Autonomous Rating Oriented Agent Allocation to Achieve High Response in Demand-Oriented Information Service System

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Abstract

The efficient and reliable information service provision and utilization is an important infrastructure in the high-assurance information service system. In this paper, we introduce a rating oriented distributed information system sustained by push/pull mobile agents to cope with providers’ and users’ heterogeneous requirements. Based on this environment, autonomous information provision technology is proposed. However, when users’ demand changes, congestion might arise in the system. In order to achieve load balancing for users’ timeliness access and guarantee that users can always get the information from a certain pathway, autonomous information reallocation technology is proposed.

1 Introduction

The demand of information services is increasing at an explosive rate. Under this background, electronic commerce is developed in great speed and the new potential opportunities and challenges are emerging in the near future.

One of the major topics in the information service system is how to guarantee the quality of service in the evolving environment. Due to the emergence of e-commerce, information services have become mission critical. There are different concerns in quality of service, such as timeliness, reliability, and fault tolerance.

In addition to, we identify that users have two more basic views of customization and situation regarding information services utilization. But these do not exist in the current information service systems. Thus fosters an urgent need for the design of high-assurance model for information service systems on the Internet.

In this paper, a new system architecture called Rating Oriented Distributed Information System (RODIS) was introduced, which sustained by push/pull mobile agents, to meet the heterogeneous requirements of service providers (SP) and users simultaneously. As a distributed information service system, the most important problem is how to propagate information from SP to the nodes and how to satisfy the users who would like to access their required information allocated in the system. Consequently, when users’ preference changes, the congestion might arise on some nodes because of the convergence of users’ changed access. Therefore, the autonomous allocation and reallocation technologies was proposed based on the current situation of the locality to achieve load balancing and eliminate contradiction in rapidly evolving situations.

2 Rating Oriented Distributed Information System

The main goal of the RODIS is to guarantee the assurance of information services provision and utilization. This architecture is based on the rating oriented replication of the information services to warrant services availability and responsiveness.
With due regard to the characteristics of the rating of the users’ access, popular information is allocated near the users and more replicas are created in the system. As a result, the multi-level distributed information services area is created. Users with different requirements for information can be satisfied at different levels in the RODIS. Consequently, the cost of service utilization (access time) and provision (update) are balanced by allocating closer to the majority of the users the most accessed part of the information services.

In the RODIS model, we propose Push Mobile Agents (Push-MAs) for distributing information and Pull Mobile Agents (Pull-MAs) for searching information on the network. A reliable mobile agent platform is available on each node, providing an execution and routing environment for mobile agents. Information provision and access in the RODIS is based on the content code communication.

3 Autonomous Information Allocation and Reallocation Technologies

The information allocation process is regulated by the number of Pull-MAs circulating inside the system. No one node has the view of the overall structure, so the notion of locality congestion is applied. Locality of a node \( N \) is defined as the set of all upper nodes having link with the node \( N \), and including node \( N \) itself. At certain node \( N \), between two Push-MAs updates, through rate, \( r(t_1, N) \) is defined as the ratio of the number of outgoing Pull-MAs proceeding to higher levels \( N_u(t_1, N) \) compared to the total number of incoming Pull-MAs at node \( N \) \( N_l(t_1, N) \).

Each node measures the degree of the congestion based on the load of its locality in coordination with Push-MAs, and can asynchronously contribute to balance the load in the system by regulating number of Pull-MAs toward upper nodes. Through rate \( r(t_1, N) \) is defined as the relative number of Pull-MAs that must proceed to upper nodes in the locality of a node \( N \) to achieve load balancing is called reference through rate \( rr(t_1, N) \). A node can determine reference through rate based on the congestion in the locality. The degree of congestion of a node \( N \) depends upon node utilization \( ρ(t_1, N) \), the proportion of the time a node remains busy for processing the requests.

Consequently, reference through rate gives a relative measure of the number of Pull-MAs that are required to proceed to upper nodes to equalize the load on each node in the locality. The node agent compares through rate with reference through rate, and adjusts information amount autonomously.

Each node monitors the total number of accessed Pull-MAs and satisfied Pull-MAs and sends this up as a feedback in the locality after a certain timeout. The upper node analyzes the feedbacks to detect whether the rating changed between the contents stored on the adjacent layers. Based on this detection, node makes a decision on whether to trigger the information exchanging process or not.

\[
γ = \frac{N_{satisfied}}{\sum N_{lower_satisfied}}
\]

if \((γ > 1)\) then trigger exchange

After the node in upper layer decides whether to and what to exchange, it generates a regional exchanging Push-MA bringing the to-be-exchanged data to its lower node(s). Node in lower layer then processes the Push-MA, stores the brought data and generates another Push-MA in return bringing the exchanged data and sends up. Finally, the upper-layered node receives the returned Push-MA and so that data exchanging transaction is finished.

However, users preference changes asymmetrically. The autonomous action, which is taken by each node, results in inconsistency of information among nodes in the same layer. This brings difficulties for the next information exchanging and proposed mechanism only deal with feedback on homogeneous contents. In order to guarantee that the Pull-MA can always get the required information on a certain path, the mechanism to maintain the consistency in information reallocation process is proposed.

Information in current node: \( CH_{local} \)
Information in lower nodes: \( CH_1, ..., CH_n \)
\[
N_{lower–CH_k} = \sum N_{lower_satisfied}
\]
\[
N_{lower–CH_k} = \text{Min}(N_{lower–CH_1}, ..., N_{lower–CH_n})
\]
Information-exchange\((CH_k, CH_{local})\)

4 Conclusion

Based on the analysis of rating of users access, Rating Oriented Distributed Information System is introduced. Under this environment, autonomous information allocation and reallocation technologies are proposed to assure timely information provision and utilization. By this means, the system is hence adaptive to the constantly changing users preference while assuring a Pull-MA can always be navigated to some node where it can get the required information.