



A robust trust model for service-oriented systems

Xing Su^a, Minjie Zhang^a, Yi Mu^a, Quan Bai^{b,*}

^a School of Computer Science and Software Engineering, University of Wollongong, Wollongong, NSW 2522, Australia

^b School of Computing and Mathematical Sciences, Auckland University of Technology, Auckland, New Zealand

ARTICLE INFO

Article history:

Received 2 March 2012

Received in revised form 26 October 2012

Accepted 8 November 2012

Available online 13 December 2012

Keywords:

Trust

Service selection

Open environments

Trust evaluation

ABSTRACT

In service-oriented computing applications, service consumers and providers need to evaluate the trust levels of potential partners before engaging in interactions. The accuracy of trust evaluation greatly affects the success rate of the interaction. Trust evaluation is a challenging problem in open and dynamic environment as there is no central mediator to manage standardized evaluation criteria or reputation records. In this paper, a novel trust model, called the priority-based trust model, is presented. The model derives the trustworthiness of a service provider from designated referees and its historical performance. In addition, consumers can specify their preferred priorities which will affect the result of trust evaluations. The experimental results show that the proposed model has better performance than other trust models, especially in open and dynamic environments.

© 2012 Elsevier Inc. All rights reserved.

1. Introduction

Service-oriented architecture (SOA) provides a way for service consumers and service providers to share and access services [1]. It supports loose coupling among system components (i.e., services), and dynamic interactions among service providers and service consumers (here we call them provider agents and consumer agents). In a service-oriented system, users can select services they require, and include them as parts of their workflows (e.g., many e-Science applications [2]).

Today, with the expansion of service-oriented applications, more and more researchers have realized that trust has become a crucial aspect in service-oriented systems [3–7]. However, the dynamic nature of service-oriented systems makes trust evaluation a challenging task. First, in many service-oriented systems, there is no centralized mechanism for controlling and coordinating the interactions among agents. Hence, the decision making for selecting suitable providers can only be based on information provided by partners (agents) [8], the local view of the agent and/or the experience from previous interactions. Second, in some complex environments, a service-oriented system may contain agents with different trust evaluation criterion and selfish goals. Trust evaluation among such environments is more complicated.

In order to tackle the challenges posed by service-oriented environments, various trust models have recently been proposed most of these models consider reputation, experience and other features of open environments [9–12]. Although some of these models can support decentralized trust management and individual trust evaluations [13–17], many existing models have limited capabilities in trust and preference representation, which greatly affect the accuracy of trust evaluations, and make them unsuitable for complex working environments. To overcome some limitations in existing trust models, a novel trust model, called the Priority-Based Trust (PBTrust) model was introduced in [18]. The PBTrust model evaluates the trustworthiness of a potential service provider from four perspectives: the provider's experience on the service, the similarity of priority distribution of attributes between the referenced service and the requested service, the suitability of the

* Corresponding author.

E-mail addresses: xs702@uowmail.edu.au (X. Su), minjie@uow.edu.au (M. Zhang), ymu@uow.edu.au (Y. Mu), quan.bai@aut.ac.nz (Q. Bai).

potential provider for the requested service and the time effectiveness of rating score from third parties. It can give a more robust and accurate evaluation of the trustworthiness of service providers in open dynamic environments. This paper extends the previous work on this topic suggesting some significant improvements and presenting comprehensive experiments and evaluations.

The paper is organized as follows. Some current literature in the field of trust evaluation and trust models are reviewed in Section 2. Section 3 explains the scope of this research and establishes some related definitions. The principle of the PBTrust model is presented in Sections 4 and 5. In Section 6, some experimental results are introduced to demonstrate the performance of the PBTrust model. Finally, the conclusion and future work of this research is introduced in Section 7.

2. Related works

Trust is a term with different meanings in different domains. In this research, trust is defined as the indicator of whether an agent is willing to rely on the actions of another agent. Hence, the result of trust evaluation will impact on the decision as to whether to establish interactions with a particular party. Trust evaluation is an essential part of many recommendation systems. However, many recommendation systems have a central server (recommender) which can access, collect and evaluate historical records from a large number of agents [19,20]. Although in recent years, some researchers have also recommended distributed architectures in recommendation systems, the recommenders still need to keep and maintain the connections with a number of agents in the system, and some trust related information such as trust criterion of different users [21,22]. Namely, the recommenders are actually providing a particular service (i.e., making recommendations) to other agents in the system. However, in distributed and dynamic environments, it is hard to ensure that recommenders can access more resources and trust information than other agents. It will also introduce extra overhead for including and maintaining a number of recommenders in distributed environments.

Several trust evaluation approaches for distributed systems have been proposed in recent years. Sabater et al. [14,15] proposed the REGRET model for trust calculation by considering the reputation values not only of the witnesses but also of the neighbors and the system. A major contribution of the REGRET model is that it assigns weights to different aspects of a service and considers weighted reputation values of all aspects in the calculation of an overall service reputation. The REGRET model can also handle witness cheating problems effectively. Schmidt et al. [23] introduced a fuzzy-logic based trust evaluation model which can integrate post-interaction processes like business interaction reviews and credibility adjustment. In the model proposed by Schmidt et al., agents can query peer agents their opinions about potential partners, calculate their trustworthiness and based its service selection upon these results. The model also considered the credibility of peer agents in trust calculations. However, a common limitation of the proposed model in [14] and [23] is that they all used single values to represent the overall reputation of a service and this cannot comprehensively evaluate the performance of a service.

Sensoy et al. [24] proposed a trust model that considers different attributes of a service. In this model, the attributes of a service are represented in ontologies. From these ontologies, service providers can understand the consumer requirements. Meanwhile, consumers can get a general understanding of the advantages and shortcomings of service providers. Tsai et al. [25] also introduced an ontological approach to trust evaluation. In addition, Tsai borrowed some concepts from Community-of-Interest systems, and classified users into different roles using Role Ontology. He then introduced four trust models for different user roles. Because of the descriptive power of ontologies, service quality and provider reputation can be described explicitly. Then, consumers can have a better understanding of the provider candidates. The ontological approach, however, involves complicated procedures to cover various situations and this is not practical, especially in highly dynamic environments.

Huynh et al. introduced the Certified Reputation (CR) model in [17]. In the CR model, the reputation information is maintained by service providers. This feature makes the CR model suitable for open and dynamic environments. However, the CR model also uses single values to represent the reputations of service providers. In addition, it is hard to obtain objective service evaluations in the CR model as most service providers will keep only the best performance records as their references.

3. Problem description and definitions

The PBTrust model was developed to overcome some limitations in the existing trust models and it is suitable for complex and dynamic environments. Before elaborating the details of the model, it will necessary to define the scope of this work and provide some necessary definitions. For the meanings of abbreviations and symbols used in this paper, see Appendix A.

In general, there are two types of agents in a service-oriented system, i.e. consumer agents and provider agents. Here, we also define another role for consumer agents, i.e., to act as *referees*. Namely, a consumer agent can provide *references* about the quality of services to other consumer agents based on its previous experience. The *reference* of a service is kept by its provider agent. After a *reference* is generated by a consumer agent, it cannot be manipulated by any other agents (especially the provider agent). The meaning and format of references are defined in Definition 5.

Download English Version:

<https://daneshyari.com/en/article/10332902>

Download Persian Version:

<https://daneshyari.com/article/10332902>

[Daneshyari.com](https://daneshyari.com)