consumer and provider information and perceiving the conditions in order to automatically settle contracts through negotiation.

Personalization is the integration of users' preferences into the process of delivering any information-related content or outcome of service computing. It is shown, for instance, that the needs of wireless and mobile users regarding information access are quite different from the needs of stationary desktop users [1]. This need is not about browsing the Web but about receiving personalized services that are highly sensitive to the immediate environment and requirements of the user. Personalization involves a process of gathering user information during interaction with the user, which is then used to deliver appropriate content and services, tailor made to the user's needs. The aim is to improve the user's experience of a service. Personalization appears to be the most appropriate solution to this need [2].

Web pages are personalized based on the interests of an individual. Personalization implies that the changes are based on implicit data, such as items purchased or pages viewed. The term customization is used instead when the site only uses explicit data such as ratings or preferences. On an intranet or B2E Enterprise Web portal, personalization is often based on user attributes such as department, functional area, or role. The term customization in this context refers to the ability of users to modify the page layout or specify what content should be displayed. There are two categories of personalization: rule-based and content-based. Web personalization models include rules-based filtering, based on "if this, then that" rule processing, and collaborative filtering, which serves relevant material to customers by combining their own personal preferences with the preferences of like-minded others [4].

However, the Current Web Services model has some disadvantages in supporting automated Web Services. First, the model does not use the appropriate method for expressing the interests of individual

information; in short, the user's personalized requirements are not applied sufficiently. Second, measurements of the quality of Rule-based services are inadequate.

For such reasons, this study suggests a Rule-based Web Services System to solve some of the above problems and enable efficient Web Services search and construction. The proposed framework is capable of searching for general Web documents and Semantic Web documents. The system was developed along with step-by-step designing method for efficient Web Services search and composition. Its efficiency and accuracy are verified by comparing with the existing systems.

The study of this study enables efficient search in Web Services and the construction of Web Services by designing and implementing the system using QoS Matchmaking algorithm and Rule-based search technique. The detailed functions of these core algorithms, which supplement the problematic points of existing studies, are given below.

A Matchmaking Engine, for which QoS technique is applied, is proposed in this study. The matchmaking algorithm is introduced in order to enhance the matching rate between service providers and service requesters so that the latter might select better qualitative service(s). In addition, this study resolves the problematic points of existing UDDI by providing an extended UDDI search module made by mapping between DAML-S profile and UDDI data model.

Second, a Rule-based Search technique in which users` preference is reflected is proposed. In contrast to the existing search methods of Web Services, in which the arrangement of search results according to the consideration of users` preference is unavailable, this study enables reflecting the preference of a service requester in the Web Services, using a personalized agent which exploits rule-based search technique, which provides a more credible Web service.

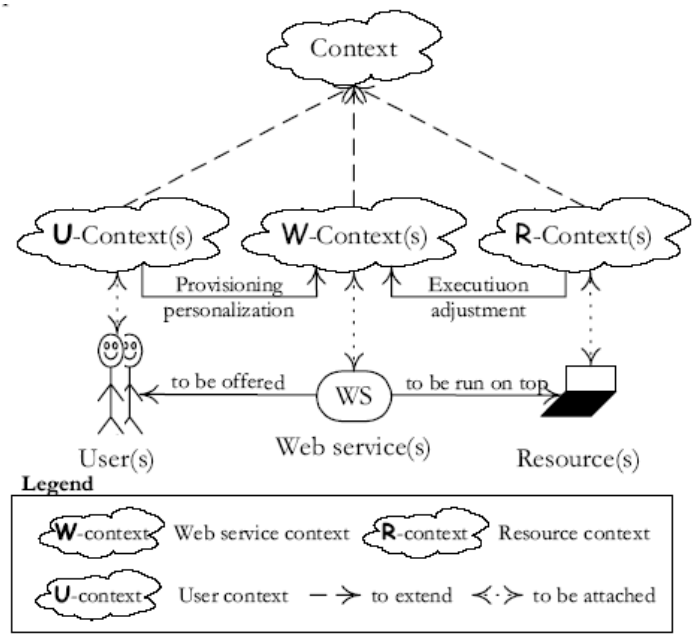
This study is organized as follows. In Section 2, it is compared with current systems. In Section 3, the architecture and implementation of a Personalized Rule-based Web Services Framework is suggested, along with the principles, characteristics of its modules and execution results. Conclusions are provided in the final section, along with plans for further studies.

2. Comparison of the system

Personalized Web Services are a very important area of research. However, to our knowledge few of the research projects have aimed at personalized services using Rule-based search method. So we present the following some of the researches that supported context-based personalization of Web Services.

In [3] the idea of personalized preference is applied to a Web environment. It discusses the way context is used for Web Services personalization. Context is the information that characterizes the interactions between humans, applications, and the surrounding environment. It emphasized that the resource on which the Web Services are performed have an impact on Web Services personalization. Figure 1 illustrates the approach backing Web Services personalization. In this approach, the core concept is context from which three sub-contexts are obtained: U-context, W-context, and R-context.

Figure 1. Personalization of Web Services[3].



The research reported in [16] addressed the main aspects of a Semantic Web information retrieval system architecture trying to answer the requirements of the next-generation Semantic Web user. It proposes a conceptual architecture for a personal Semantic Web information retrieval system. It incorporates Semantic Web, Web Services and multi-agent technologies to enable not only precise location of Web resources but also the automatic or semi-automatic integration of hybrid Web contents and Web Services. However, the superiority of the system in this work is not assured in that system development situation, real applied examples and research techniques are not referred to, and only the system design method is described.

This study suggests a Rule-based search method in which ontology and rules are combined to supplement the faults of the existing research, design a search engine using the suggested method and established an operation system for the search engine. By doing this, our study intends to solve the problem that the existing Web Services models are inclined toward theoretical aspect and the research is conducted mainly on this segment. In addition to it, the suggested method can provide more exact and credible information to the users, as it actively reflects personalized preference in Web Services results by performing an analysis of various possible situations and searching with inference and service extraction rules. A comparison of the current and suggested systems is shown in Table 1.

Table 1. Comparison of the systems.

Condition	[3]	[16]	Proposed System
Factors & Measuring Method	U-context, W-context, and R-context	Conceptual architecture	Personalized Agent, Matchmaking Algorithm
Weak Point	Ranking algorithm is not used.	Real applied examples and research techniques are not referred	A little complexity due to too many algorithms

3. Personalized Rule-based Web Services Framework

3.1. DAML-S Rule-based Framework

The DAML-S Rule-based Framework suggested in this Section is established by designing extended DAML-S through the combining of DAML-S and DamlRuleML [6]. Viewing the technological elements and the criteria of the suggested system primarily, they are like below.

Table 2. The technology factors of Semantic Web Services.

Semantic Web		**Web Services**	
Technology factor	Suggested technology standard	Technology factor	Suggested technology standard
Rule-based Services	Expanded DAML-S (DAML-S + DamlRuleML		Rule-based Services
Ontology	DAML+OIL	Expanded UDDI	Discovery
	RDF Schema	WSDL	Description
	RDF	SOAP	Wire
Security	XML Encryption XML Digital Signature		Security
Syntax	XML, XSL		Syntax
Network Protocols	HTTP, FTP, SMTP		Network Protocols

The technological elements of the suggested Semantic Web Services are made by the graft of Semantic Web technology and Web Services technology. The Semantic Web technology, described in the left side, is composed of RDF, RDF Schema, DAML+OIL and the Web Services technology in the right side, is composed of SOAP(Simple Object Access Protocol), WSDL(Web Services Description Language), Expanded UDDI(Universal Description Discovery and Integration), as both technologies are commonly based on the technology of XML, XSD, and security technology. The uppermost level is made by the grafted technology of DAML-S and DamlRuleML which is a DAML-S extension. Here, DamlRuleML is what the RuleML in SCLP(Situated Courteous Logic Programs) version is expressed by DAML+OIL.

The personalization agent suggested in this study has the user information profile on John expressed by DamlRuleML, like below. In this user information profile, it is recorded that John prefers HanMack, an OEM product for a large enterprise.

Definition 1: DamlRuleML Fact

John prefers an OEM product of HanMack for a large enterprise.

```
<damlRuleML:fact>
        <damlRuleML:_rlab>favoriteProduct</damlRuleML:_rlab>
        <damlRuleML:_head>
                <damlRuleML:atom>
                        <damlRuleML:_opr>
                                <damlRuleML:rel>HanMack<damlRuleML:rel>
                        </damlRuleML:_opr>
                        <damlRuleML:ind>John</damlRuleML:ind>
                </damlRuleML:atom>
        </damlRuleML:_head>
</damlRuleML:fact>
```

The information that john has the tilt to select a product which has diverse functions compared to it`s price, can be expressed as a rule like below.

Expression 2: DamlRuleML Rule

The product style which John prefers is the style to own diverse functions compared to the price.

```
<damlRuleML:imp>
    <damlRuleML:_rlab>
        <damlRuleML:ind>favoritestyle</damlRuleML:ind>
    </damlRuleML:_rlab>
    <damlRuleML:_body>
        <damlRuleML:andb>
            <damlRuleML:atom>
                <damlRuleML:_opr>
                    <damlRuleML:rel>Productfunction<damlRuleML:rel>
                </damlRuleML:_opr>
                <damlRuleML:var>diverse</damlRuleML:var>
            </damlRuleML:atom>
            <damlRuleML:atom>
                <damlRuleML:_opr>
                    <damlRuleML:rel>Price<damlRuleML:rel>
                </damlRuleML:_opr>
                <damlRuleML:var>average</damlRuleML:var>
            </damlRuleML:atom>
        </damlRuleML:andb>
    </damlRuleML:_body>
    <damlRuleML:_head>
      <damlRuleML:atom>
          <damlRuleML:_opr>
              <damlRuleML:rel>SelectProduct<damlRuleML:rel>
          </damlRuleML:_opr>
                  <damlRuleML:var>Product/damlRuleML:var>
```

```
        </damlRuleML:atom>
    </damlRuleML:_head>
</damlRuleML:imp>
```

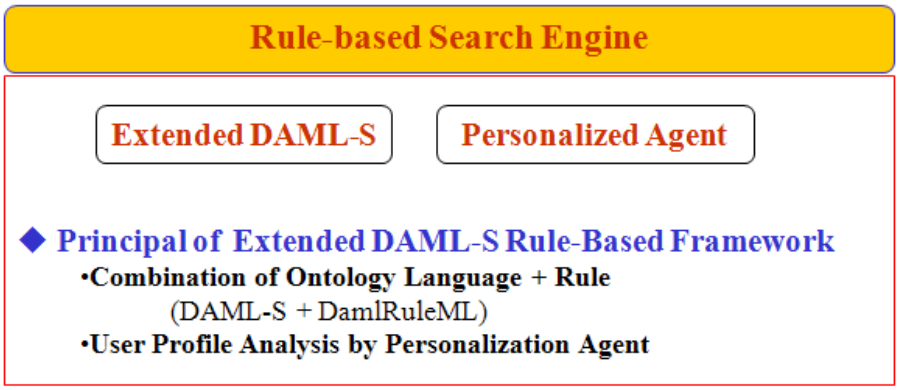
3.2. Principal of Rule-based Search Module

In the existing method, the reflection of user preference by using user profile registry is insufficient and the methodology for applying rules to ontology is frail. Hence, this study suggests the Rule-based Search Engine in which user preference is reflected through the utilization of Extended DAML-S and the Personalization Agent. The extension method of DAML-S Rule-based Framework is like below.

First, the methodology with high efficiency on ontology and rule is suggested by combining DAML-S which is an ontology language and DamlRuleML which is a rule language. Here, the insufficient points in ontology language are supplemented by rules.

Second, appropriate information is provided to the user by user profile analysis which is made by the Personalization Agent. Figure 2 is the principal of the Rule-based Search Engine applied users' preferences.

Figure 2. Principal of Rule-based Search Engine.



The Rule-based Search Engine performs Rule-based search which selects only the appropriate service in formations by comparing the query result produced from the Search Manager (Search Module) which is the user interface of the search engine and the rule of the user fetched from the user profile registry.

As an illustration of an imaginary scenario of the Rule-based search method, John wants to purchase a cellular phone costing less than 200 thousand won, but if the Samsung phones cost over 200 thousand won, he considers purchasing an OEM brand product instead. Here, to satisfy the precondition of the user, the analysis using the user information profile fetched from the user profile registry should be performed first. In the example of this study, through the analysis of user information profile using the Personalization Agent, the information that John prefers HanMack OEM product for a large enterprise and also has the preference to a product which has diverse functions compared to the product price, is obtained.

Conclusively, the Web Services provides the result of "HanMack mobile phones with the price below 200 thousand ", which is most appropriate information to John, obtained by comparing the fact "John prefers HanMack OEM products", which is the user information profile obtained from user

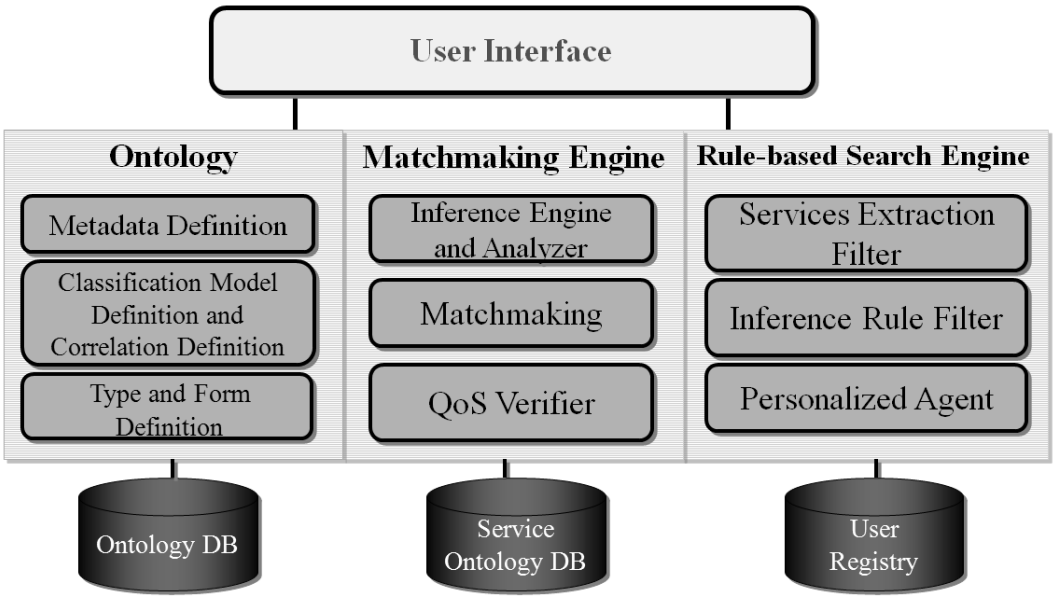
profile, and the search result of the Web Services analyzed by the Matchmaking Engine. The need to find out the most appropriate information through the analysis of user information profile and the produced result of the Web Services here, can be performed by the Rule-based Search Engine.

Figure 3. User Profile Analysis using Personalization Agent.

3.3. System Architecture

The Rule-based Web Services System proposed in this study makes an automated framework by supplementing the disadvantages of existing information search systems and existing Web Services systems, as it gives ranks to search results using detailedly subdivided Matchmaking Services and Rule-based Search Services. The structure of the Web Services System proposed in this study, is as in Figure 4, and the range of research for the proposed system is as below.

Figure 4. System Architecture



The most critical matter in the phase of input is to find out the exact result for a user query by repeating the user query even through the synonyms of the original user query terms, on top of the

original terms. First, for this purpose, the proposed system uses the ontology composed of concept of knowledge of specific sphere. In the ontology server, the definition of the meta-data of specific sphere is preserved, and the definitions of data classification principle and data correlation are also preserved.

Second, the proposed system provides more exact search result to users through the Matchmaking Engine. The proposed Matchmaking Engine is designed to be able to provide more exact and efficient search result, using Matchmaking algorithm by which more exact examination and reflection of search query can be conducted according to the user request, as a new QoS technique to execute quality estimation, is applied for the engine.

Third, the proposed system executes inference and examination for the user query on the extracted results by rules through the Rule-based Search Engine. The proposed system, in addition, can provide more credible Web Services to the users as the system provides customized service in which an individual user's preference is reflected using the personalization agent.

3.4. Execution Results

[Figure 5] is the contrast of the retrieved screen images of the Rule-based Search Engine and a common Web search engine, by entering search terms for query. It shows that the Rule-based Search Engine in which users` preference and rule-based search technique is applied, provides a differentiated screen image from that of the existing common Web search systems.

The information in the search here are ones taken from the real data of four internet portal sites in Korea (Empas, Yahoo Korea, Naver, Daum) and processed, mainly on the basis of keywords, ranking results, price information, demand frequencies and QoS information.

The screen image is the result that the key words entered by the user, are applied to the Rule-based Search Engine utilizing the criteria of price information among QoS information, system response time, maximum information treat quantity, availability, credibility, and accessibility. Screen images show up differently according to users` preference.

Figure 5. System Architecture.

4. Conclusions and Future Studies

This study implemented an integrated Rule-based Web Services System based on the differentiated technologies, in order to supplement the defective point of the previous studies that they could not suggest an integrated Web Services System from the overall standpoint of view, as they lay too much stresses on methodological aspect. This system may provide an automated framework fundamental for application integration and process integration, not only for large enterprises which are now leading business model integration but also for small and medium enterprises, research institutes, and other institutions which have development potential in the future.

In the previous studies, the treatment for quality element of a service is insufficient, and the search for a service by mirroring a user`s preference is not realized. This study enhances the matching rate between service providers and service demanders, hence enables the service demanders opt services of fine quality, to supplement the defective point of the previous studies. This study also enables a more credible service providing by mirroring the personal preference of a service demander to the Web Services through the result generated from the Rule-based search engine in which a user`s preference is mirrored.

However, this study has some weak points as below.

First, the proposed system has a little complexity due to too many algorithms activation, which might cause search time to become long. This problem is yet to be solved.

Second, an accurate and objective estimation for the proposed method by the criteria of verified test mark was not yet performed, but the estimation was done only by correspondence elements so far.

Lastly, For the establishment of the proposed system, diverse external technologies are mobilized, and differentiated major techniques for the proposed system of it`s own, has not been concentratively developed, which may be the most critical fault of this study.

As future research task to complement this study, the development of a real Web Services System in which the Rule-based search method proposed in this study, is applied, is necessary prior to anything else. Additionally the development of real-time search technique by which users` demand can be reflected while moving seems also necessary.

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