An Approach to Detect Malicious Feedback Rating for Measuring Web Service Reputation

Subhodh Kumar and Chhaya Nayak

M.tech Scholar, BM College of Technology, Indore
subodhkumar.cs@gmail.com
Asst. Prof, BM College of Technology, Indore

chhaya2007@gmail.com

Abstract

In the field of service computing, reputation of a Web service is usually calculated using feedback ratings provided by service users. However, the existing malicious ratings and different preferences of different service users often lead to a bias towards positive or negative ratings. In this paper, we propose a novel reputation computation approach for accurately measuring the reputation of Web services. The proposed approach uses three phases to measure and compute service reputation such as, feedback data collection, malicious rating detection and reputation computation for improving the reputation computation accuracy. A framework is also proposed to detect the malicious feedback rating and determine the accurate service reputation for reliable service selection.

Keywords: Web service; Feedback rating; Reputation, Ranking

1. Introduction

Web services are becoming more and more popular to enable organizations to use the Web as a market for selling their Web services and consuming existing Web services. The explosive growth of Web services increases the difficulty for users to choose among a large number of Web services. Therefore, selecting and ranking Web services effectively becomes a key challenge for the Web service community. Traditional Web service selection approaches are usually based on the promised qualities offered by the service providers. However, service provider's promises to provide quality on the published services but unfortunately fails partially or fully to deliver on these promises at runtime [1]. It is not an easy task since some service providers are unable to provide the promised quality. Reputation of the service providers needs to be considered when making service selection. Hence, accurate reputation measure of Web services is critical for business applications. The discovered services can be evaluated and ranked according to the feedbacks from service users.

The importance of reputation measure of Web services have been recognized by several research works. Although previous work on existing solutions has explored the efficacy and robustness of measure approaches, most of them suffer from the certain weaknesses. Firstly, it is difficult to ensure the purity of feedback ratings because of existing malicious service users. Malicious service users might provide some malicious feedbacks to affect the measure results for commercial benefits. Hence, malicious service users can report malicious feedback ratings for a Web service.

Secondly, existing approaches fails to ensure the accuracy of feedback ratings. There is a large variety of service users on the Internet. Service users can express their QoS preferences services [1,2]. The user ratings are often subject to service users' preferences. As some service users provide low ratings on various Web services, whereas some others may be aggressive or neutral and provide high ratings [7]. Hence, different service users

often give different ratings to the same used service. To address the aforementioned weaknesses, a novel reputation computation approach is proposed for accurately measuring the reputation of Web services. The proposed method uses three phases such as, malicious rating detection, rating adjustment and reputation computation for improving the reputation computation accuracy. A framework is also proposed to detect the malicious feedback rating and determine the accurate service reputation for reliable service selection.

This paper is organized as follows Section II describes related work carried out. Section III describes proposed approach along with a framework for feedback rating detection and reputation computation, which contains malicious rating detection and adjustment. Finally Section IV concludes the paper.

2. Related Work

Reputation has always been a primary issue among the online as well as offline business communities. The consumers choose provider or services based on their reputation. In the context of web services, the reputation of services or service providers is used primarily by the web service composers for first selecting and then composing them for various online business operations. Many researchers have worked on trust and reputation using various mechanisms, incentive based, association based, previous invocation based *etc*. In this section, various reputation computation approaches are identified.

A popularity based service search method is adopted, which consists of tracking all kind of services. It stores important information into database related to discovered, invoked or published services which is helpful in finding frequency of used web services, their availability, usage history *etc* [3]. The trust among two or more users in the web of trust increases the quality of recommendation in two ways. Firstly, the trust metrics reduce the computability of similarity assessment of users or items. Secondly, the reputation of users may be computed using trust propagation. A novel approach is proposed that dynamically recommends web services that fit users' interest [4]. This approach is a hybrid approach which combines collaborative filtering and content-based recommendation. In particular, this approach considers simultaneously both rating data and content data of Web services using a three-way aspect model.

An approach for trust-based recommender system is proposed to solve the problem of traditional recommender system which is often ineffective and unable to compute user similarity weight for many of the users [5]. It accepts trust metrics and rating matrix as input and generates neighbors using trust metrics and user similarity respectively. In this approach, to solve the problem of traditional recommender system, trust-based issues are discussed such as, data sparsity, cold-start users, malicious attacks on recommender systems and centralized architectures. A semantic enhanced personaliser (SEP) framework of hybrid recommender system is proposed for web personalization [6]. SEP comprises three techniques of recommendation, such as original, semantic and category-based recommendation. The original recommendation consists of three components, such as user-based collaborative filtering, item-based collaborative filtering and item-based contextual filtering. This recommendation is based on explicit feedback and contextual information provided by the web users. While semantic and category-based recommendation is based on implicit feedback using data mining techniques such as, association-rule-mining (ARM), similarity measures and clustering. The SEP is capable to solve the problem of scalability, sparsity, quality of recommendation, synonymy, *etc*.

A novel Web service recommendation approach is proposed which incorporates user's potential QoS preferences and diversity feature of user interests on Web services [8]. User's interests and QoS preferences on Web services are first mined by exploring the Web service usage history. Then we compute scores of Web service candidates by

measuring their relevance with historical and potential user interests, and their QoS utility. A diversified Web service ranking algorithm is also proposed to find the top-k diversified Web service ranked list. It is based on functional relevance including historical user interest relevance and potential user interest relevance, non-functional relevance such as QoS utility, and diversity feature. In their future work, they will study Web service clustering methods to improve the similarity computation and conduct real user survey to evaluate the usefulness of their method further. In addition, proposed diversified ranking measure mainly focuses on the immediate neighborhood information in the Web service graph. More tests will be performed by our diversified ranking measure with k-hop nearest neighbors in the future work.

A QoS prediction framework, called WSPred, is proposed to pro-vide time-aware personalized QoS value prediction for different service users [9]. QoS performance of services is highly related to the service status and network environments which are variable against time. A neighborhood based collaborative filtering approach is presented to predict unknown values for QoS-based service selection [10]. Most recently, some CF based service recommendation approaches employed the matrix factorization theory to improve the accuracy of QoS prediction [11, 12]. A hybrid service recommendation approach is presented by combining collaborative filtering with content-based features of Web services [13]. This approach exploited both rating data and content data of services using a three-way aspect model. In their work, user interests are represented by a set of latent variables, which is developed offline. However, QoS preferences of users are not considered in these works.

Although, existing solutions has explored the efficiency and robustness of reputation measure approaches, most of them suffer from certain weaknesses. Firstly, it is difficult to ensure the purity of feedback ratings because of existing malicious service users. Malicious service users might provide some malicious feedbacks to affect the measure results for commercial benefits. Secondly, previous approaches fail to ensure the accuracy of feedback ratings. There is a large variety of service users on the Internet and these service users can express their preferences over Quality of Service (QoS) attributes of services [10]. The user ratings are often subject to service users preferences. As some service users are conservative (provide low feedback ratings on various Web services), whereas some others may be aggressive or neutral [7]. Hence, different service users often give different ratings to the same used service.

A novel reputation measure method is proposed for web services which work in two phases [14][15][16]. These are malicious rating detection and rating adjustment. The two phases are used to enhance the reputation measure accuracy. The proposed system detects malicious feedback ratings by using cumulative sum method and reduces the effect of user feedback preferences by Pearson correlation coefficient. The limitation with this approach is that only negative feedback ratings are dropped because they cause malicious ratings.

There exist various shortcomings in existing approaches of reputation assessment. Reputation assessment at QoS parameter level requires that each QoS parameters should be monitored and tracked dynamically due to its dynamic nature. Also, most of the approaches are fully rely on users' feedback. Due to different abilities and intentions of users, it is difficult to ensure the accuracy and reliability of users' feedback. In order to overcome these limitations, a novel reputation computation approach is proposed for accurately measuring the reputation of Web services. The proposed method uses three phases such as, feedback data collector, malicious rating detection and reputation computation for improving the reputation computation accuracy. A framework is also proposed to detect the malicious feedback rating and determine the accurate service reputation for reliable service selection.

3. Proposed Approach

Reputation of a service can also be evaluated according to feedback ratings provided by service users. A user of the services plays an important role in the assessment of reputation prediction accuracy of services. Therefore, feedback ratings provided by service users can not be completely avoided. But the major issue with user feedback rating is the trustworthiness and accuracy of their feedback. This issue can be solved by providing an automatic mechanism for detecting malicious user feedback which assesses the service reputation by discarding the malicious users. Figure 1 shows the feedback rating evaluator and reputation computation mechanism through discovery agent. The proposed mechanism involves four components such as, service consumer, service provider, service repository and service discovery agent. In this figure, service discovery agent plays major role which is responsible for evaluating malicious feedback rating and measuring the service reputation accurately to improve service reliability. Service consumers are the users who requests and consumes the services. Service providers are the users who provide their services to be consumed.
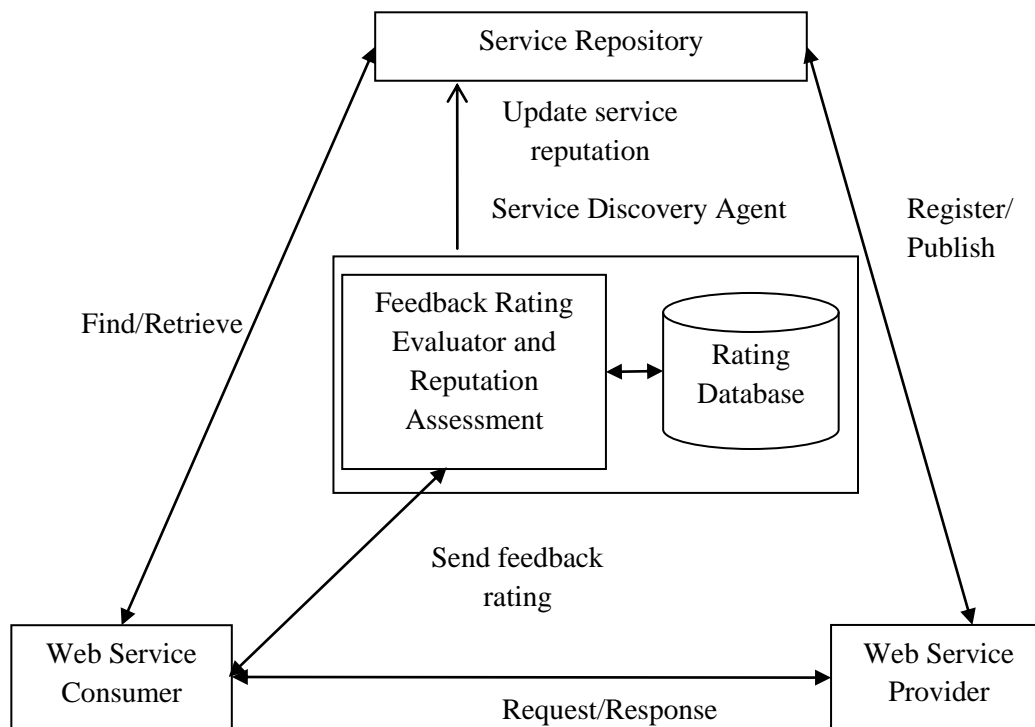

Figure 1. Feedback Rating and Evaluation Mechanism Using Discovery Agent

Consider r(si) to represent the reputation score of si in a global time. Then r(si) can be calculated by using

$$r(s_i) = \frac{1}{n} \sum_{i=1}^{n} r_i \qquad (1)$$

Where, ri represents the ith feedback rating. However, because of the existing of malicious ratings and different users' preferences, many studies are limited in their ability to support web services. They do not cater for the reliability of reputation measure, which makes the reputation of web service deviate from its actual value in composition system.

Hence, in order to solve the problem, we propose a feedback rating evaluation and reputation computation approach based on feedback rating.

As shown in Figure 2, our method mainly contains three phases *i.e.*, feedback data collector, malicious rating detection and reputation computation. The first phase involves collecting the feedback data from the feedback data collector repository. The second phase involves computing feedback similarity of different service users and detects malicious feedback ratings collected by data collector by performing similar data analysis. Finally, reputation computation component computes the accurate service reputation with actual feedback ratings and store the reputation score into the repository and provides the reputation score of services when requested by Discovery agent.
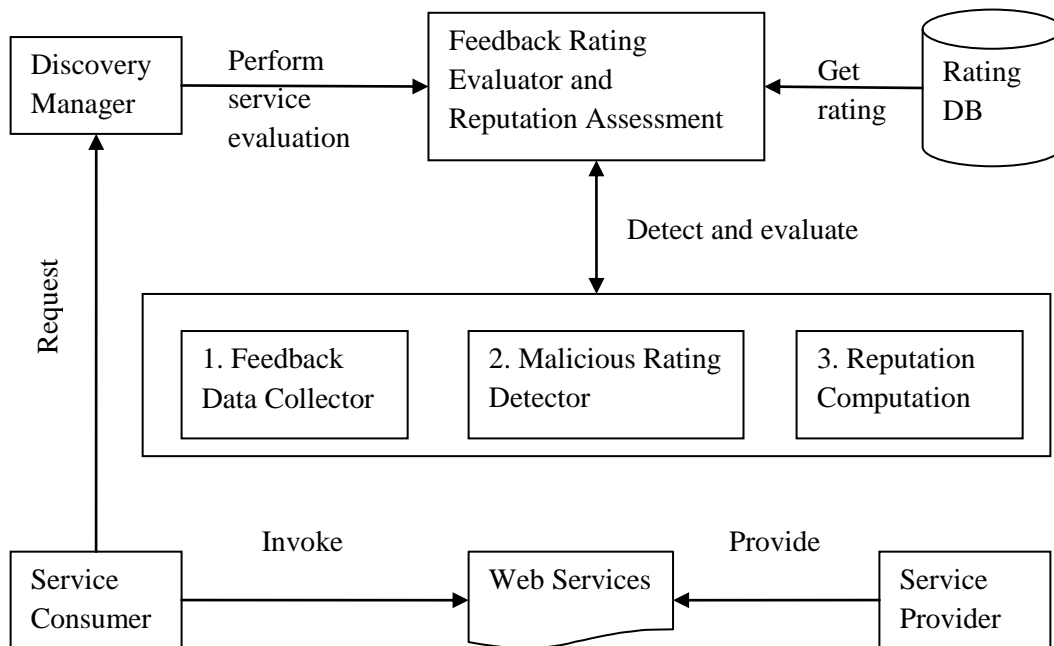

Figure 2. Working of Feedback Rating Evaluator and Reputation Assessment Component

3.1. Feedback Data Collector

The feedback data collector component stores and manages all the feedback ratings from the service user. For each service si that the service consumer has invoked, a service user provides a feedback rating that indicates the level of satisfaction with a service after each interaction with the service. A rating is simply an integer ranging from 1 to 10, where 10 means extreme satisfaction and 1 means extreme dissatisfaction. These feedback ratings are stored and managed by data collector component which is further used for malicious rating detection.

3.2. Malicious Rating Detection

In this mechanism, feedback data is separated into two parts in which the first part contains all the malicious feedback ratings and the second part contains the actual feedback ratings. This can be achieved by setting up the maximum and minimum threshold value for malicious and normal feedback ratings. By comparing both the parts, if the majority of users provided negative feedback rating then the service reputation is

computed based on negative feedback ratings and considered to be of poor reputation. If majority of users provides actual feedback ratings then the service reputation is computed based on actual feedback ratings. Here, the simple averaging method is used to compute the service reputation based on negative or actual user feedback ratings. If the service reputation is computed on the basis of actual feedback ratings then this computed value is compared against the ideal reputation value in order to exclude or include in composition. In this phase, only the feedback ratings from trustworthy users are considered for reputation assessment.

Feedback ratings are often subject to the different preferences of the user with the same service, which fails to ensure the accuracy of feedback ratings. As it is well known that there is a large variety of service users on the Internet. Theses service users who have different preferences report their feedbacks, which are often subject to their preferences. Some service users may be conservative, whereas, some others may be aggressive or neutral. Hence, it is imperative to shield the influence that these users' feedbacks may be conservative, whereas some others may be aggressive or neutral to the same service. In this paper, feedback similarity computing is proposed to shield the influence of different preferences of users and adjust their feedbacks by assuming a minimum and maximum threshold value. Malicious user ratings can be detected with the following steps:

Step 1: Get user feedback.
     f_user_rating=get_users(ws)
Step 2: if (f_user_rating< Rl)then
        list1[]=get_no._of_negative_user (f_user_rating)
Step 3: if (f_user_rating> =Ru)then
        list2[]=get_no._of_actual_user (f_user_rating)
Step 4: if (average (list1)>average (list2)) then
         ufb_flag=false
      else
         ufb_flag=true
Step 6: return ufb_flag

Here, ws is the name of service, f_user_rating is the user feedback rating, Rl is the lowest rating level, Ru is the upper rating level and boolean is return type of function. List1 and list2 are the list for storing feedback ratings for actual and malicious users. Ufb_flag is user feedback rating flag, which returns boolean type value.

3.3. Reputation Computation

We assume that there are m service users, n Web services, and the relationship between users and Web services is denoted with a m × n matrix. Then each entry $r_{i,j}$ in the matrix denotes the feedback rating of Web service i rated by the user j. Having executed the two phases mentioned above, in order to gain the accurate reputation measure, we transform (1) to (2) by the following equation:

$$ir(si)=r(si)-mr(sj)$$

Where, $r(si)=\frac{1}{n}\sum_{i=1}^{n} r_i$
and $mr(sj)=\frac{1}{n1}\sum_{j=1}^{n1} r_j$
Where r_i and r_j represents the ith feedback and jth feedback rating.

4. Conclusion

Due to different abilities and intentions of users, it is difficult to ensure the accuracy and reliability of users' feedback. In order to overcome these limitations, a novel

reputation computation approach is proposed for accurately measuring the reputation of Web services. A framework is also proposed to detect the malicious feedback rating and determine the accurate service reputation for reliable service selection. Future work involves the implementation and experimental evaluation of proposed approach.

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Authors

Subhodh Kumar, He is a M.Tech scholar in BM college of technology, Indore, India. He has also completed his Bachelor's degree in engineering from RGPV University, Bhopal.

Chhaya Nayak, She is working as an Assistant Professor at BM college of Technology, Indore, India. She has received her M.Tech Degree in Computer science engg. from Rajiv Gandhi Technical University, Bhopal, India. She is having 10 years of teaching experience. Her areas of research are Software Engineering, Service-Oriented Computing, Distributed computing and Cloud computing. She has published around 10 research papers in various national and international conferences and journals. She has guided 10 M.Tech Dissertations. Currently she is guiding 4 M.Tech Scholars.