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Web Service Recommendation Based on Usage History

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Abstract: With the rapid development of technologies based on Web service, large quantities of Web services are available on the Internet. Web service recommendation aims at helping users in designing and developing service-oriented software systems. How to recommend web services with better QoS value receives a lot of attention. The modern information systems on the Internet are services integrated software components for the support of interoperable machine to machine interaction over a network. Web services have been widely employed for building service-oriented applications in both industry and academia in recent years. The number of publicly available Web services is steadily increasing on the Internet. However, this proliferation makes it hard for a user to select a proper Web service among a large amount of service candidates. An inappropriate service selection may cause many problems (e.g. ill-suited performance) to the resulting applications. In this system, we propose a location-aware Web service recommender system which helps users to select services with optimal Quality-of-Service (QoS) performance. Our recommender system employs the location information and QoS values to cluster users and services, and makes personalized service recommendation for users based on the clustering results.

Keywords*:* Web service, service recommendation, quality of service (QoS), service selection.

I. INTRODUCTION

WEB services are software components designed to support interoperable machine-to-machine interaction over a network, usually the Internet. Web service employs WSDL (Web Service Description Language) for interface description and SOAP (Simple Object Access Protocol) for exchanging structured information. Benefiting from the cross-language and cross-platform characteristics, Web services have been widely employed by both enterprises and individual developers for building service-oriented applications. The adoption of Web services as a delivery model in business has fostered a paradigm shift from the development of monolithic applications to the dynamic set-up of business processes.

A web service enables communication among various applications by using open standards such as HTML, XML, WSDL, and SOAP. A web service takes the help of:

- XML to tag the data
- SOAP to transfer a message

A. Benefits of Web Services

Web services provide several technological and business benefits, a few of which include:

- Application and data integration
- Versatility
- Coder-use
- Cost savings

B. Quality-of-Service (QoS)

Quality-of-Service (QoS) is widely employed to represent the non-functional characteristics of Web services and has been considered as the key factor in service selection. Quality of service (QoS) is the overall performance of a computer network, particular performance seen by users.

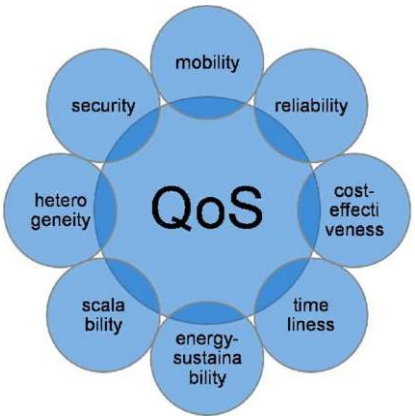

Figure 1: QoS Requirements for Web Services

With the proliferation of web services as a business solution to enterprise application integration, the QoS for web services is becoming increasingly important to service providers. Quality of Service (QoS) of a web service is an important factor that differentiates similar services offered by different service provider.

The QoS requirements for web services here mainly refer to the quality aspect of a web service. These may include performance, reliability, scalability, capacity, robustness, exception handling, accuracy, integrity, accessibility, availability, interoperability, security, and network-related QoS requirements.The performance of a web service represents how fast a service request can be completed.Web services should be provided with high reliability. Reliability here represents the ability of a web service to perform its required functions under stated conditions for a specified time interval.

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II. BRIEF LITERATURE SURVEY

For presenting the non-functional characteristics of the Web services, QoS models of Web services have been discussed in a number of research investigations [1]. Based on the QoS performance of Web services, various approaches have been proposed for Web service selection, which enables optimal Web service to be identified from a set of functionally similar or equivalent Web service candidates. To obtain the values of the user-dependent QoS properties for a certain user, Web service evaluations from the client side are usually required.

Collaborative Filtering (CF) is widely employed in commercial recommender systems, such as Netflix and Amazon.com. The basic idea of CF is to predict and recommend potential favourite items for a particular user employing rating data collected from other users. CF is based on processing the user-item matrix. Breese et al. [2] divide the CF algorithms into two broad classes: memory based algorithms and model-based algorithms. The most analysed examples of memory-based collaborative filtering include user-based approaches, item-based approaches, and their fusion. User-based approaches predict the ratings of users based on the ratings of their similar users, and item-based approaches predict the ratings of users based on the information of item similarity. Memory-based algorithms are easy to implement, require little or no training cost, and can easily take ratings of new users into account. However, memory based algorithms do not scale well to a large number of users and items due to the high computation complexity. Model-based CF algorithms, on the other hand, learn a model from the rating data using statistical and machine learning techniques.

Service selection and recommendation have been extensively studied to facilitate Web service composition in recent years. Wang et al. [3] present a Web service selection method byQoS prediction with mixed integer program. Zhang et al. [4] provide a fine grained reputation system for QoS-based service selection in P2P system. Zhu et al. [5] employ clustering techniques to their QoS monitoring agents and provide Web service recommendations based on the distance between each user and their agents. El Hadadd et al. [6] propose a selection method considering both the transactional properties and QoS characteristics of a Web service. Hwang et al. [7] use finite state machine to model the permitted invocation sequences of Web service operations, and propose two strategies to select Web services that are likely to successfully complete the execution of a given sequence of operations. Kang et al. [8] propose AWSR systemto recommend services based on users' historical functional interests and QoS preferences. Barakat et al. [9] model the quality dependencies among services and propose a Web service selection method for Web service composition. Shao et al. [10] employ a user-based CF algorithm to predict QoS values. Combination tasks of different types of CF algorithms are also engaged in Web service recommendation. Zheng et al. [11] combine user-based and item-based CF algorithms to recommend Webservices. They also integrate Neighbourhood approach with Matrix Factorization in their work. Chen et al. [12] use a region-based CF algorithm to make Web service recommendation. To help users know more about Web service performance, they also propose a visualization method showing recommendation results on a map. Lo et al. employ the user location in a matrix factorization model to predict QoS values.

A. Motivation

Location-aware Web service recommender system (named LoRec) is a system which employs both Web service QoS values and user locations for making personalized QoS prediction. Web service QoS prediction is used in different ways in LoRec to facilitate Web service recommendation. First, when a user searches Web services using LoRec, predicted QoS values will be shown next to each candidate service, and the one with the best predicted value will be highlighted in the search result for the active user. Moreover, LoRec selects the best performing services (services with the best submitted QoS) and services with the best predicted QoS from the whole service repository for the active user so that he/she can quickly find potential valuable ones instead of checking the service one by one.

B. Objective

The general objective of the system is to provide optimal Quality-of-Service to the users. An inappropriate service selection may cause many problems (e.g., ill-suited performance).The objective of this paper is:

- To predict Web service QoS values and recommend the best one for active users based on historical Web service QoS records.
- To enhance the prediction accuracy.

III. EXISTING SYSTEM

When developing service-oriented applications, developers first design the business process according to requirements, and then try to find and reuse existing services to build the process. Currently, many developers search services through public sites like Google Developers (developers.google.com), Yahoo! Pipes (pipes.yahoo.com), programmable Web (programmableweb.com), etc. However, none of them provide location-based QoS information for users. Such information is quite important for software deployment especially when trade compliance is concerned. Without knowledge of these things, deployment of service-oriented software can be at great risk.

A. Problems in Existing System

The first problem is that the existing approaches fail to recognize the QoS variation. Different users may observe quite different QoS values of the same Web service. It is impractical for users to acquire QoS information by evaluating all service candidates by themselves, since conducting real world Web service invocations is time consuming and resource-consuming.The second problem is an inappropriate service selection may cause many problems (e.g., ill-suited performance) to the resulting applications. Some developers choose to implement their

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own services instead of using publicly available ones, which incurs additional overhead in both time and resource. Effective approaches to service selection and recommendation are in an urgent need.

IV. PROPOSED WORK

The proposed system, try to propose personalized QoS value prediction for service users by employing the available past user experiences of Web services from different users. This approach requires no additional Web service invocations. Based on the predicted QoS values of Web services, personalized QoS-aware Web service recommendations can be produced to help users select the optimal service among the functionally equivalent ones. From a large number of real-world service QoS data collected from different locations, we find that the user observed Web service QoS performance has strong correlation to the locations of users.

To enhance the prediction accuracy, system propose a location-aware Web service recommender system (named LoRec), which employs both Web service QoS values and user locations for making personalized QoS prediction. Users of LoRec share their past usage experience of Web services, and in return, the system provides personalized service recommendations to them. LoRec first collects user observed QoS records of different Web services and then groups users who have similar QoS observations together to generate recommendations. Location information is also considered when clustering users and services.

The main contributions of this work are two-fold:

- First, system proposesa location-aware Web service recommendation approach, which significantly improves the recommendation accuracy.
- Second, system conduct comprehensive experiments to evaluate approach by employing a real-world Web service QoS data set.

A. Web Service Recommendation

Web service QoS prediction is used in different ways in LoRec to facilitate Web service recommendation. First, when a user searches Web services using LoRec, predicted QoS values will be shown next to each candidate service, and the one with the best predicted value will be highlighted in the search result for the active user. It will be easierfor the active user to decide which one to have a try. Moreover, LoRec selects the best performingservices (services with the best submitted QoS) and services with the best predicted QoS from the whole service repository for the active user so that he/she can quickly find potential valuable ones instead of checking the service one by one.

Table I: Example of Lo Rec Data Storage

User	Location	Service 1	Service 2	Service 3	Service 4	Service 5	Service 6	Service 7
Amy	Beijing, CN	20000ms	?	2000ms	?	?	?	2800ms
Bob	Houston, US	600ms	3300ms	?	3300ms	2000ms	?	?
Carol	Houston, US	650ms	2600ms	200ms	?	?	?	?
David	Houston, US	620ms	2500ms	2000ms	500ms	?	2000ms	?
Edward	Hong Kong, CN	1000ms	2500ms	2000ms	5000ms	?	2400ms	?

B. Advantages of Proposed System

1. Improves the recommendation accuracy compared with existing service recommendation.
2. Web service recommender system help users to select services with optimal Quality-of-Service (QoS) performance.

V. SYSTEM OVERVIEW

Web 2.0 applications such as social networking sites and self publishing sites encourage users to share their knowledge and learn from others. LoRec employs the idea of user collaboration and provides a platform for users to share observed Web service QoS values and search Web services. This system will generate personalized service recommendations based on user shared QoS values. The more QoS records users contribute, the more accurate the recommendations will be, since more information can be mined from the user contributed QoS values.

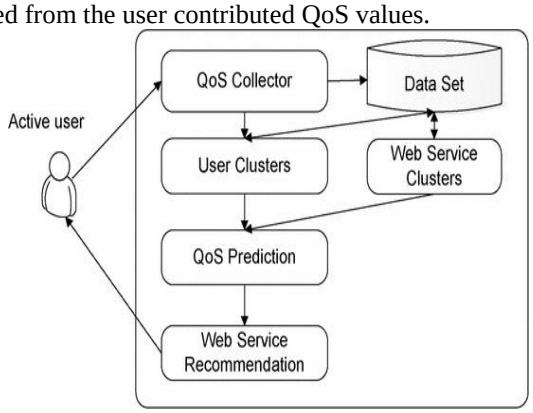
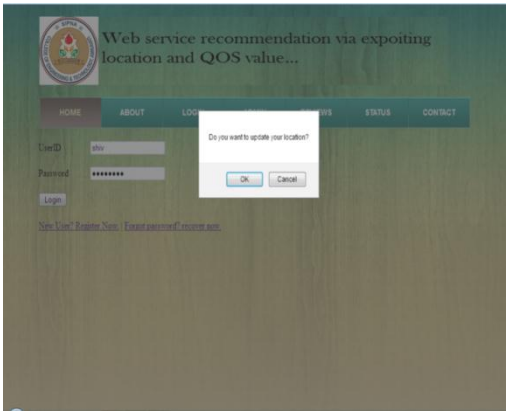


Figure 2: System Overview of LoRec

Figure2.Shows the architecture of our LoRec



Recommender system, which includes the following procedures:

- Web service users log on to LoRec system and share observed Web service QoS records with other users. In this system, users who have submitted Web service QoS records to LoRec are called training users.
- LoRec clusters training users into different regions according to their physical locations and past Web service usage experiences.
- LoRec clusters functionally similar Web services based on their QoS.

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- LoRec maps the active user to a user region based on historical QoS and user location.
- The recommender system predicts QoS values of candidate Web services for the active user and recommends the best one.

VI. IMPLEMENTATION

Description: Figure 3 shows the Web Service Recommendation via Exploiting Location and QOS value Web Site Home Page with various modules.

Figure 3: Web Site Home Page

Description: This is the login page; if user is registered then he/she can login by entering user id and password. After the login process clicking on login button, the web site will ask to update user location as per shown in figure 4.

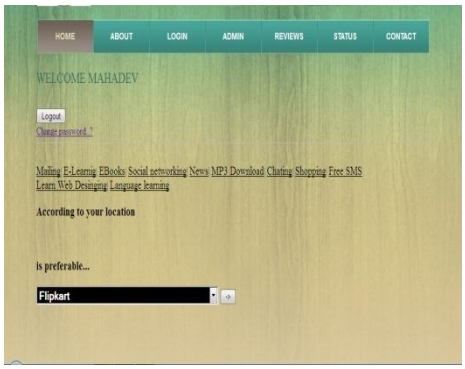
Figure 4: Registered User Login Frame

Description: In the below figure 5 updating user location, several web services are given. According to user location the user will be recommended optimal quality-of service based on historical QOS Records.

Figure 5:Web Service Recommendation

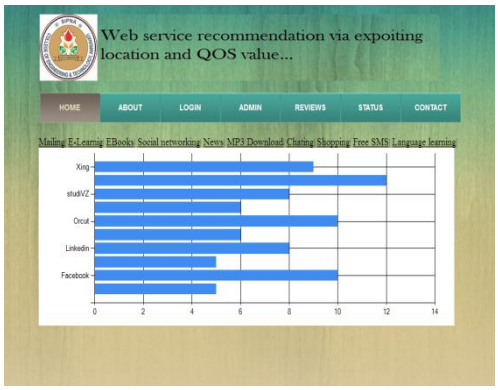
Description: The registered user or non-registered user can give their reviews on web services. As per category wise: Average, Satisfied, Excellent as per shown in figure 6.

Figure6: Reviews Frame



Description: After giving the reviews to the web services by the users, the status of the web service will be show in this format as per below figure 7.

Figure7: Status Frame



VII. CONCLUSION AND FUTURE WORK

Quality of Service (QoS) of a web service is an important factor that differentiates similar services offered by different service provider. The proposed systems tryto presents a QoS aware Web service recommendation approach. The basic idea is to predict Web service QoS values and recommend the best one for active users based on historical Web service QoS records. Web service recommender system helps users to select services with optimal Quality-of-Service (QoS) performance. Our Web service QoS data set is released to promote future research and make our experimental study reproducible. This Web service QoS data set not only be employed for investigating Web service Qos value prediction, but also be employed for a lot of other QoS driven research topics, such as service selection, optimal service composition, composite service reliability prediction, Web service recommendation .

VIII. RESULT AND DISCUSSION

In this paper, we have proposed location-aware Web service recommendation approach, which significantly improves the recommendation accuracy. Location-aware Web service recommender system (named LoRec) is a system which employs both Web service QoS values and user locations for making personalized QoS prediction. This approach requires no additional Web service invocations. Based on the predicted QoS values of Web

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services, personalized QoS-aware Web service recommendations can be produced to help users to select the optimal service among the functionally equivalent ones.

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