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ISSN 1812-5638

# INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 12 (24): 8412-8417, 2013
ISSN 1812-5638 / DOI: 10.3923/itj.2013.8412.8417
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# A Study of Selection Strategy in Web Service

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**Abstract:** The stusy proposed a sort of selection strategy in Web service based on the fusion of QoS and reliability aiming at the Web function being too similar to quickly filter out Web services. The study made the analysis on the limitations of the current selection mechanism and evaluated the Web service selection from two aspects in subjectivity and objectivity and constructed the model of Web service selection based on the model of monitoring, target consumption group, service quality estimation and feedback evaluation. It took three cases as example to make the simulation and validated that the proposed strategy not only could adapt dynamic varying environment but also could ensure the actual service quality and overcame the individual difference of evaluation. The research results demonstrate that the proposed strategy of service selection can filter speedily out the Web service needed by requester from the set of Web service in abundance.

**Key words:** Web function, web service, fusion, QoS, service reliability, selection strategy

## INTRODUCTION

The selection mechanism of Web service has gone through two stages, namely the QoS based selection and user evaluation feedback based selection (Gao and Zhang, 2008). The former is a sort of service selection method based on objective evaluation. Its selective model is shown in Fig. 1. The module of Service Match Make in Fig. 1 is used for match evaluation in QoS of Web services that meet the functional requirements but the precondition is that the data in QoS must be truly credible.Practically, there are a large number of false services in the network. The model ignores the dynamic changes in QoS, therefore, the selected service based on QoS may not be the best service (Pei and Chen, 2011). The later is based on user evaluation feedback. Its service selection model is shown in Fig. 2. Its accuracy depends on the actual effect of service evaluation from the service consumer. It is a sort of service evaluation method based on subjective evaluation. Therefore it is difficult to obtain the high quality Web service (Hwang *et al*., 2008). What cause puzzles of the Web service selection is that the model built can not completely reflect the essence of the object. Therefore, the study made further study on selection strategy of Web service based on QoS and confidence fusion in order to get a better selection model.

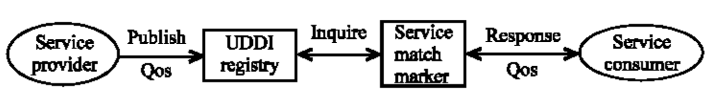


Fig. 1: Web service selection model based on QoS

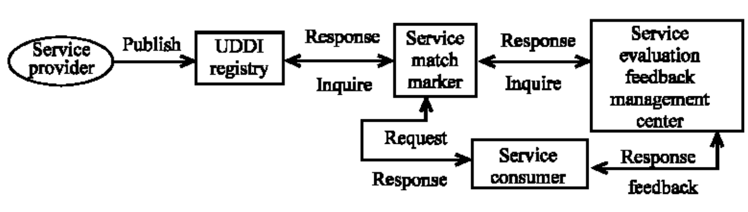


Fig.2: Web service selection model based on feefback

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## IMPROVEMENT ON SELECTION STRATEGY

Aimed at the puzzles of one-sidedness and limitation mentioned above, in order to avoid false QoS made by service provider in the attribute value of QoS for objective evaluation, the monitoring mechanism of QoS was introduced. Moreover, the model of object consumer group was introduced to overcome the influence of context dependency in user feedback. And the model can distinguish effective and invalid evaluation so as to put an end to the influence of invalid evaluation for Web service.

**QoS monitoring model:** The monitoring model was shown in Fig. 3. It can make the monitoring and update of QoS attribute value periodically to ensure the confidence and real time effectiveness of QoS attribute value. Suppose the Web service to be as $S_i$, QoS attribute value as $Q_i = \{q_{i,1}, Q_{i,2},...,q_{i,n}\}$, then $Q_i$ can be updated as shown in Eq. 1:

$$Q_i = w \times Q'_{i,0} + (1-w) \times f(Q'_{i,1}, Q'_{i,2}, ..., Q'_{i,j}) \quad (1)$$

where, $Q'_i = \{Q'_{i,1}, Q'_{i,2}, ..., Q'_{i,j}$ is the QoS data collected by monitor, $Q'_{i,0}$ is the initial QoS data provided by service provider. W is the weight of initial QoS and it expresses by exponential function $1/2^n$ and n is the data number collected by monitor. Therefore the weight value of initial QoS can be adjusted dynamically with increase of collected data amount, namely the specific weight of $Q'_{i,0}$ gets more and more small in the computation. F is a statistical function as shown in Eq. 2:

$$f(Q'_{i,1}, Q'_{i,2}, ..., Q'_{i,j}) = \frac{1}{j}\sum_{m=1}^{j} \lambda^{date(t-t_m)} Q'_{i,m} \quad (2)$$

**Target consumption group mode:** The model of target consumption group was shown in Fig. 4. For a certain service, the consumers can be divided into m individual group. With regard to Web service $S_i$ it puts up two announcement parameters, namely the announcement vector QoS of service quality and target service group of the service. For any target group of them it can be identified by a unique service quality vector, namely $TCDraup_{ik} = TCGQoS_{i,k}$, $0<k\leq m$. For such a target group it can also be expressed as $TCGroups_i = [TCGQoS_{i,1}, TCGQoS_{i,2}, \cdots, TCGQoS_{i,m}]$. The flowchart of classification for target consumer was shown in Fig. 5. The service provider can locate several consumption groups for service $S_i$ it can be expressed as $TCGraupSi = \{TCGroup_{i,1}, TCGroup_{i,2},...,TCGroup_{i,m}\}$. For service consumer C, the requirement quality is expressed

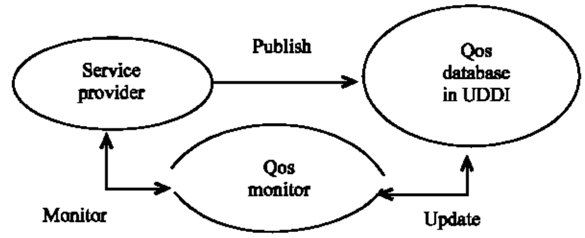


Fig. 3: QoS monitoring model

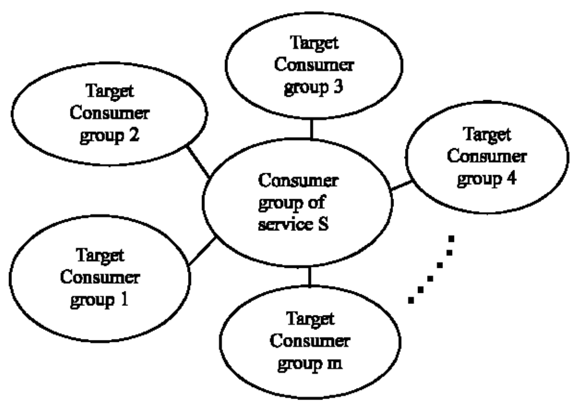


Fig. 4: Target consumer group model

as $Q_c$ and after computing the similarity between $Q_c$ and $TCGroup_{i,1}$, $TCGroup_{i,2}$,...,$TCGroup_{i,m}$ it sorts according to rule from big to small, elects target consumption group of biggest similarity and makes it join in the target consumption group. The measure of similarity difference is adopted by cosine similarity value, because it mainly focuses on the difference in direction of two vectors and not distance or length. The similarity value is directly mapped into the interval [-1, 1] and the dependency value lies on the between from -1 to 1. In which, "1" shows completely positive correlation and "-1" represents completely negative correlation.

Assume the requirement QoS of service consumer $Qc = \{q_{c,1}, q_{c,2},...q_{c,n}\}$ to be as $TCGroup_{i,k}$ and the QoS feature of target consumption group $TCGroup_{i,k}$ of service provider is $TCGQoS_{i,h} = \{tq_{i,h,1}, tq_{i,h,2}, ..., tq_{i,h,n}\}$, then the similarity between the both can be expressed by Eq.3. If the value is smaller then it shows that the similarity between the both is bigger.

$$Sim(Q_e, TCGQoS_{i,h}) = \frac{\sum_{j=1}^{n}(q_{c,j} tq_{i,h,j})}{(\sum_{j=1}^{n} q_{c,j}^2 \sum_{j=1}^{n} tq_{i,h,j}^2)^{\frac{1}{2}}} \quad (3)$$

**Service evaluation model:** The model of service evaluation makes evaluation service from two aspects,

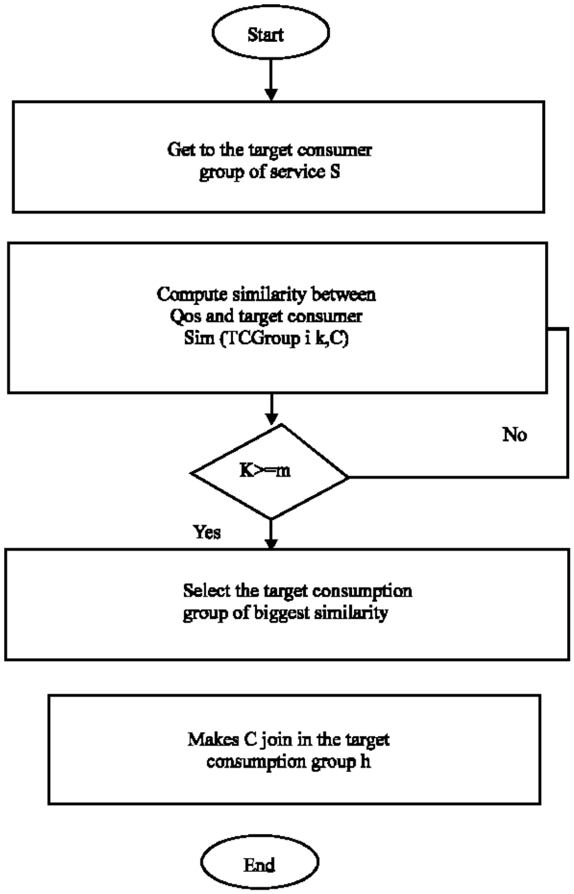


Fig. 5: Flowchart of position target consumer groups for service consume

namely subjective and objective evaluation. The service selection model based on QoS monitoring and evaluation classification can make QoS own the real effectiveness through introducing time factor to update the QoS dynamically. The confidence of consumer for Web service comes from direct confidence and indirect recommendation confidence and after respectively computing it can obtain the totality confidence of candidate Web service. It is shown as Eq. 4:

$$T = W_t \times \text{Direct Trust} + (1-W_t) \times \text{IndirectTrust} \quad (4)$$

In which, $W_t$ represents the confidence weight.

**Evaluation feedback model:** The user evaluation feedback management model can be shown in Fig. 6. In which, each service has m target consumption groups and anyone service consumer must be assigned into a target consumer group. The service evaluation of one and the same target consumption group also must be put into the

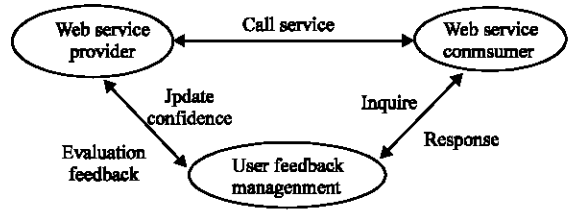


Fig. 6: User feedback management model

same storage pool. If the feedback information does not belong to the malicious evaluation then it must be encouraged and rewarded, else it must be punished for evaluation of service consumer. The mechanism of evaluation of rewards and punishments can make corresponding reward and punishment according to average evaluation similarity of belonged target consumer group. If it is high for the average evaluation similarity of the service consumer group, then it illustrates that the evaluation confidence is higher and when it is greater than a certain getting value then it can be considered that the evaluation made by service consumer is impartial it should be encouraged and rewarded. In opposite it should be punished. The mechanism of rewards and punishments can reduce the malicious evaluation.

## SERVICE SELECTION STRATEGY BASED ON FUSION

Based on the service selection mechanism of service classification and confidence, the service being suitable user can be selected according to the objective service quality value of comprehensive evaluation and user subjective evaluation value. The service selection algorithm flow was shown in Fig. 7.

**QoS constraint processing:** It first makes semantics matching for service request QoS and service announcement QoS (Liu and Wu, 2008) and it can obtain the service announcement vector set $Q_v$ of semantics matching satisfied by the service request vector (Liu *et al*., 2007).

**Short-cut process constraint of QoS:** In order to unify the computing and comparative analysis, by means of unit transform mode of Unit Conversion record in ontology Database it makes single standard processing for measure mode of QoS service announcement vector. The classification of short-cut process constraint of QoS constraint consists of numerical value type and Boole type and grade type and the short-cut process constraint

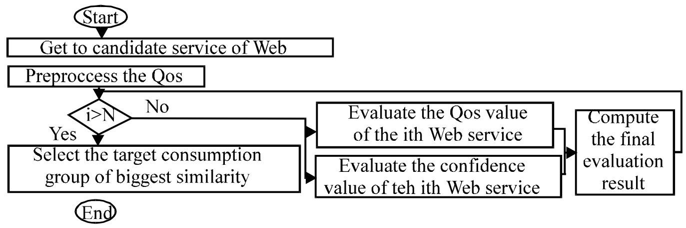


Fig. 7: User feedback management model

makes short-cut process constraint processing for service announcement set of satisfied QoS semantics matching.

**Constraint processing of QoS:** After QoS constraint processing it can obtain the Web service candidate set $S = \{S_1, S_2, S_m\}$ and each service has n pieces of QoS attribute, therefore it can constructs a m×m matrix Q as shown in Eq.5. In the matrix Q, each row represents a Web service and each column represents one and the same QoS attribute:

$$Q = \begin{bmatrix} Q_1 \\ Q_2 \\ \vdots \\ Q_m \end{bmatrix} = \begin{bmatrix} q_{1,1} & q_{1,2} & \cdots & q_{1,n} \\ q_{2,1} & q_{2,2} & \cdots & q_{2,n} \\ \vdots & \vdots & & \vdots \\ q_{m,1} & q_{m,2} & \cdots & q_{m,n} \end{bmatrix} \quad (5)$$

In the matrix Q, the large the numerical value is, the beneficial for service request. According to the QoS attribute after quantization it can compute the QoS evaluation value of Web service, as shown in Eq. 6.

$$QoS(S_i) = \frac{1}{n}\sum_{p=1}^{n} q_{i,p} \quad (6)$$

**Confidence evaluation:** It has been researched on confidence (Yu and Lin, 2005) but they ignored all the correlation of context and it results in different for the same service confidence in different service consumer. Aimed at the shortage mentioned above, the study firstly seeks that the service consumer belongs to which target consumption group of the service, then after seeking attribute target consumption group it can find direct confidence value through computing. Finally according to Eq. 7, the indirect confidence value can be found.

$$\begin{aligned} &\text{Indirect} - \text{Trust}(C, S_i, t) \\ &= \left(\sum_{r=1}^{Z} RP_{c,r} \times valfr_{i,r} \times \lambda^{date(t-t_r)}\right) / Z \end{aligned} \quad (7)$$

In which, $Rp_{c,r}$ gives the confidence of service consumer of $fr_{i,r}$, $valfr_{i,r}$ is the evaluation score of consumer for the service $S_i$.

**Web Service Selection:** After completing the evaluation $S = \{S_1, S_2, S_m\}$ of all services it can obtain an evaluation matrix $ER = \{ER_1, ER_2, ER_n\}$ of comprehensive considering QoS as well as confidence. Sorting the element in ER from big to small it can obtain the biggest value $ER_i$ in ER and the service $S_i$ of the biggest value $ER_i$ must be the only section. The above flow joined the evaluation computing of user evaluation value of requirement similarity and the evaluation value joined more actual subjective judgment information, therefore it enhanced the service precision ratio and it can satisfy the QoS selection requirement of user Web service.

## IMPLEMENTATION OF SERVICE SELECTION STRATEGY

**Service selection frame:** The total frame of service selection mechanism implementation was shown as in Fig. 8. The module QoSMM monitors the QoS vector of service announcement, stores the history data of monitoring and updates the parameter value of QoS announcement vector periodically. The pretreatment module QMM makes pretreatment for service request QoS vector and service announcement QoS vector. The evaluation module QEM makes average value computing for result set QoS and finds out the QoS evaluation value. The input of module QEM is the result set of pretreatment module QMM. For confidence evaluation module TDEM, the input is the module QMM. It produces candidate service set after through QoS matching. (5) The service selection module SSM makes the sum of evaluation value produced by QEM and TDEM according to the weight value. (6) Module SPRM is in charge of collecting user satisfaction degree of process execution result in service selection.

**Response mechanism of service request:** The flow of response mechanism was shown as in Fig. 9. After receiving the QoS service request, through four processing flow it can provides the response result. (1) It can create a new QoS matrix after the candidate service set through the QoSMM QoS pretreatment. (2) QEM module

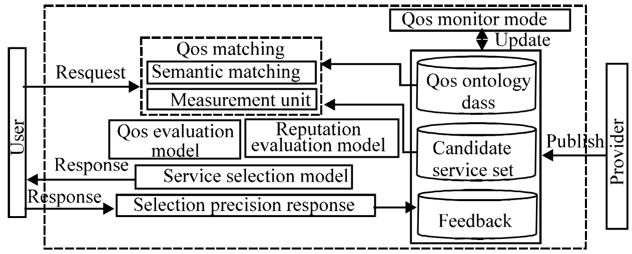


Fig. 8: Service selection frame

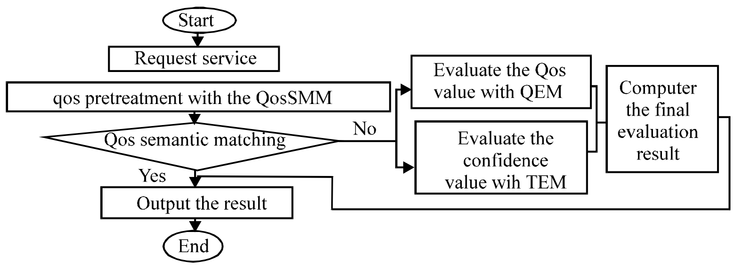


Fig. 9: Response flow of service request

completes the evaluation for QoS. (3)TDEM module finds out the target consumption group according to the requirement QoS of service consumer and it computes the user evaluation value and completes the confidence evaluation. (4) SSM module is in charge of service selection and makes its result provide to service consumer. In the confidence model of the proposed mechanism it owns the comparability because of the criterion being based on the evaluation of the same target consumption group and therefore it can finds out the most suitable service of requirement itself for user

## EXPERIMENT SIMULATION

For convenience of comparison and description, here the algorithm of Web service selection based on QoS is called as SMQ and the mechanism of service selection based on QoS and user feedback is called as WSMQF. Compared WSMQF with SMQ algorithm it increased the steps of feedback evaluation and therefore it increased the time cost. Compared WSMQF with SMF algorithm it increased two steps of evaluating QoS and seeking target consumption group, therefore its time cost is also increased a little. But after locating the belonged target consumption group, because the number of user evaluation is reduced compared with the original, so the time cost is also reduced. The following is the test results of simulation contrast for the time cost of three sorts of algorithm under different conditions.

For the service consumer C, under the condition of invalid evaluation being fixed with the increasing of valid

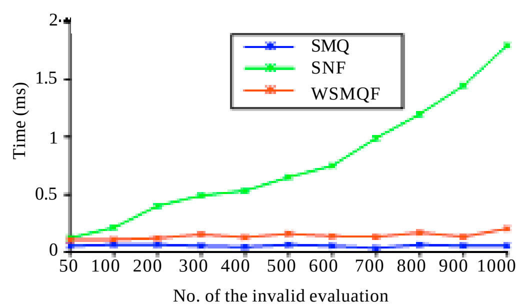


Fig. 10: Time spending under different invalid evaluation

evaluation number, the simulation result of time cost is shown as in Fig. 10 under different mechanism. With the increasing of valid evaluation, the time cost of WSMQF is also increased. Related to SMF, under the condition of the same number of invalid and valid evaluation, the time cost of WSMQF is less than SMF. SMQ does not deal with user feedback and only deals with static state QoS evaluation and therefore its time cost is less and basically it is not changed steadily.

For service consumer C, under the condition of valid evaluation number being fixed with the increasing of invalid evaluation, the simulation result of time cost of WSMQF is shown a s in Fig.11. With the increasing of invalid evaluation, the time cost of WSMQF keeps a stable value basically and the time cost of SMF is increased with invalid evaluation increasing. And the time cost of SMQ is the same as (1) and it is in a stable status.

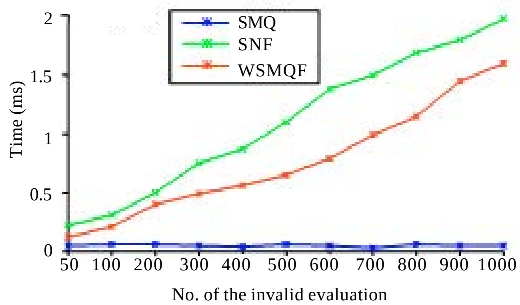


Fig. 11: Time spending in different valid evaluation

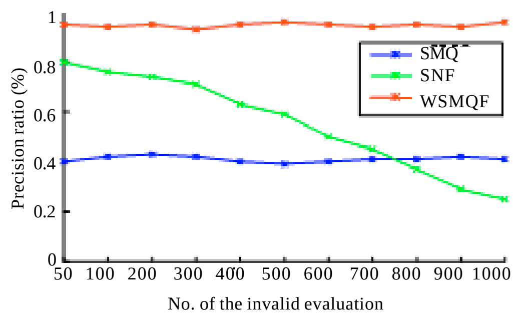


Fig. 12: Selection precision ratio in different invalid evaluation

**Simulation experiment on the precision ratio:** The precision ratio shows that after according to the requirement QoS of service consumer selecting the service for consumer, the selected service number of times takes a percentage of ideal service number of times of service request in the service selection system. Aimed at the precision ratio, the statistical result of simulation for proposed algorithm is shown as in Fig. 12.

Compared with the simulation result it can be seen that the precision ratio of SMQ is lower and the precision ratio of SMF is reduced with the increasing of invalid evaluation but the precision ratio of WSMQF is also to keep a higher level and it can not be reduced with the increasing of invalid evaluation. From the simulation experiment it can also be seen that the time cost of SMQ is less but the precision ratio is less. The time cost of SMQ SMF is higher than SMQ does but related to SMQ it is still high. Compared with SMF, the time cost of WSMQF is less but compared with SMQ, the time cost is big a little and the precision ratio is the highest and the most stable in the three sorts of selection mechanism. From the above mentioned, we can see that under the condition of acceptable time cost, the time cost of WSMQF has obvious improvement in precision ratio.

## CONCLUSION

The study explored in detail the selection strategy of Web service based on the fusion of subjective and objective evaluation for QoS aiming at the puzzle of Web service selection for functional similarity. By means of simulation experiment, the rationality and effectiveness of the service selection strategy had been validated preliminarily. In view of the complexity of service selection mechanism it is still necessary to make further research to some puzzles, such as how to make reasonable partition for target consumption group according to the actual requirement, how to determine initial confidence value of service consumer so as to restrain the malicious evaluation of service consumer.

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