Web Service Based Architecture and Ontology Based User Model for Cross-System Personalization

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Abstract

Personalized support for users becomes even more important, when service access takes place in open and dynamic service-oriented environment. This paper shows how to realize personalized service support in cross-system/service environments based on ontology and Web service technologies. First, we introduce the related approaches for supporting cross-system personalization and give their insufficiency respectively. Aimed at the problems we propose a Web service based architecture for cross-system personalization. The loosely coupled structure of Web service can easily integrate personalization service from various information systems and provide seamless access to the users. In order to reuse user models we also present an ontology based user model to support cross-system personalization. Compared with the existing approaches, our approach can effectively support the various existing personalized systems and user models, and the realization of cross-system personalization is more simply and efficiently.

Key Words:

Cross-system personalization, Web service, Ontology, User model

1. Introduction

In the past decade we have witnessed a growing interest in applying personalization and adaptation in numerous application domains, especially in ecommerce and digital libraries. Many ecommerce sites (e.g. Amazon, eBay, Ringo and MovieLens etc.) have offered personalization services for their users. However, personalization in various information systems occurs separately within each system that one interacts with.

From the user's point of view, there are several drawbacks with isolated personalization approaches. Firstly, information about users in a personalized system can not be reused to other systems. So users often have to access and obtain information from multiple sources. Secondly, the personalized systems collect information about users respectively according to the specific service context provided by the system. Thirdly, users have little or no control over their user profile, because user profiles are deeply buried in personalization engines. Finally, given the current trend of dynamic service-oriented, information resource make a transition from centrally controlled to dynamic federations of service, which arise challenges to traditional approach of personalization [1].

To tackle above problems, research on reuse of user model in distributed environment is emerging. The existing methods often propose a unified or standard user model in various systems. But in the real-world scenario, to build a system which can reuse existing user models is more efficiency than to adapt a unified user model with giving up the existing user model. In this paper we propose a Web service based architecture for cross-system personalization. The communication between various user models is implemented based on the idea of Web service. We also present an ontology-based user model to supporting cross-system personalization. Services which dynamically join the system can benefit greatly from the existing personalization information.

The rest of this paper is organized as follow: In section 2, we provide a brief review of related approaches for supporting personalization cross different system presented in several projects. Section 3 introduces the Web service based architecture for cross-system personalization. Section 4 presents an
ontology-based user model. In section 5, we make a conclusion for this paper.

2. Approaches for supporting cross-system personalization

Recent focus on decentralized systems has led to interest in personalization in distributed systems [1]. The research on reuse user model is emerging.

We roughly classify the approaches that involve the idea of cross-system personalization into 4 kinds.

2.1 Generic user modeling system approach

Generic User Modeling System (GUMS) can support a variety of distributed applications. Research on GUMS has experienced the evolution from academic user modeling shell system to commercial user modeling systems [2, 3].

Most current commercial systems employ client-server architecture, in which user modeling systems are not functionally integrated into the application but communicate with the application through inter-process communication.

Information about the user is stored in a non-redundant manner and maintained in a central or virtually integrated repository. User information acquired by one application can be employed by other applications, and vice versa. User information dispersed across various applications can be integrated.

2.2 Multi-agent based approach

In 1999, Isabel Machado presented a learner modeling server in a multi-agent platform and an intelligent learning environment [4]. The learner model could be accessed by different applications. Domain ontology was used to share parts of the learner models in the modeling process.

In 2002, Julita Vassileva introduced a distributed multi-agent based collaborative environment for peer help in I-help project [5]. Then in 2005, they presented a purpose-based user model [6]. A decentralized user model was employed which was dispersed in various autonomous agents as fragments. Based on these user model fragments, various goals of the user can be achieved in variety of specific contexts.

In 2005, Gustavo González described a multi-agent smart user model to support cross-domain recommender in next generation of open, distributed and heterogeneous environment [7].

2.3 Ontology based approach

In 2003, Peter Dolog proposed a service-based architecture in ELENA project [8]. The learner model based on two of the most important standards for learner modeling, PAPI (Public and private information) and IMS LIPS (learner information package specification). For sharing learner model in the learning network a domain and learner ontology were introduced.

In 2005, Dominik Heckmann introduced the GUMO (General User Model Ontology) for the uniform interpretation of distributed user models in intelligent semantic Web enriched environments [9]. They developed a RDF-based user model exchange language UserML to enable decentralized systems to communicate between user models. To deal with the challenge of reuse user information in ubiquitous computing environment, they suggest representing user profile as statement.

The GUMO based approach is efficient in decentralized and mobile services where users only require some simple service.

2.4 Unified user context model based approach

Claudia Niederée presented the idea of cross-system personalization and a multi-dimensional Unified User Context Model (UUCM) [10]. The required user information was integrated by the mediator named as context passport. They propose to reuse user model by exploiting the same user profile in several systems. The communication between Context Passport and service provider was achieved by a Cross-system Communication Protocol (CSCP).

The UUCM Based Approach introduces a method to support personalization cross different systems. However the system requires every participant exploit UUCM model and support CSCP protocol.

2.5 Deficiencies and challenges in existing approaches

The above researches provide foundation and methodology for further research. Nevertheless there’re still many deficiencies and challenges to be overcome.

Firstly, the above-mentioned approaches similarly implement user model reuse by exploiting the same user model in various systems. This means the personalized service providers have to replace the user model. The personalized systems will be made a great change.

Secondly, the service providers joined in have to agree with a communication protocol to exchange information of user model or support autonomous
agent to collect fragments of user model. Consequently the personalized system of service providers has to be modified to adapt the service network.

As a result, above approaches can’t support the user models existed in the service providers.

3. Web service based architecture for cross-system personalization

To tackle above shortage, we propose a Web service based cross-system personalization architecture. We don’t try to build a standard/unified user model, but to provide a method to support the existing user model. Taking advantage of the loosely coupled structure of Web service, our approach can support the existing personalization system and easily integrate personalization service. Based on the idea of Web service the communication between user models from different personalization system is implement by bind XML document to the SOAP protocol. Sharing user models in this architecture will improve the coverage and reliability of the integrated user models and thus allow better functions of adaptation.

![Figure 1. Web service based architecture](image)

This section introduces the Web service based architecture for cross-system personalization, where personalization service is provided by various systems. The idea of Web service was employed to reuse the existing user models stored in different personalization system, as depicted in Figure 1.

The personalization mediator is constructed by 4 modules: personalization engine, personalization wrapper/mapping, registry and user model.

The personalization engine have two main roles in the system: (1) to update and maintain the user model on the basis of user interaction and the change of user model collected by service providers, (2) to recommend service to users based on the related characteristics of the users. The personalization wrapper enables the service providers that themselves do not support personalization to provide personalization service. For the service providers with personalization function the mapping wrapper enables the bidirectional exchange of data about users between personalization engine and related service provider. Service provider registers its service and user model schema in registry. Personalization engine initializes the user models relying on the register information of users, and updates them according to the change of user information and user interaction collected by the service providers.

The reusing of user models relies on the SOAP protocol. Related communication information is represented as XML format, and bound with SOAP protocol to support the exchange of data about users. To participate in our service network the personalized system only need to agree with a simple protocol based on HTTP and added with privacy protection term. At the same time, the communication of user information between service provider and personalization engine is achieved.

4. Ontology based user model for supporting cross-system personalization

Based on the architecture aforementioned, the defined user model has to be comprehensible. Since the cross-system personalization should contain services from various domains, and the users require various services as different roles each time, the defined user model should cover as more information about users as possible. In our approach the advantage of the existing approaches was used for reference to define our user model.

In this section we describe an ontology based user model. In order to extract the useful information from user model for every related service required by the user, we present an ontology based User Role Model (URM) that can be used for modeling users and their related roles according to the service they accessed. We classify the users by the role they usually act in different service and mapping it to the role they act in current task (taskrole). Every role was described by the five dimensions: Geninfo, Preference, Relationship, Task and Taskrole.

Geninfo Dimension: The geninfo dimension describes general personal information of the user. It contains the basic information require by website for
information accessing, e.g. user id, location, email, phone number, etc.

Preference Dimension: The preference dimension contains the facets about the habit, competence and general interest of user. Based on the property used in existing personalization, we selected the following facets in the preference dimension.

Geninterests: The facet geninterests describing the interests of a user use a interest ontology, based on the user profiles kept in the service provider. It contains the behavior regulation, interest, etc.

Competence: The facet competence with two facet subclasses skill and expertise.

Privpreference: The facet privpreference that can be used to model the privacy preference of the user to enable user to protect and control the privacy.

Relationship dimension: The relationship dimension describes the social relationship the user involved in, for the relationship related information affect the needs of user to a certain extent.

Task dimension: The task dimension describes task related information about the user. It contains goal, history task and current task.

Taskrole dimension: The taskrole dimension is different from the role which was based on to classify the users. Here we define the concrete role of users in a specific task. In an accessing a learner could act as an employee or a writer related to various tasks.

The user ontology can be extended according to various character of the service provider participant in the system and the information required retrieving personalization service.

5. Conclusion

In this paper we presented the Web service based architecture and ontology based user model for cross-system personalization. The service network is constructed in loosely coupled way. Information between service provider and personalization mediator was exchanged only with a small quantity of change on the system. Focusing on reuse the existing user model, the information about user is exchanged according to the user schema the service provider registered in registry. By bind XML document to the SOAP protocol, the communication can be implemented. Instead of agreement upon a complex protocol for communication, our approach only requires a simple protocol to inform the transfer of the XML document. In conclusion, our approach has follow advantages: Firstly, it doesn’t require unified user model to participate in; Secondly, our approach can achieve communication between personalization mediator and service provider by SOAP protocol; Finally, defining user model based on the role they act can effectively support the various existing personalization systems and their user models.

The architecture and user model is only the first step to realize the cross-system personalization. There are many challenges and further work to deal with. We’ll keep effort to consummate and realize the Web service based cross-system personalization.

References