ENHANCED WEB SERVICE RANKING APPROACH BASED ON NON-FUNCTIONAL QOS CRITERION WITH USER PREFERENCE

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ABSTRACT

Web Services provides a systematize way to integrate web applications over an internet protocol. As numerous web services exist in internet, selecting appropriate web service is vital in many web service applications. Quality of Service (QoS) is the predominant parameter which is used for selecting web services in terms of their quality. Based on user's preference on service quality, we services are ranked and best web services are selected. But the difficulty with this approach is that it is strenuous to precisely define QoS property. Hence an enhanced fuzzy multi attribute decision making algorithm for web service selection is presented in this paper. The proposed method periodically collects user's feedback to update web service QoS ranking. Experimental results show that the proposed method can satisfy service requester's non-functional requirements. Moreover, the proposed method out performs the traditional random and round robin web service selection techniques.

Key words : Web Services, Service Providers, SOAP, UDDI, WSDL

1.INTRODUCTION

Since heterogenous technologies are available in internet, we need reusable components that can work on different platforms and programming languages. The technologies such as COM, CORBA and RMI can do well to fulfill requirements[1]. But these components are either language dependent or platform dependent. The solution to this problem is to use web services[2].

Web Services interact with different web applications to exchange data. Web services convert existing applications to web applications. It may be a piece of software that uses a standard XML messaging system to encode all communications[3]. Web services may be defined as self-contained, distributed, dynamic applications published over the internet to create products and supply chains.
Web service may be a collection of open protocols and standards used to exchange data between applications

and systems. A Web service could be an assortment of open protocols and standards used for exchanging knowledge between
applications or systems. The components of web service include SOAP (Simple Object Access Protocol), UDDI (Universal Description Discovery and Integration) and WSDL (Web Services Description Language)[4].
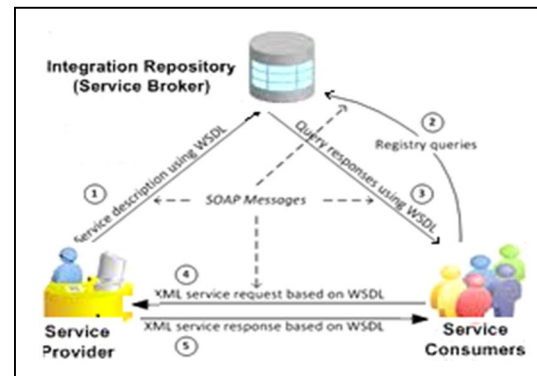

Fig 1 Web Service Architecture

Simple Object Oriented Protocol (SOAP) is a platform and language independent protocol that allows data transfer between applications. It is based on XML. SOAP also provides a platform to communicate between programs running on different operating systems. Universal Description Discovery and Integration (UDDI) is also a platform independent framework that provides directory service to store information about web services[4].

UDDI can communicate via SOAP, CORBA, Java RMI specifications. Web Services Description Language (WSDL) is a XML-based language that allows users to describe web services[5]. It is also used to locate web services. Web service contains three components viz. service requester, service provider and service registry. Owner of the web service is said to be service provider and provides services to software applications using WSDL[5]. Consumer of the service is the service requester. To perform the service, service requester interacts with service registry and suitable service is invoked. Selection of suitable service is based on QoS information[5].

QoS is the quality parameter which can be used to select appropriate web service. QoS calculation is based on several properties such as security, response time, latency, accessibility, availability, etc. These properties represent technical quality of a web service leaving managerial quality. Moreover, QoS property may include several sub properties[6]. Complexity in accessing a web service, dynamism, unit cost are necessary properties that are necessary to evaluate QoS. Properties of QoS contains different levels of abstraction. Therefore, QoS properties are not well suited for web service selection process.

The two major criteria of web or domain relevant to the services: functional and non-functional criteria. Functional properties outline specific behavior or functions are domain relevant to the service. Whereas non functional criteria is applied as a metric for performance of the Web Service. Non Functional properties are often known as QoS[7].

This criterion describes what services supposed to be. Given the explosive range of functionally similar services offered on the web, there is a necessity to distinguish them from the user's view. Among functionally equivalent services, non-functional properties play a serious role in ranking the services. Since users take a lot of count of the quality of services, the foremost applicable service that meets a user's demands ought to be elect by QoS criterions[8].

The motive of our work is to make the service choice process straightforward by ranking the available services for an equivalent practicality that successively makes the composition of the services more effective and time efficient.

Web services are the rising new technology that is now quite common in all streams of internet technology. So the number of available suppliers for one function or domain is now increasing rapidly. This increases the supply of the many services for one function that successively increases the choice ion for the Service Requestor. But this also increases the complexness in choice of the proper and efficient service for the practicality. As the Requestor has very little information about the QoS constraints of WS it's tough for the SR to make the selection. Just in case of complex services this complexness could increase further[7][8].

The best solution for this is to rank the services consistent with the QoS of the service and also the past User feedback for that service. Considering these two properties it's not very straightforward to rank the services. These are the critical characteristics of the services and it must be maintained and updated often to fulfill the growing demands of the user. In this approach we apply fuzzy approach to rank the services[9]. This technique will solve the crucial process of ranking the services with the available data and the user feedback.

2. RELATED WORK
2.1 QoS Criterions

The instructed approach guarantees that the Service finally hand-picked is that the best in terms of QoS. An interested QoS attribute chosen by potential users might be divided into many sub-criterions. Completely different weights can be given to different QoS criterions, thus do the sub criterions[10]. The weights represent a possible user's Judgments of the priorities of QoS criterions.

Criterion	Meaning	Metrics
Execution Time - T. (Sec.)	It is a measure for performance. Time delay between request and response.	Execution Time (T) = $T_{process}$ + T_{queue}. $T_{process}$ is the service processing time; $T_{queue.}$ is the queuing time for WS processing
Cost - C. (Rupees)	Total cost paid for individual service and transmission . Service cost : cost for executing the service. Transmission cost : cost for transmitting resultant data from server to SR.	Service cost is defined by SP . Transmission cost is based on network operator. C=Csc+Ctc Csc: service cost; Ctc: transmission cost.
Service availability - A. (%)	Service availability (A) is the probability that a service is available for accessing.	A=Ta/Ttot Ta: Amount of time the service is available; Ttot: Total time measured.
Reliability - R . (%)	Service ability to perform consistently even under unexpected situation. Based on historical data.	R = No. of times the service successfully invoked within the time / total number of attempts.
Success Rate – S (%)	Success Rate is probability of returning responses after web services are successfully processed.	Success Rate S = Number of Successful Response / Number of Requested Message

2.2 Fuzzy Logic

Fuzzy set theory was introduced by Zadeh [33] for modeling classes or sets whose boundaries are not quite defined. For such objects, the transition between full membership and full mismatch is gradual rather than crisp. Fuzzy Logic (FL) is a problem-solving system

methodology that lends itself to implementation in systems starting from easy, small, embedded micro-controllers to giant, networked, multi-channel laptop or workstation-based information acquisition and management systems.

Definition 1. A fuzzy set ˜ in a universe of discourse is characterized by a membership function (X) which associates with each element in a real number in the interval [0, 1]. The function value (X) is termed as the grade of membership of in ˜.

Definition 2. A triangular fuzzy number ˜ can be defined by a triplet (,m,b). Its conceptual schema and mathematical form are shown by **Eq. (1)**

$$\mu_{\tilde{A}}(x) = \begin{cases} \dfrac{x-a}{m-a}, & \text{if } a \leq x \leq m \\ \dfrac{b-x}{b-m}, & \text{if } m \leq x \leq b \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

3. EXISTING SYSTEM

Besides the QoS model, current existing Web Service choice mechanisms lack the capability to manage the fuzzy QoS data. Many researchers have applied the fuzzy sets theory to develop and to unravel the inexactly QoS criteria and quantified the subjective weight that is delineated by linguistic [16].

Chen et al adopt Fuzzy Multiple Criteria deciding (FMCDM) approach to capture however customers create their analysis of services additional effectively [13]. Huang et al presents a tempered fuzzy web service discovery approach to model subjective and fuzzy opinions, and to help service customers and suppliers in reaching a accord [14] [15]

In the fuzzy approach, various weights are used for the normalization of the fuzzy values. One such method is the entropy weights [17]. This paper describes the various stages in the calculation of entropy weights and also their relevance in the fuzzy algorithm is analyzed.

The single price decomposition technique [18] is another method that uses a matrix to represent the QoS criterions. This single matrix is divided further into 3 matrices based on varied criteria. The values of those matrices are represented in 2D area within the kind of a graph and based mostly on the proximity of values are allotted. The disadvantage here is that for advanced attributes the scale of the matrix becomes large[11].

A number of QoS-aware service choice approaches [19] [20] [21] [22] are projected within the literature. Numerous QoS criterions are accustomed describe non-functional aspects of net services. QoS is a broad idea that encompasses variety of non functional properties like value, accessibility, reliableness, and Reliability [23]. As per Std. ISO 8402 [24] and ITU E.800 [25], QoS could involve variety of nonfunctional properties like cost, response time, availability and reputation [26]. QoS problems are analyzed from each service provider's perspective and service user's perspective in [28]; and also the QoS criterions enumerated are accessibility, security, reaction time, and throughput. Since some QoS criterions are common in diverse application domains, they're organized into 2 categories [27].

In [29], [9] planned 2 models for the QoS primarily based service composition problem: combinable and graph model. They used 2 heuristic algorithms supported applied math for service procedures with a serial flow and a general flow structure to modify the choice of QoS directed services. The matter of the algorithms lies in quantifiability.

Meng et al.[31] gift requester's preferences obtained from past QoS values. They propose a QoS model during which users are allowed to specify their preferences whereas providing combination of multiple QoS properties to provide support in servicing overall rating to a service. Then, the similarities between users are measured by the correlation between their rankings of services.

To summarize, in the existing system the ranking is based on QoS or functional behavior of the services. If both are considered the user must have the knowledge about the Qos constraints so that he will be able to provide feedback about the services. But probability based approach is the most commonly used method for ranking the service using user feedback. The major issues of the existing methodology in crisp points are as follows.

Issue 1: Either functional or non-functional approach will be used. But not both the approaches simultaneously.
Issue 2: If both the approaches are used requestor must have knowledge regarding the functional properties of the service.
Issue 3: The ranking procedure is static.
Issue 4: Service Provider or the third party plays an important role in deciding the rank of the service
Issue 5: User preferences for the quality of service is considered without knowing the user experience in the non functional parameters

Issue 6: Real time users of the services are not considered while ranking the web service.

The proposed algorithm is enhanced such that the ranking of the available web services are changed dynamically based on the user experience about the service. The Qos parameters are also changed so that it is well known by the user and can be judged by the user without any much technical experience regarding the service.

3.1 THE DECISION MAKING PROCESS OF SERVICES WITH QOS CONSTRAINTS

Definition 3: A Quality constraint factor is defined as a triplet (Q, V, and F).
Where, Q is the name of the QoS factor
V ≡ Value of quality decisive factor
F ≡ Function that gives the unit of measurement used for each QoS factor.

Definition 4: QoS Description Model
To infer there exist a set of web services WS (f) = {S1,S2,…Sn} (n ≥ 2) that performs a common functionality with set of QoS Constraints q = { q1,q2,..qj} .
Where n is the number of candidate services for the specific function f and j is the no. of quality requirements.
For simplicity we denote K = {1, 2, 3... k} and N= {1, 2, 3...n}. WSD indicates individual service with default quality criterions set, WSU indicates user-defined quality criterions, Hence a Service Request quality criterions WSR = WSD && WSU.
This default quality criterions sets
WSD = {Availability, Cost, Response Time, Reliability, Success Rate}.

Definition 5: QoS description model of candidate service
Suppose n candidate services are selected based on functional constraints, the service set is represented as:
WSC ={SC1, SC2, …, SCn}, where SC_i = ((q_{i1}, g_{i1}), (q_{i2},g_{i2}) , …, (q_{im}, g_{im})) is the quality of service of the ith-candidate Web services, $1 \le i \le n$, q_{ij} ($1 \le j \le m$) is the property name of the first jth QoS quality in SC_i, g_{ij} shows the corresponding quality attribute values which is provided by services.

Definition 6: QoS description model of Service Request
WSR = ((q_1, w_1, g_1), (q_2, w_2, g_2), …, (q_n, w_n, g_n))
Where, q_k ($1 \le k \le n$) is the kth quality criterions in service requests, w_k indicated the weight which requester assigns to the quality criterions, g_k is requester's expectations of the quality attribute.

4. PROPOSED SYSTEM

4.1 Enhanced Service model with QoS Factor

The decision making algorithm determines which WS (f) with relevant QoS constraints provided by the SP best ensemble the requirement through the following phases:

Step 1: QoS Matrix. Suppose candidate service sets by functional match
$S = (S1, S2, S3, ..., Sn)$, Si has m QoS criterions, $1 \leq i \leq n$, and $Si(i \in K)$ then construct an $n \times m$ order decision matrix Q , where each row represents a candidate service corresponding to each QoS property value, each column represents attribute values of all candidate services representing its respective QoS criterion qj , where $(j \in N)$.

$$
q_{14} \quad q_{15} \quad \begin{pmatrix} q_{11} & q_{12} & q_{13} \\ \\ q_{21} & q_{22} & q_{23} \end{pmatrix}
$$
$$
q_{24} \quad q_{25}
$$

Let Un be user feedback of the services for the QoS
$Un= \{u1,u2,u3,u4,u5\}$
Let W be the set of weight vector defined by the SR for each QoS

$$W = \{w1,w2,w3,w4,w5\}$$

such that $\sum wk=1$ and $\qquad$ (2)

Wk represent the weight of Kth quality criterion

Step 2: Updating QoS Matrix and Weight of the Services using User Feedback
Each element in Qnx5 matrix is updated by using following formula

$$qij = \frac{(Un [uj]*10)+qij}{2} \quad if \ (qij -25)< (Un[uj]*10) <(qij +25)$$

$$qij = qij - 3 \qquad if \ (qij -25) > (Un[uj]*10)$$

$$qij = qij + 3 \qquad elsewhere$$

where $3 \leq j \leq 5$, $1 \leq i \leq n$ $\qquad$ (3)

Update the weight with user feedback

$$X = \frac{1}{\sum \ Uk} \qquad (4)$$

Each element in Un is multiplied by X such that
$$\sum \ Uk =1 \text{ in all Un}$$

Now update the set W with Un

$$Wk = \frac{Wk[wj] + Uk[uj]}{2}$$

where $1 \leq j \leq 5, 1 \leq k \leq n$ $\qquad$ (5)

Step 3: QoS Normalization
Based on the tendency of QoS attribute, it can be either positive or negative criteria.

Every QoS attribute differ each other, hence each attribute need to be normalized. It is an essential step as certain value should be maximized and certain to be minimized to get best results. For negative criteria such as cost and time the QoS value need to be minimized and for the positive criteria such availability, Reliability and success rate, the QoS value have to be maximized.
The following formula is used for scaling the Qnx5 matrix. The values of negative criterions are normalized by Eq. 6. And the values of positive criterions are normalized by Eq. 7.

$$qij =1 - \frac{qij}{max(qij)+min(qij)} \qquad (6)$$

$$qij = \frac{qij}{max(qij)+min(qij)} \qquad (7)$$

Where max(qij) is maximum value in jth column and min(qij) is minimum value in jth column associated with Candidates Service.

Step 4: Define Quality Vector and Euclidean Distance
Let g be the quality vector of the positive ideal solution

$g=(g1,g2,g3,g4,g5)=(max(qj1), \ max(qj2), \ max(qj3), max(qj4), max(qj5)) \ 1 \leq j \leq n$

Let b be the quality vector of the negative ideal solution

$b=(b1,b2,b3,b4,b5)=(min(qj1), \ min(qj2), \ min(qj3), min(qj4), min(qj5)) \ 1 \leq j \leq n$

A distance measure is required for grouping the services. To compute the distance between the service vectors, we apply the Eq. 8 and Eq .9. This is inspired from Euclidean Distance similarity measure.

$$d_{ig}= \sqrt{ \quad [\quad k(g_j - q_{ij}) } \qquad 1 \leq i \leq n$$

(8)

$$\overline{\qquad\qquad}$$

$$d_{ib} = \sqrt{\qquad [\quad {}_k(q_{ij} - b_j) \qquad 1 \le i \le n}$$

(9)

Step 5: Calculate Degree of membership
A Fuzzy approach is applied to find the membership value of each service according to the quality, which the Service Requestor prefers more.

The membership function is calculated using Eq. 10

$$\mu(i) = \frac{10}{1 + [dig/dib]\,2} \qquad 1 \le i \le n$$

(10)

Services are arranged in the descending order of the value of μ(i).

The values for the web services are based on the Eq. 10 with the service having highest μ(i) is selected as the final decision alternative.

5. EXPERIMENTS AND RESULTS

We have prototyped our approach in Python and Django Web Framework on an Intel® Core ™ Duo CPU, 2.53 GHz, 4GB RAM and Window 7 Operating System. This application as a GUI for implementing a decision making algorithm with feedback and ranking logic. User interface part deals with the data that is provided to the logic for calculation of rank for each web service. The interface is in such a way that the required parameters are clearly explained when the page is viewed by the user without any further explanation.

Django provides MVC controller that helps to separate business logic from presentation. This eases the design process to handle dynamic changes throughout the web application. At the ranking logic uses dynamic updating of the QoS constraints of the web service. These dynamic changes are based on the user feedback regarding this service.
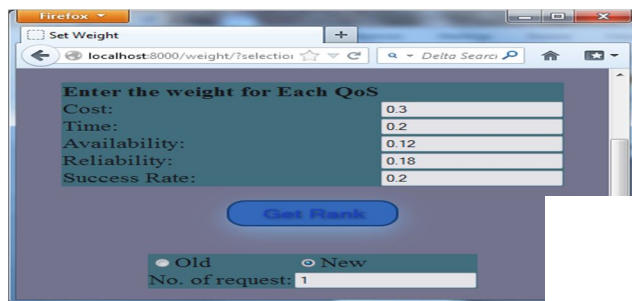
Figure 2: Client Interface showing weights for QoS

Figure 3 : Client Interface for User Feedback

The Client Interface to enter the weight and Feedback points for each QoS constraints of the candidate Web services is shown in Fig 2 . The number of candidate web services are eight. The number of QoS constraints is fixed to five (i.e. cost, time(T), availability(A), reliability(R), success rate(S). The reference dataset [32] used for our approach is given below.

WSC Tendency	Rank	Cost (Rs) Min.	T (Sec.) Min.	A (%) Max.	R (%) Max.	S (%) Max.
sorting6.xml	6.859	56	43	90	84	85
sorting4.xml	6.711	29	37	71	55	32
sorting7.xml	6.289	12	81	78	24	35
sorting8.xml	5.441	32	75	98	65	26
sorting3.xml	4.602	76	28	52	96	70
sorting1.xml	3.805	49	68	91	91	12
sorting2.xml	3.757	85	56	62	72	94
sorting5.xml	0.684	68	95	83	43	25
Weight		0.3	0.2	0.12	0.18	0.2

PERFORMANCE RESULTS

The need for our experiment is to compare our model with [32]. The weight vector,
W = (0.3, 0.2, 0.12, 0.18, 0.2) the resultant decision table of our approach is given in table.2

WSC Tendency	Rank	Cost (Rs) Min.	T (Sec.) Min.	A (%) Max.	R (%) Max.	S (%) Max.
sorting6.xml	8.389	56	43	90	84	85
sorting4.xml	6.527	29	37	71	55	32
sorting7.xml	5.618	12	81	78	24	35
sorting1.xml	5.405	49	68	91	91	12
sorting3.xml	5.208	76	28	52	96	70
sorting2.xml	4.847	85	56	62	72	94

Figure3: Rank Score of each WS on 1st Request

TABLE 2: RESULTANT DATASET

Analysing the two results, Table 1 and Table 2 we can find the variations in the order the service are ranked. Let us see the change that is brought up by our approach and the reason for the change.

Consider the service8 which is up in the order is pushed down by three services1,2 and 3. The reason for that is, even though cost is the most prefered QoS by the SR other QoS also has a role in determining the rank of the service. From the above four services we have taken the service8 may be cost effective but service3 inspite of its cost provied the shortest execution time among the aailable services and the success rate of this service three times better than service8. And in case of service1 all the QoS constraints fall in the average values.It does not excel in one QoS and retard in other QoS. This is the stability of the service which has been recognised in the our approach and this service is brought up in the order. And at last the service2 which is pushed up one in the order, this is because the success rate and execution time of the service is comparitively good but because of the cost this service has move only one place in the rank.

Once rank for each web services are generated the results are represented as a XY chart. As we calculate the rank for each time the services are requested ,the rank for the service is updated. The rank of the services will be updated according to the user feedback in our approach but in case of [32] it is not done. By comparing the chart that is obtained by each time the rank is calculated it is clear, services are ranked exactly how the requestor needs, as it uses the feedback of the user used in real time. But in other approach[32] only the Service Provider or the third party decides the rank of the service which may not exactly reflect the need of the Service Requestor.

Fig 3 – 5, shows changing service ranking score based on 1st, 10th, and 40th time of service request. The higher the number of request is generated higher is the accuracy of the service rank.
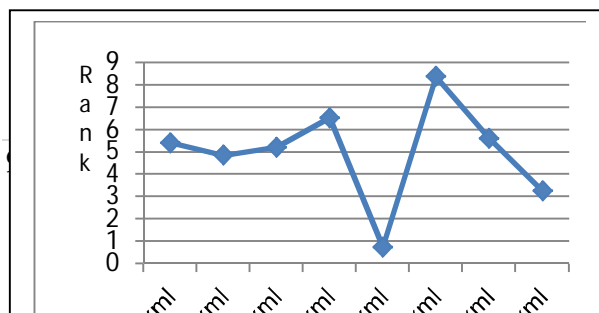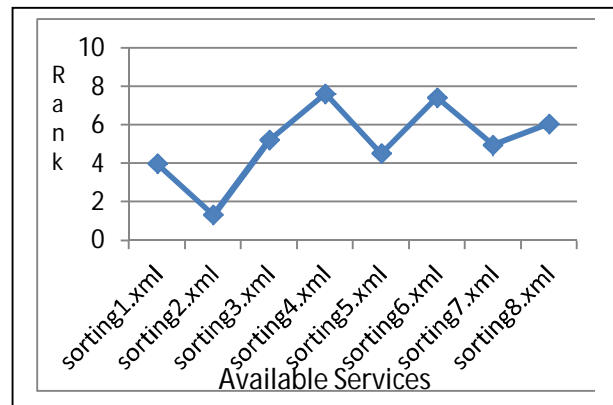

Figure5: Rank Score of each WS on 40th Request

6. CONCLUSION

Web services are the emerging technology in the current computer field. This is language neutral so it gains more interest from the scholars and attaining new development. But the complexity comes in the selection process of the web services. To overcome this problem a ranking methodology with user feedback is illustrated in our approach.

Some of the noteworthy advantages of our proposed approach are as follows.

- Irrespective of user domain knowledge he can prioritize the QoS constraints according to his use.
- Dynamic ranking algorithm increases the performance
- Both functional and non functional properties are given equal importance in the algorithm
- Simple algorithm which reduces the complexity of the computation
- Users directly determine the ranking process instead of some third party of the SP itself. This increases the accuracy and satisfies the needs of the SR very efficiently.

As our approach uses dynamic strategy it is capable to change its nature according to the user speed and also the QoS errors are minimized automatically.

As a part of our ongoing research, the QoS validation process is to be automated which will make the selection process more easily without any human intervention, considering the real dataset on the web. Also to improve the optimality of our approach.

REFERENCES:

[1] J. Sommerville, Software Engineering, 8th ed. Addison Wesley, 2006.

[2] T. Erl, Service-oriented Architecture: Concepts, Technology, and Design.Prentice Hall, 2005.

[3] Chen S J. Fuzzy multi attribute decision making: methods and applications, Berlin: Springer-Verilog, 1992

[4] Chen Shouyu. "Theory of fuzzy selection for multistage and multi objective decision making system", The Journal of Fuzzy mathematics, 1994, 2(1)

[5] David Booth. "Web Services Architecture", W3C Working Group Note 11, February, W3C Technical Reports and Publications, http://www.w3.org/TR/ws-arch/

[6] Liangzhao Zeng. "QoS-Aware Middle for Web Services Composition", IEEE Tranctions on Software Engineering, IEEE Press, NJ USA, 2004, 30(5),pp.311-327.

[7] Liangzhao Zeng. "Quality Driven Web Services Composition", Proceedings of the 12th international conference on World Wide Web, ACM Press, NYUSA, 2003, pp. 411-421.

[8] Michael P.Papazoglou. "A survey of web service technologies", Technical Report #DIT-04-058, University of Trento, 2004.

[9] Mohamed Almulla, Kawthar Almatori, Hamdi Yahyaoui , A Qos-based Fuzzy for Ranking Real World Web Services,. Kuwait University

[10] Shuping Ran. "A Model for Web Services Discovery With QoS", ACM SIGecom Exchanges, ACM Press, NY USA 2003, 4(1), pp. 1-10.

[11] Tran. V, H. Tsuji, R. Masuda, "A new QoS ontology and its QoS-based ranking algorithm for Web services", Simulation Modelling Practice and Theory, 17(8):1378-1398, 2009.

[12] Wang. P, "Qos-Aware Web Services Selection With Intuitionistic Fuzzy Set Under Consumers Vague Perception", Expert Systems With Applications 36.3:4460-4466, 2009.

[13] M.F. Chen, G.H. Tzeng and C.G. Ding, "Fuzzy MCDM approach to select service provider", Proc. of the 12th IEEE International Conference on Fuzzy Systems, St. Louis, MO, USA, Vol. 1, pp. 25-28, May 2003.

[14] C.L. Huang, C.C. Lo, K.M. Chao and M. Younas, "Reaching consensus: A moderated fuzzy web services discovery method", Information and Software Technology, Vol. 48, Iss. 6, pp.410-423, June 2007.

[15] C-L Huang, et al., "A Consensus-based Service Discovery", First International Workshop on Design of Service-Oriented Applications, Amsterdam, 12-14, Dec, 2005, IBM Research Report.

[16]Vuong Xuan TRAN and Hidekazu TSUJI, QoS based Ranking for Web Services: Fuzzy Approaches, 4th Intl. Conf. on Next Generation Web Services Practices, Oct 20, 2008-Oct 22, 2008, Seoul, Republic of Korea, pp.77-82

[17] Pengcheng Xiong and Yushun Fan, "QoS-aware Web Service Selection by a Synthetic Weight", FSKD Proceedings of the Fourth International Conference on Fuzzy Systems and

Knowledge Discovery - Volume 03, 2007,pp 632-637.

[18] Hoi Chan, Trieu Chieu and Thomas Kwok, "Autonomic Ranking and Selection of Web Services by Using Single Value Decomposition Technique", 2008 IEEE International Conference on Web Services , pp 661- 666.

[19] L. Zeng, B. Benatallah, M. Dumas, J. Kalagnanam, andQ.Z. Sheng, "Quality driven web services composition", in Proc. WWW, 2003, pp.411-421.

[20] G. Canfora, M.D. Penta, R. Esposito, and M.L. Villani,"An approach for QoS-aware service composition based on genetic algorithms", in Proc. GECCO, 2005, pp.1069-1075.

[21] G. Canfora, M.D. Penta, R. Esposito, F. Perfetto, and M.L.Villani, "Service composition (re)Binding Driven by Application-Specific QoS", in Proc. ICSOC, 2006, pp.141-152.

[22] X.T. Nguyen, R. Kowalczyk, and J. Han, "Using Dynamic Asynchronous Aggregate Search for Quality Guarantees of Multiple Web Services Compositions", in Proc. ICSOC,
2006, pp.129-140.

[23] J. O'Sullivan, D. Edmond, and A.H.M.T. Hofstede,"What's in a Service?", Distributed and Parallel Databases, 2002, pp.117-133. [24] ISO9000:2000, IS08402:1986: Quality vocabulary, 2000, http://www.shere2000.co.uk/pdf/isovocab.pdf last retrieved on 23/04/2013.

[25] ITU-T Rec. E.800: Terms and definitions related to quality of service and network performance including dependability, 2008.

[26] S. Wang, Q. Sun, and F. Yang, "Quality of service measure approach of web service for service selection", IET Software, 2012, pp.148-154..

[27] D.A. Menascé, "QoS Issues in Web Services", IEEE Internet Computing, 2002, pp.72-75.

[28] K. Kritikos and D. Plexousakis, "Requirements for QoSBased Web Service Description and Discovery", IEEE T.

Services Computing, 2009, pp.320-337.

[29] M.Ramakishnan and M.Suchithra, "A Review on Semantic Web Service Discovery Algorithm", Intl. Journal of Soft Computing, 8(4), 2013,pp.313-320.

[30]. Tajudeen Adeyemi Ajao Safaai Deris and Isiaka Adekunle Obasa, "QoS- based Web Service Selection Using Filtering, Ranking and Selection Algorithm". In proceeding International Journal of Scientific & Engineering Research, Vol 4, Issue 7, July-2013.

[31].Meng,L., J.Li, and H.Sun. WSRank: A Collaborative Ranking Approach for Web Service Selection in Computer and Information Technology (CIT), 2011 IEEE 11th International Conference. 2011. IEEE.

[32] Hongxia,et al," A Fuzzy Multi-Attribute Decision Making Algorithm for Web Services selection based on QoS", In proc.IEEE Asia-pacific conf. on Service Computing,2006.

[33] Lotfi A. Zadeh, "Fuzzy sets". In: Information and Control, Vol. 8, June 1965, pp. 338–353