Optimal Web Service Selection with Recommendation and Pre-allocation

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Abstract— QoS plays an important role in Web service recommendation, according to which similar services can be ranked and selected for users. The number of publicly available web services, is steadily increasing on the internet. However, this proliferation makes it hard for a user to select a proper web service among a large amount of service candidates which provide similar functionalities. Quality of service is considered as the most important non-functional criterion for service selection. This research provides comprehensive information for selecting an optimal web service by providing recommendation and predicting its behavior in terms of response time. When user wish to use any service the system can provide recommendations, but only recommendation is not sufficient to improve QoS of the web service so that scheduling is applied on the user requests to optimize the performance and reduce the response time and for more precise response time service provider allocate a service to a user before his request that is called pre-allocation. The system also provides a standard way to measure and predict web service behavior in terms of response time sing HMM (Hidden Marcove Model).
Keywords: Response Time, Recommendation, Pre-Allocation, Service Scheduling, HMM

I. Introduction

System Oriented Architecture (SOA) is an architectural style for building enterprise solutions based on services. SOA is concerned with the independent construction of business-aligned services that can be combined into meaningful, higher-level business processes and solutions within the context of the enterprise [9]. SOA define Web services and related components and the IT infrastructure that allows applications to be composed from services written in different languages and running on different platforms.

"Web Service is a distributed application designed to support interoperable Machine to Machine interaction over internet." A Web Service publishes information on the Internet or an intranet. Like a web page, a Web Service is accessed through a Uniform Resource Locator (URL). Web service are based on open protocols and standards such as SOAP,WSDL, WS-BPEL, WS-Choreography, WS-Transaction, WS-Security, WS-Addressing, and many more developed by standardization organizations such as W3C and OASIS. Web service can be publish, discover and bind. Web Service registry is a logically centralized directory of services. A Web service provider needs to create a Web service and then publishes the Web service information on the Web service registry. Web service client uses the Web service registry to find out the Web service information. Finally, the Web service client invokes the Web service available at the Web service provider.

In this Internet world web service is getting more and more popular technology today. Due to this popularity many web services are developed with similar functionality. When user searches service into UDDI directory, directory retrieve several web service with similar functionality. The problem become more complicated when discovery process return several web service with similar functionality. User has no way to select suitable web service. In this situation quality of web service is consider as secondary approach for service selection. Furthermore Service provider required high quality service for service composition because one service with low quality can affect quality of overall web service. So, web service recommendation with non-functional quality become very important.

Web services have made tremendous impact in the world of information technology and would make more in the years ahead, so that selection and recommendation of web service are becoming more important. Optimality of web service is depending on the performance of web service. Quality-of-Service (QoS) is widely employed to represent the non-functional performance of web services and has been considered as the key factor in service selection. Users usually get a list of web services from service brokers or search engines that meet the specific functional requirements. They need to identify the optimal one from the functionally equivalent candidates. Therefore it is difficult to select the best performing one, since service users usually have limited knowledge of their performance. The difficulty is selection of optimal web service.

The proposed system gives a novel approach for recommending the selective web service by giving low response time and high QoS, with the help of scheduling, pattern mining, pre-allocation and HMM (Hidden Markov Model).

Firstly pattern mining is applied on a dataset of user logs. From this step patterns are found then scheduling with S-T map and load balancing is applied on these logs and resulted file is compared with result of HMM and then final recommendation is given to the user and recommended service is pre-allocated. To receive effective recommendations, users are required to supply their observed QoS values. Therefore the research proposes a simple yet effective privacy-preserving framework by applying data obfuscation techniques and anonymity.

II. Motivation

A QoS might be as useless as a service not providing the desired efficient results. It is impractical for every user to measure QoS performance of all the web service as there is large number of web services available.

A web service is a software system designed to support interoperable machine-to-machine interaction over a network. The number of publicly available web services is steadily increasing on the internet.

However, this proliferation makes it hard for a user to select a proper web service among a large amount of service candidates which provide similar functionalities. Quality of service is considered as the most important non-functional criterion for service selection. For internet

services, the presence of low-performance servers, high latency or overall poor service quality can translate into lost sales, user frustration, and customers lost. This research provides comprehensive information for selecting an optimal web service and predicting it's behaviour in terms of RT. When user wish to use any service the system can provide recommendations, but only recommendation is not sufficient to improve QoS of the web service so that scheduling is applied on the user requests to optimize the performance and reduce the response time and for more precise response time service provider allocate a service to a user before his request that is called pre-allocation. Overall aim of the research is to get well optimized web service which having great quality of service with very low response time.

III. LITERATURE REVIEW

Waseem Ahmed propose a probabilistic model for predicting response time of web service and then selected an optimal web service at runtime from the list of functionally equivalent web services. To know the probabilistic insight of Web Services he had used Hidden Markove Model. Model assumed that WS is deployed on a cluster of web servers and sometime the delay or crash during WS invocation is because the bad node in sever clustering responds to users' requests. With the help of HMM, he predicted the probabilistic behavior of these web servers and then selected the WS based on their probabilistic value [2]. According Tao has an efficient algorithm for selecting appropriate web services based on user's provided weights. They have mapped web service composition with the Knapsack problem and then calculated the optimal path for executing user's requests [3]. Zibin Zheng, make the first attempt to cope with the privacy concerns for web service recommendation. Specifically, he proposes a simple yet effective privacy-preserving framework by applying data obfuscation techniques, and further develops two representative privacy-preserving QoS prediction approaches under this framework [4]. Rina Malik focuses on response time out of different QoS properties. In this approach the requests send by the user are scheduled on the basis of Earliest Deadline First. Then by combining the advantages of network coordinate based approach, simple regression, clustering approach and WSP approach, the response time between user and web services can be accurately predicted[5]. Priyanka D.Doltade doing the analysis of web usage of users based on the location, age along with other parameters which helps in improving the quality of web services in terms of providing faster web browsing to clients and based on their frequent usage of a particular website, ISP will provide buffering to those particular websites only [6]. Nikita R.Gurjar presents an innovative QoS-aware Web service recommendation approach .The basic idea is to predict Web services QoS values and recommends the best one for active users based on historical Web service QoS records. In order to better recommend Web services to users from amount of services with identical functions, he proposed a Web service recommendation approach based on collaborative filtering. In this paper, recommendation approach considered the correlation between QoS records and users physical locations by using IP addresses, which has achieved good prediction performance and makes the QoS prediction more confident for web service recommendation [7].

IV. CHALLENGES IDENTIFIED

1) With the emergent number of Web services, it has become an urgent task to make operative selection from the large number of functionally-equivalent Web service candidates. There are number of different service provider and we have to effectively select the optimal one from web service candidates. In our approach the requests send by the user are scheduled on the basis of user and service priority scheduling.
2) It is impractical for each user to actively measure the QoS values due to the expensive overhead of invoking large number of service so that, to get more effective QoS and minimizing the response time recommendation and pre- allocation is used.
3) Collecting user's data for mining puts user privacy at risk; as a result privacy becomes challenge in developing a recommender system. So that privacy preserving is performed.
4) By combining the advantages of pattern mining, scheduling and the HMM model the overall response time required for the allocation of services is minimized.

V. PROBLEM STATEMENTS

"To develop a system for selecting the web service having low response time and assuring good quality of service."

1) In proposed system user priority and service scheduling is performed for selecting better service from available services. Privacy preserving is also provided for the user security purpose.
2) Pattern mining gives the recommendation and pre-allocation. In recommendation by observing the user behaviour next service is recommended as a suggestion, and the service is also already allocated so that response time will decreases.
3) Service provider contains web server cluster for load balancing and HMM model is used for giving probabilistic method of response time of services.

VI. OBJECTIVES

The proposed work has following objectives,

1) Implement the system which gives user priority based scheduling
2) Implement service scheduling based on time and load balancing
3) Design and implement the system which gives recommendation and pre-allocation to users.
4) Implement a service provider which gives methodology for providing lowest response time to user.

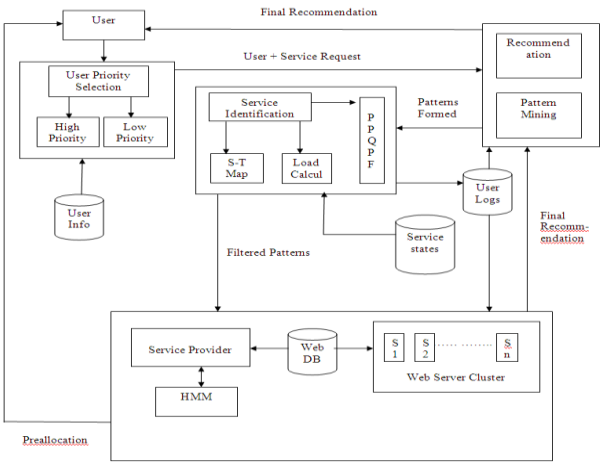

Fig. 1: Architecture of Service Request Scheduling based Web Service Selection

Proposed work is based on selecting the optimal web service which is having improved quality of service. For implementing proposed work the system architecture is defined here which is having four different techniques that are used, first the user request is send to user priority identification module where scheduling is applied according to user authority and priority, after that logs are stored for applying pattern mining and patterns are formed. Then these patterns are given to service identification module, time and load scheduling is used for selecting better service out of all available. After that service provider apply HMM on web services and give the optimized response time based web service with its future hidden states prediction. By comparing the patterns and HMM results recommendation is send to user, at the same time pre-allocation of services is given Whenever user wish to use the service his/her privacy issue arises so that privacy preserving is also performed by Privacy Preserving Quality of Service Prediction framework.

Module 1: User Priority Scheduling

User priority selection module make user request queue to process each user and provide priority to each user request based on user information. All user requests are stored into queue. Requests are assigned into different priority queues, these queues are served according to their priority from the highest to the lowest. High priority user treats as administrator users and provides fast response for their request. For low priority users response will base on the requested service. For this approach scheduling is used and scheduling is implemented with the help of user priority scheduling algorithm.

Module 2: Pattern mining

This model gives the recommendation and pre-allocation of services to user. Nowadays weblog usage is tremendously increased. There is need of storing the log for further requirements and analysis. Web usage log store the activities of user from web sites. These activities can collect from web server or web browser. The user logs are stored into user log database, after that applying collaborative filtering and aprori algorithm, patterns is formed to predict the user behavior.

When user requests a service then this module performs pattern mining on user's current request and their logs taken from dataset. Here patterns are formed according to per user past usage behavior. Initial mining is completed with apriori algorithm and resulted patterns are sent to Service Identification Module.

Module3: Service Request Scheduling

In this approach service requests are scheduled according to time and load balancing algorithm. User service request response time is identified with the help of service identification module. This module keeps record of approximate execution time for each service. These records are arranged in format of Service- to-Time map given below in figure 2. With the help of this map, service scheduling is conducted by selecting first executing service with shortest response time. For service to map scheduling following steps are performed in algorithm 1.

Patterns taken from pattern mining module are compared here, and by considering the process time of a service from service to time map patterns are filtered that having minimum processing time.

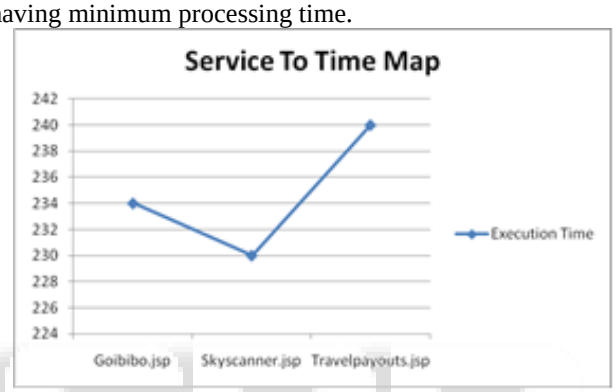

Fig. 2: Service to Time Map

Algorithm 1:
Input: r_que;user request que L_T map: Table
Output: scheduled r_que
step1: set scheduled_r_que=Ø
index=0;
step2: map=load L-T map
step3: map= sort(map) //based on time
step4: for each req from r_que
process step 5 to 9
step5: if(index==0)
scheduled_r_que[index]=req
else
for each s_r from schedule_r_que
step6: perform step 7 to 8
step 7: t1=map.time(s_r)
t2=map.time(req)
step8: if(tq>t2)
{
shift s_r to right
locate req at s_r position
index++;
go to step 4
}
step9: else continue step6
step10: return scheduled_r_que

In similar way service identification module keep records of current execution load on each service per time unit, and update these records periodically as shown in figure 3. These load records are based on service state database operated by web service provider. Same like service to time map load calculation gives record of load per

unit time and comparing this with patterns resulted from service to time map scheduling again pattern filtration is performed and small set of pattern is found.

These resulted patterns are further given to HMM model for next process. This load calculation is also performed with steps same as service to map scheduling process.

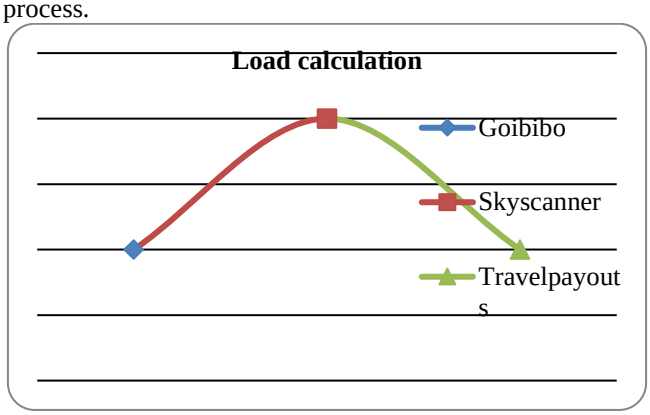

Fig. 3: Load Calcution

Here user privacy is also secured with the help of Privacy Preserving Quality of Service Prediction framework (PPQPF) by data obfuscation and anonymity method.

Anonymity detection method is used for securing the dataset from outsource threats. There are different level are given. It is decided by choice that, how many levels you wish to hide the data that is data obfuscation.

The following figure 4 shows the resulted.txt file by privacy preserving module.

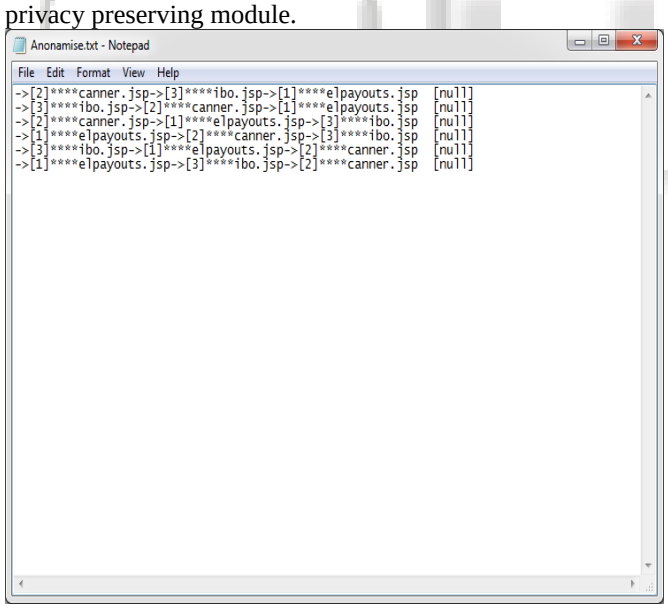

Fig. 4: Snapshot of Privacy Preserving Quality of

Module 4: Service provider

In this approach user request is actually processed with HMM. It composed of different servers, providing list of services to users, including web database and web server cluster. It provides direct response to user for his/her request. It also contains HMM as probabilistic methodology for response time predication. At the time of execution of a process it updates status of each service according to load on that service. These updates are managed in service states database which further will used by service identification module to perform scheduling task. Here for finding hidden states and hidden path the optimal web service selection algorithm 2 is used.

Algorithm 2:
Input: DIRECTED_GRAPH
//V = set of hidden states group by web services and E represent edges from each Hidden State group by observation symbol i.e. (Good/ Normal/ Bad)
Output: OPTMAL_PATH
Step 1: for each v_s in V
Step 2: for each v_{hs} in V_s
Step 3: for each e (starts, v_{hs}) in E
Step 4: CALCULATE_MIN
Step 5: CREATE_PATH P_i
Step 6: If ($v_{hs,}$ End) true
Step 7: FINE_MIN_PATH P_i
Step 8: ADD MIN_PATH P_i to Graph G
Step 9: Else
Step 10: Initialize_Parameter
Step 11: For each P_i in Graph G
Step 12: For each P_i in $Group_i$
Step 13: Sum_Q_oS
Step 14: FIND_MIN_PATH
Step 15: OP=Build_OPTIMAL_PATH
Step 16: IF (P_i in Graph G ends) true:
Step 17: Return OP;

Algorithm 2 indicates that application at client side exploits HMM parameters for each WS to build a directed graph among hidden states. Later, it returns the optimal path by calculating MIN of QoS values i.e. response time. Finally, system uses this optimal path to execute user's requests efficiently and reliably. This probabilistic result is compared with the patterns resulted from service identification module and final recommendation is given to the user as service selection. And the recommended service is also pre-allocated to the user. This pre-allocation is base on future prediction of the recommended result selection probability. Due to the pre allocation response time required to the service is decreased and performance is increased hence the quality of service is also improved.

VII. RESULTS

The figure 5 gives the final result given to user which shows differentiation in response time before pre-allocation and after pre allocation of the recommended service to the user. Here we considered different number of web service pages for observing the response time. As there is limited number of services available hence combinations of web service pages are used for more accuracy. The graph shows web service response time before and after pre-allocation with respect to web service pages.

Fig. 5: Requested service's response time before and after pre-allocation.

A. Service Response Time Before Pre-allocation:

After recommendation the recommended service is shown on the current service which is in use by the user. If he/she selects the recommended service then he will get faster response rather than going by the process that is, go to service selection and then select that service, because pre-allocation is provided. So that the recommended service is already allocated for the user and response time for service allocation is decreases. This shows the response time required for service before pre-allocation.

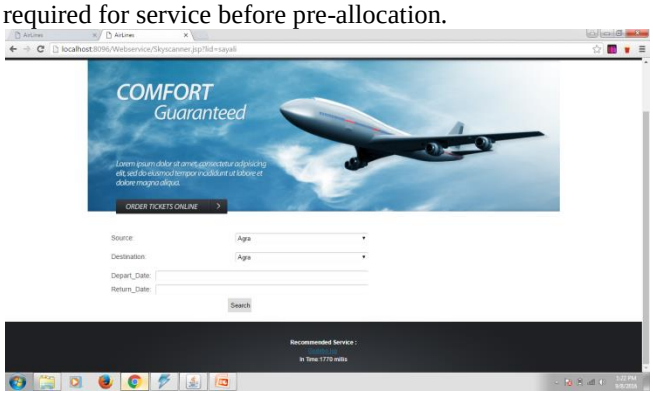

Fig. 6: Snapshot of service response time before pre-allocation

B. Response Time After Pre-allocation:

This shows the response time required for service after pre-allocation. Due to pre-allocation of the service user get a service in minimum time.

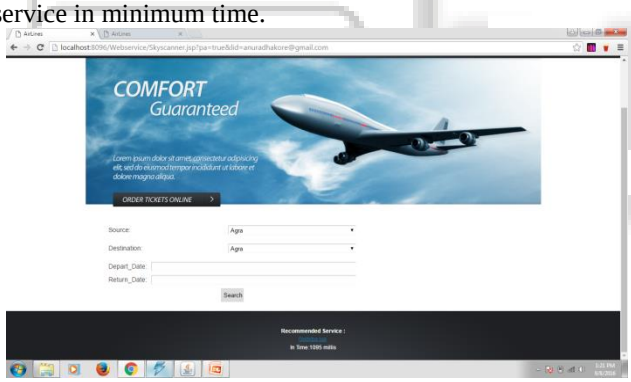

Fig. 7: Snapshot of service response time after pre-allocation

VIII. CONCLUSIONS

A QoS might be as useless as a service not providing the desired efficient results. QoS plays an important role in Web service recommendation, according to which similar services can be ranked and selected for users. User gets optimal web service for his request. This web service selection interface is developing newly in proposed system. That is selection of services is done with the help of Recommendation and pre-allocation. To improve the performance of recommendation, scheduling, pattern mining, probabilistic model for response time i.e.: HMM is used. Here patterns are filtered with different techniques and these are compared with HMM so that recommendation result will be increased. So the performance of web service selection with recommendation is optimized with assuring good quality of service.

IX. FUTURE SCOPE

In our future work, besides response time, throughput and more QoS properties will be investigated. And the work should be carried out on real time web services we can implement proxy cache server and cluster based recommendation.

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