AN AUTOMATIC FAILURE RECOVERY METHOD
FOR WORLD-ALTERING
COMPOSITE SEMANTIC WEB SERVICES

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Abstract

The reliability of services is a critical factor in ensuring positive customer perception on overall quality. To perform complex actions, it is necessary to combine smaller services to generate a synergy of services. However, a composite Web service will not fulfill a user's goal, unless the composite services can be recovered should there be a failure. It is inevitable that several Web services may either perish or fail before and during the execution. One of the responsibilities of the mediator, which stands between providers and the consumers, is to monitor the execution of the services. In case of a failure, the composite service needs to be adapted so that the system survives.

The challenging issues of the recovery of composite services are its probability, the accuracy of the resulting composite service, and the Quality of Service (QoS) deviation from the original. Traditionally, service-based systems often substitute a matching service for the failed service. The accuracy of a matching can be enhanced by employing semantics. Semantic annotations of Web services describe the services' functionality unambiguously. However, finding a matching service is not always successful. There are some approaches, which replace a sequence of services, including the failed service with another set of services to comply with the required task. Their experiments show improvements to the recovery of the unsuccessful composite services. Nevertheless, these methods have not totally rectified the problem.

In the proposed solution, called SRPFR, an automatic renovation plan is utilized to improve the likelihood of impeding the system from a total failure. The method first considers a subgraph of services (including the failed service) in a digraph of Web services, i.e. the Original Subdigraph. The subdigraph may begin not only from the failed service but also preceding the well-executed services. Then, the method searches for a compatible subdigraph (Replacement Subdigraph) to be placed in lieu of the Original Subdigraph. Broadening the beginning point of the search for the Original Subdigraph increases the probability of discovering a matched replacement. The Original Subdigraph may contain world-altering services with real-world effects, which must be compensated before the replacement. The recovery is divided into two phases, offline and online, to reduce the delay of the replacement at the onset of failure. The time-consuming calculations are done in the offline phase, and the replacement is done in the online phase. This prevents any increment of the response time of the composite service, even though a failure may occur.

The proposed approach is evaluated with synthetic test collections of composite semantic services using the atomic services and their related ontologies of a standard atomic service test collection called OWLS-TC. The simulation results show a recovery probability of more than 55\% for a more realistic collection of services. In addition, the actual replacement delay is maintained at a minimum constant value regardless of the size of the test collection. From the QoS deviation aspect, the method can adapt the composite service without a major change in the prioritized QoS properties.