CHAPTER 7

CONCLUSIONS AND SCOPE FOR FUTURE WORK

7.1 SUMMARY OF FINDINGS

Research in the phases of cloud computing has become important, imperative and challenging with the increasing development of various cloud services. The effective discovery of cloud services, identification of service trust and the recommendation of appropriate services are the major issues in the cloud computing arena. This challenge has attracted many researchers to adopt novel techniques in the broker-based cloud service discovery.

The first part of this research work discovered the infrastructure type of cloud services from the providers. However, the incorrect service details and uncertainties in the service specification leads to delay the service discovery process. Few of the works have addressed the issues and tried to improve the service discovery process. In order to overcome those issues, a broker based cloud framework with a new way of specifying the service requirements is proposed. To tackle the problem of incorrect submission of service details, the work proposes an intelligent cloud broker with a constructive end-user portal for getting the service requirements very precisely in terms of numerical values. In order to solve the issue of uncertainty in service representation, a cloud ontology is constructed to represent the knowledge. With the ontology, the appropriate services are denoted using a knowledge representation technique called ‘semantic network’ to represent semantic relations among concepts. As part of this
work, a simulation in a C# .NET is designed and developed to demonstrate the broker functionalities with respect to the cloud users’ requirements. Further, the cloud broker recommended a set of infrastructure services with add-on features as per the expected budgetary constraints.

In the second part of the research work, the problem with respect to the uncertainty of service specification during the requirements phase is addressed. Instead of remembering the numerical terms of the infrastructure services, the linguistic representation is preferred in this work to educate the in-experienced cloud user. With fuzzy logic principles, the proposed broker identified the exact requirement of the user by their linguistic representations. By acting as an intermediator between the provider and consumer, the proposed broker finds out the appropriate services through the fuzzification and de-fuzzification techniques. Then, performs service aggregation through Sugeno integral. With the incorporation of fuzzy decision tree, the final decision has been made for the right selection of services in a ranked order.

The third part of the work concentrated on the evaluation of trust level by pre-processing the user’s feedback. With the advent of cloud computing, different kinds of services are availed through the internet. Though the services are availed, it is very hard to acquire the quality services. Nowadays, there are many kinds of QoS evaluation methods exist to ensure the trustworthiness of the services. As an alternate, this work focussed the consideration of cloud user’s feedback for the prediction of trust value. Due to the increase in more number of services and feedbacks, it is hard to reap meaningful trust level of services. Hence, a solution is proposed to incorporate a big data processing framework with MapReduce framework to pre-process the cloud user’s feedback with respect to the quality of service factors such as availability, reliability, portability, scalability and privacy.
Moreover, the broker used the fuzzy logic principles to arrive a decision about the final trust value of the services.

Finally, the work presented a recommendation of services to the cloud user. By considering the issues in the previous parts, this work removed the barrier in the phases of cloud lifecycle such as service discovery, selection, trust level prediction and recommendation. After understanding the difficulties of the existing research with respect to the finding of service similarity methods (PCC, COSINE), the recommendation methods based on collaborative filtering and the QoS prediction through matrix factorization approach, a new technique is proposed for cloud service recommendation. Before recommending the services, the contextual information are retrieved for the proper selection of services and then Matrix factorization is accounted for the prediction of missing QoS values. Hence, the broker performed the better recommendation of services as per the cloud user’s requirements. In this work, a real benchmark dataset (WS-DREAM) is considered to evaluate the proposed algorithm with the well-known metrics MAE and RMSE.

All the proposed techniques have been evaluated using several experimental studies. The results show that these techniques are effective, efficient and promising.

7.2 PRACTICAL APPLICABILITY OF RESEARCH

The impact of academic research would be greatly realized only when the developed ideas and techniques can successfully transform the societal development for further progressive shift. The novel ideas and identified techniques put forth in a research proposal should augment the practical applicability into a finer extent. This section approaches the potential practicable applicability of the techniques discussed in the research proposal.
Designing an intelligent healthcare cloud broker for the prediction and analysis of diseases by analysing the multiple sources of healthcare big data on the basis of MapReduce based Fuzzy Inference System would be one such practical application. Recently, the domain of healthcare witnesses the increasing volume of data sources in heterogeneous formats. Hence careful analysis of participatory data sources would facilitate the identification and prevention of diseases in the inception stage itself. Accordingly, an intelligent healthcare cloud broker can be constituted with the hybrid feature of Hadoop based MapReduce programming model and fuzzy logic principles. The broker would perform the pre-processing of multi-sourced healthcare big data in a Hadoop based distributed file systems with the inclusion of MapReduce programming model. The mapper and reducers would process the data sources and can generate disease symptoms in terms of key-value pairs. Incorporation Fuzzy inference system (FIS) further processes the generated key-value pairs (patient’s information) towards predicting the disease details. Further, fuzzy decision-making process can be carried out by considering the output of FIS. At the end, prediction and type of disease would be resulted by the cloud broker.

7.3 SCOPE FOR FUTURE WORK

There are still several challenges exist in cloud service lifecycle and recommendation of trusted services. Some of the scope for the future research with the cloud broker is listed below:

Adding intelligence to the cloud broker: By incorporating the dynamic intelligence feature into the cloud broker for improving the service discovery and provisioning process.

Service discovery using personalization techniques: Prediction of user interest with respect to their needs are now possible through their surfing style
in the internet. By recording the user activity, it becomes possible to predict the needed services for any kind of user.

**Secure trust based solutions for cloud service:** Sharing of trust information and its security is very urgently needed in the cloud computing paradigm. Sharing of service trust among the cloud users’ needs to be monitored before the services are to be accessed.

**More focus towards user and service based context:** By combining the user and service context for the prediction of service with budgetary constraints is to be focussed in near future. The context of user side includes consideration of user location, financial status, knowledge level, category (student, researcher, public, scientist, politician, etc.). Similarly, by analysing the service context towards the effective matching of service requester is also indeed.

**Optimization of service utilization:** Through the effective utilization of services, the optimization is achieved. In addition to improve the service utilization, appropriate optimization techniques are to be performed in the cloud user side also.

**Dynamic prediction of QoS values for the services:** In the current scenario, the QoS values are predicted by static only. The prediction of service trust with respect to the demanded time can improve the prediction process. Hence, it is highly expected to perform the service QoS prediction during the runtime itself.

Thus, there is a good scope for research in the development of cloud broker for effective utilization of cloud services.