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A SCALABLE PERSONALIZED WEB SERVICE RECOMMENDATION SYSTEM WITH TRUST MANAGEMENT

B. Ramya Sri[1], V.VaraLakshmi[2] and M.Vijayalakshmi[3]

[1]Asst.Prof.,Dept of IT, SMEC, Secunderabad,India
[2]Asst.Prof.,Dept of IT, SMEC, Secunderabad,India
[3]Asst.Prof.,Dept of IT, SMEC, Secunderabad,India

ABSTRACT

Web services are the software components which provide support for the interoperable machine to machine interaction over a network. Web services have been used for creating service-oriented applications in the fields of industry and academics recently. The number of web services available freely and publicly is increasing on the Internet. An inappropriate service selection may result in many problems such as degraded performance to the resulting applications. Many existing recommender systems are used to assist users select services with efficient Quality-of-Service(QoS) performance which are based on collaborative filtering. The key issue considered in this paper is to discover the dishonest or malicious users. Another problem occurs when clustering the QoS values observed. In this paper, we advise a trust management system in web service recommendation along with an efficient clustering algorithm named as EM algorithm. The proposed system helps users to select the appropriate web services based on feedbacks gathered from past transactions.

Keywords: *Web Service, Trust Management System, EM algorithm.*

I. INTRODUCTION

Web Service is a software system to be used over internet to connect multiple machines. Web services describe the operations in standard XML messages. Those can be accessed via a network. Web Services enable cross-platform and provide language independent access to data and functionality over the Internet. Web services can be accessed which are dispersed over the internet. Web services are reusable elements of software which combine discrete functionality.Web Services interacts with other services dynamically using the standards SOAP, UDDI etc. These web services are used for developing Service Oriented applications in the fields of industry and academics mainly.

When developing Service Oriented applications, based on the given client requirements developers design the business process then searches for the reusable services to build the business process. Currently, Google, Yahoo etc., are providing services for reuse but they are not providing QoS information based on location which is necessary while deploying the application. Some web services are accessible only at particular locations and cannot be distributed to other countries. So some developers wish to develop their own services which involve time and resource overhead.

Service selection mechanisms based on QoS values will play a vital role in Service Oriented applications because developers wish to utilize services that meet their requirements exactly.QoS is characterized as a set of properties including response time, throughput, durability, reliability etc. Among these properties, values of certain properties such as response time need to be measured at client side. Therefore,experiencedQoS values may differ from user to user for each web service.

In other context, users cannot obtain QoS information by accumulating all service candidates by themselves as real world web service invocations are time-consuming and resource-consuming. One key concern in the Web Service area is to discover the most appropriate web services that meet the functional requirements of application to be developed by the users absolutely.

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To attack this challenge, personalized service recommendation systems are in need. One of the service recommendation systems is Location aware recommendation (LoRec) system that was proposed in [1].

The paper is structured as follows. Section 2 describes the related work of LoRec system. Section 3 presents need for Trust Management System. Section 4 gives the steps involved in Trust Management system. Section 5 discuss about EM clustering algorithm to group the observed QoS values efficiently. Section 6 presents the proposed architecture and Section 7 concludes the paper.

II. RELATED WORK

Collaborative Filtering:
The essential thought of Collaborative Filtering (CF) is to anticipate and suggest potential most loved things for a specific client by utilizing the rating information collected from different clients. The CF approaches are classified into two classes: memory-based and model-based.

LoRec System:
LoRec is the web service recommender framework which depends on the possibility of Collaborative Filtering. LoRec recommender framework incorporates the following steps:

- Web service users sign on to LoRecframework and offers watched web service QoS esteems with different users. user who have submitted Web service QoS records to LoRec are called training uers. In the event that a training user requires web service suggestion, at that point the client turns into an active user.
- LoRec bunches training users into various regions as indicated by their physical areas and past web service QoS values.
- LoRec groups practically comparable web services in light of their QoS likenesses.
- LoRec maps the active user to a user region in view of past QoS values and client location.
- The recommender framework predicts QoS estimations of candidate Web service for the active user and suggests the best one.
- The activeuser gets the anticipated QoS estimations of web services with the proposal comes about, which can be utilized in decision making.

III. NEED FOR TRUST MANAGEMENT

Trust is characterized as "a companion's confidence in another associate's abilities, trustworthiness and unwavering quality in view of its own immediate encounters".

LoRec system assumes that all training users are submitting the valid QoS records. In reality, all training users are not trust-worthy because they may provide incorrect QoS records to affect the reputation of particular web service. To identify the inaccurate users or users submitting wrong feedbacks, Trust Management is in need. Incorporating trust in web service environments will help to increase the user satisfaction, to improve recommendation efficiency etc.

IV. TRUST MANAGEMENT SYSTEM

The components involved in the Trust Management system are given below:

Submitting the feedback:
When the user has submitted feedbacks, all feedbacks are summarized in one binary value pack. The assumption in this step is that users can assess if the delivered QoS of a web service is agreed or not. A value 1 means that user is satisfied and 0 describes the disappointment of user from the received service.

Trust Manager:
Once all the feedbacks are gathered, a trust management service is needed to handle and manage the collected data called Trust Manager. The Trust Manager is used as a feedback collector.

To collect feedbacks, two alternatives are possible:

a. Getting feedbacks from all users who invoked a particular web service.
b. Selecting aarbitrary set of users from all these users.

Impact of Dishonest users:
Malicious users or dishonest users may submit wrong feedbacks to impact the reputation of some web services. To secure the trust data, the honest users has to be given with more weight while minimizing the effect of dishonest users.

The following are the some methods to minimize the effect of wrong feedbacks:

a. Keeping the track of historic user experiences or feedbacks
b. Multivariate outlier detection technique: this technique expresses the abnormal data behavior i.e., data deviated from the natural data
c. The use of trustworthy users: the regular users are treated as trustworthy users. When forecastingQoS values for recommendation, these values can be given more weights than the others.
d. A voting system: collecting different feedbacks and a majority vote is used to eliminate false values.

V. EM ALGORITHM FOR CLUSTERING

Clustering:
Clustering is the method of grouping the data objects together such that intra-cluster similarity of data objects is higher than inter-cluster similarity.

In LoRec System, users of web service share their observed QoS values with other users. These values are clustered into two regions: one depends on user location and other on web service QoS values.

The Grouping must be done efficiently so that when new user shares his experienced values, they must be stored in their corresponding regions or clusters for the accurate personalized recommendation of web services.

EM algorithm:
For grouping the observed QoS values, the usage of EM algorithm is discussed in this paper, which calculates the probabilities of cluster memberships based on different data distributions.

EM algorithm was first explained by Arthur Dempster, Nan Laird and Donald Rubin in 1977. EM algorithm is repetitive method used to find the maximum likelihood or maximum a posteriori (MAP) values of parameters in Statistical model where model is determined by unobserved latent variables. A latent variable can't be examined directly but can be deduced from other variables which are observed.

EM algorithm varies between 2 steps: expectation in which a function is applied to evaluate the expectationof log-likelihood by means of the present estimate for parameters, maximization which evaluates parameters augmenting the expected log-likelihood found in previous step.

Description:
Given a Statistical model, set X represents observed data, set Z represents unobserved or latent data and vector Θ represents unknown parameters and one likelihood function $L(\Theta;X,Z)=p(X,Z|\ \Theta)$.

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In this paper, For the LoRec System considered, set X consists of IP address, network properties and variousQoS properties such as response time, throughput etc. set Z consists of location of user along with location dependent QoS properties. Vector Θ consists of the clusters in which observed or new data to be grouped.

Algorithm:
In this algorithm, we imagine that there are n User Clusters and m Web Service Clusters. For each user and web service clusters, cluster centervalues $c_i$are to be calculated before applying EM algorithm. In the algorithm, c_i' specifies new cluster center after new user or web service is includedinto the cluster. The algorithm proceeds as follows: the following pseudo code is used when a new user has arrived into LoRec system.

In this algorithm, Θ^{t+1} is used which improves the likelihood of the current estimate. Here λ and α are predefined threshold values. L represents the log likelihood function that estimates the likelihood of new user or web service belonging to the current cluster which in turn considers the location. If the likelihood value is greater than certain threshold value λ, then grouping is performed. Else the process is repeated for all the clusters till clustering is completed or new cluster is created.

Once the clustering is done, the deviation between the original and new cluster centers is calculated. If the deviation is less than the predefined value then the user is grouped correctly else the user is considered to be in a new cluster. For any new user, this new cluster is taken into consideration and now there are n+1 user clusters. Similar steps will be taken for a new web service.

```
for each new user a,
in: clusters u1,.....un
for i=1 to n
        L (Θ; X) =log p(X, Z| Θ)
          if (L (Θ; X)> λ)
                a € ui (group the user into this cluster)
          else
                continue till all clusters are examined
          if (diff (ci, ci') <α)
                new user has been grouped properly
          else
                new cluster is created
                n=n+1
                Θt+1=argmax L(Θ| Θt)
end for
end for
```

VI. PROPOSED ARCHITECTURE

The steps in the proposed architecture are given below:

a) The feedbacks which are submitted by the user are primarilytransformed to a binary value pack.
b) That binary value pack is managed by the Trust Manager.
c) Any of the above specified methods are used to identify malicious users by analyzing the binary value pack.
d) Then all users and web services are assembled into clusters.
e) Then QoS values for the candidate service are predicted.
f) The user obtains the estimatedQoS values of web services which are used in the decision-making.

In this proposed architecture, the EM algorithm is used once the application of Trust Management is completed to divide the users and web services into clusters.

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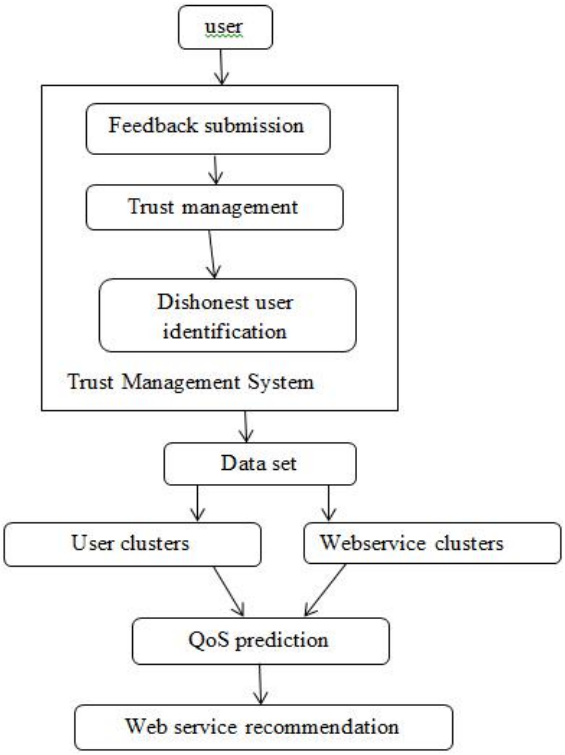

Fig 1: Web Service Recommendation with Trust Management

VII. CONCLUSION

As the recommender system (LoRec) discussed in above sections of the paper works on the fundamental idea to propose the best web service for the user based on the earlier web service QoS values experienced by other users. But trust is not involved in LoRec system.

It believes that all users who are submitting the feedbacks are trust worthy but in reality, it is difficult. In this paper, for identifying the malicious users, we proposed a trust management system for web services environments. It contains the different components of trust management system. The proposed structure of trust management system is presented with its components.

This paper also discusses the idea of applying EM algorithm to group the users and the web services into different regions. This paper can be further extended by considering the other methods to discover malicious users and by considering the correlation between different QoS properties to progress the recommendation accuracy.

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