A Trust-Based Agent Learning Model For Service Composition In Mobile Cloud Computing Environments

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ABSTRACT

Mobile cloud computing has the features of resource constraints, openness, and uncertainty which leads to the high uncertainty on its quality of service (QoS) provision and serious security risks. Therefore, when faced with complex service requirements, an efficient and reliable service composition approach is extremely important. In addition, preference learning is also a key factor to improve user experiences. In order to address them, this paper introduces a three-layered trust-enabled service composition model for the mobile cloud computing systems. Based on the fuzzy comprehensive evaluation method, we design a novel and integrated trust management model. Service brokers are equipped with a learning module enabling them to better analyze customers' service preferences, especially in cases when the details of a service request are not totally disclosed. Because traditional methods cannot totally reflect the autonomous collaboration between the mobile cloud entities, a prototype system based on the multi-agent platform JADE is implemented to evaluate the efficiency of the proposed strategies. The experimental results show that our approach improves the transaction success rate and user satisfaction.

I. INTRODUCTION

Mobile cloud computing is the application of cloud computing in mobile Internet. It refers to the delivery and use mode of IT resources or information services to provide/obtain infrastructure, platform, software (or applications) through mobile network in an on-demand and scalable manner. Mobile cloud computing builds up a hybrid application environment of cloud computing, Internet and mobile ends, improving the computational and storage capability of mobile terminals and providing users with a more rich and colorful functional experience.

However, mobile cloud computing inherits both the advantages and disadvantages of cloud computing and mobile internet. The features of resource constraints, openness and uncertainty lead to the high uncertainty and unstable Quality of Service (QoS) provision and serious security risks [1], [2]. Especially in the face of complex service requirements, how to achieve efficient service composition, and how to ensure the credibility of combined services has become hot issues in the mobile cloud computing researches [3]. Many valuable task scheduling and service composition strategies have been proposed for the traditional Internet environment.

However, they cannot cope well with the active collaboration of participants in the mobile cloud computing markets. For this reason, agent-based cloud computing models are introduced [4]. Mobile cloud systems based on a multi-agent architecture are much easier to react the autonomy, intelligence and initiative of cloud entities, and to realize the independent evolution of the cloud service market, which is closer to the essence of a commercial market [5]_[11]. To meet these requirements, we propose a Trust-based Agent Learning Model for Service Composition (TALMSC) in mobile cloud computing environments. We design a novel trust management model based on fuzzy comprehensive evaluation method and propose a trust-enabled service composition model. In order to obtain customers' service preferences and accelerate service classification, we equip service brokers with a learning module based on a two-stage improved Fuzzy C Means (FCM) learning mechanism which can also improve the transaction success rate and user satisfaction.

To make TALMSC more efficient, satisfactory and reliable, in the construction of our approach, the following key questions are addressed: What is the most suitable framework for the multi-agent based mobile cloud scheduling model? How can agents interact with each other? Since trust is fuzzy and context-aware, what is an efficient and integrated trust management model? What is the suitable learning algorithm to learn customers' service preferences? In contrast to the existing research works, this paper mainly focuses on the impact of the external mechanisms on the service scheduling process.

The main contributions of the paper are as follows: (1) the design of a multi-agent based cloud service scheduling model under trust mechanism. (2)a proposed novel trust management model based on fuzzy comprehensive evaluation method. (3) the design of a two-stage improved FCM method based learning algorithm to obtain user service preferences. Furthermore, we carry out a couple of experiments to test and evaluate the influence of trust and learning methods on the mobile cloud markets. The rest of the paper is organized as follows. Section 2 briefly introduces the related work. Section 3 introduces system architecture along with the design details. A fuzzy comprehensive evaluation based trust model is proposed in Section 4. Section 5 donates a two-stage improved FCM learning mechanism in scheduling. And performance evaluation is presented in Section 6. The last section concludes the paper along with future work.

II. EXISTING SYSTEM

- Dou et al. [13] proposed a resource co-allocation method for the efficient and load balance scheduling. Basu et al. [14] designed a cognitive model of bio-inspired approach to find the optimal solution of task scheduling of IoT applications. Damián et al. [15] proposed energy-efficiency strategies for task scheduling under several security constraints. Tian et al. [16] developed a method to find the optimal solution to minimize the energy consumption in job migrations. Alkhanak and Lee [17] proposed a completion time driven hyper-heuristic approach for cost optimization of cloud scheduling. Ren and Zhong [18] established a mathematical model of cloud task scheduling and proposed an improved simulated annealing algorithm to shorten the completion time of tasks under a given user satisfaction. Lin et al. [19] introduced a cost-driven strategy for the deadline-constrained workflow

scheduling. Keshanchi et al. [20] proposed an improved genetic based cloud task scheduling algorithm and designed a series of approaches to analyze the correctness and efficient of their strategy. Liu et al. [21] designed an adaptive penalty function to accelerate the convergence and prevent the prematurity of GA based constrained scientific workflow scheduling algorithms in cloud computing environments.

- Deng et al. [22]_[25] proposed novel service selection and scheduling methods, which could effectively get the optimal composition in terms of minimized energy consumption, lower running risks and optimal QoS, respectively. Furthermore, in order to provide high quality of service (QoS) for service provisioning system, Deng et al. [26] proposed a novel service cache scheduling method which efficiently takes advantage of the composability of services and indeed significantly improves the performance of service provision systems for real applications.
- Li and Gui [27] proposed a dynamic trust model to accurately quantify and predict user's cognitive behavior. In 2015, they presented a trust aware service brokering scheme named T-broker for the efficient service matching in cloud [28]. Tan and Wang [29] proposed a combination-weighted approach based on relative entropy to evaluate user behavior. Some researchers put forward evolutionary algorithms combined trust mechanisms [30], [31]. Wang et al. [32] proposed the trust assessment method based on the cloud model. Xie et al. [33] designed the double excitation and deception detection based trust model. Ahmadi and Allan [34] proposed a trust-based decision making model for multi-agent societies. Sule and Li [35] and AbdAllah et al. [36] presented the mechanisms of trust evaluation methods for the cloud-based applications. Wang et al. [37] introduced a trust-based probabilistic recommendation model for social networks. To meet the trust requirements of multi-cloud communities, Wahab et al. [38] proposed a three-fold solution including trust establishment, the bootstrapping of trust and trust-based hedonic coalitional game. Deng et al. [39] innovatively proposed a two-phase recommendation process to effectively utilize deep learning in initialization and to efficiently synthesize the users' interests with their trusted friends' interests together, which remarkably improved the recommendation accuracy and effectiveness.

Disadvantages

- In the existing work, the system is less effective due to absent of Trust Model Based on Fuzzy Comprehensive Evaluation Method.
- The system has trust enabled learning agent model.

III. PROPOSED SYSTEM

- The system proposes a Trust-based Agent Learning Model for Service Composition (TALMSC) in mobile cloud computing environments. We design a novel trust management model based on fuzzy comprehensive evaluation method and propose a trust-enabled service composition model. In order to obtain customers' service preferences and accelerate service classification, we equip service brokers

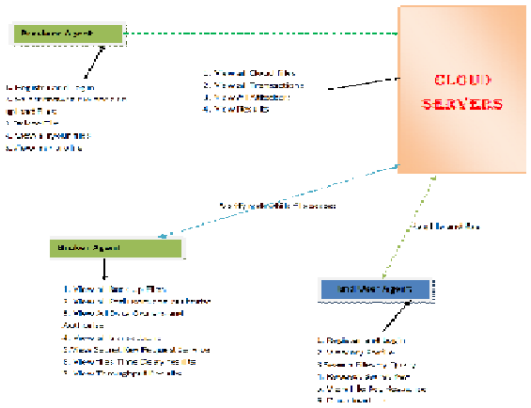
with a learning module based on a two-stage improved Fuzzy C-Means (FCM) learning mechanism which can also improve the transaction success rate and user satisfaction.

- The proposed system also aiming at better reflecting the autonomy and collaboration of cloud entities, some other scholars prefer the agent-based cloud systems. Gutierrez-Garcia and Sim [8] proposed fourteen scheduling heuristics for concurrently executing the bag of tasks in Cloud environments and also an elastic cloud resource allocation mechanism. They designed an agent-based Cloud BoT execution tool named Cloud Agent to support concurrently BoTs execution in multiple Clouds [9]. As for the composition of cloud services, they proposed an agent-based approach to compose services in multi-Cloud environments for different types of Cloud services.

Advantages

- An effective design of a multi-agent based cloud service scheduling model under trust mechanism.
- The system gives a proposed novel trust management model based on fuzzy comprehensive evaluation method.
- The design of a two-stage improved FCM method based learning algorithm to obtain user service preferences.

IV. ARCHITECTURE DIAGRAM



V. IMPLEMENTATION

- Provider Agent

  In this module, the provider agent uploads their data in the cloud server. For the security purpose the provider agent encrypts the file and then store in the cloud. The provider agent can have capable of updating and deleting of a specific file. And also he can view the transactions based on the files he uploaded to cloud.

- End User Agent

  In this module, receivers logs in by using his/her user name and password. After Login receiver will Search for files and request for secret key of a particular file from broker agent Server, and get the secret key from cloud for downloading files. After getting secret key he is trying to download file by entering file name and secret key from cloud server.

- Broker Agent

  In this module, the Broker Agent helps to check transaction of files and also. It also performs the following operations

such as View all Back Up Files, View all End users and authorize, View All Data Owners and Authorize, View all transactions, View files Time Delay results, View Throughput Results, View all Secret Key results.

- Cloud Server
  The cloud service provider manages a cloud to provide data storage service. Data owners encrypt their data files and store them in the cloud for sharing with Remote User. To access the shared data files, data consumers download encrypted data files of their interest from the cloud and then decrypt them and performs the following operations View all Cloud Files ,View all Transactions, View All Attackers, View Results.

VI. CONCLUSIONS

This paper proposed a novel trust-enabled service composition model (TALMSC) for mobile cloud environments. TALMSC is a three-tier mobile cloud market model which includes the mobile cloud users (customers), the service providers, and the service intermediator (broker). Brokers are the key entities who manage the providers and help the users to find the most suitable providers/resources. In order to improve the efficiency, reliability and satisfaction of service scheduling, trust and learning mechanisms are introduced in the service matching process.

A novel integrated trust model based on FCE method is proposed. The new trust mechanism is comprehensive, context-aware, and able to combine the direct trust with the recommendation trust. In addition, a two-stage improved FCM algorithm is designed to improve the learning ability of brokers. We tested the efficiency of the trust mechanism on Net Logo and based on JADE, we developed a multi-agent based service composition system by which the performances of four related methods (the two-stage improved FCM, the FCM, the K-Means and the random transaction) were evaluated. The simulation results prove that learning ability is a very important factor in improving user satisfaction when the providers are not clear about their customers' service preferences and the improved FCM learning method is efficient. As part of the future work, we plan to explore the following issues: 1) how can trust integrate well with the other modules like service matching, learning, forecasting, etc. 2) with the learning ability, brokers are easily to obtain users' service preferences and adjust their market strategies which will speed up the market differentiation. Thus, how the brokers will classify or differentiate, as well as how the cloud market
evolves.

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