

ENHANCING WEB SERVICE SELECTION USING ENHANCED FILTERING
MODEL

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A dissertation submitted in partial fulfillment of the
requirements for the award of the degree of
Master of Science (Computer Science)

Faculty of Computing
Universiti Teknologi Malaysia

JUNE 2013

To my parents, teachers and lecturers

ACKNOWLEDGEMENT

I wish to express my appreciation to my supervisor, **Prof. Dr. Safaai Deris** for his invaluable guidance, precious advice and endless support during my study and research work at Universiti Teknologi Malaysia (UTM). He inspired me on this research work and taught me the rules of the game. His willingness to imparting knowledge is unparalleled. Thank you Prof.

Besides, I would like to appreciate Dr. Mamoun Mohamad Jamous for his valuable assistance on my research work, my lab mates (Artificial Intelligence & Bioinformatic Research Group) for the good interactions we had together. Also, my gratitude goes to the authority of the Faculty of Computing, Universiti Teknologi Malaysia for providing the enabling environment for learning and research.

Furthermore, I wish to express my appreciation to my kind and understanding Director General, Mr. Alex Abaito Ohikere and the management team of National Steel Raw Materials Exploration Agency, Malali, Kaduna, Nigeria for giving me the opportunity to study in UTM, Malaysia.

Finally, I would like to express my warm appreciation and love to my friends and to my wonderful family for their support, endurance, understanding and prayers during my stay at UTM, Malaysia for academic advancement.

ABSTRACT

The upward trends in web service providers, consumers as well as web services pose remarkable challenges in the area of web service description, discovery and selection. While remarkable works have been done in web service discovery, selection still remains an area of challenge. Therefore, emphasis is being placed on how to find an optimal service that satisfies requester's functional and non-functional requirements. Majority of the existing approaches either ignore the role of user's non-functional requirements or place unnecessary burden on the requester to provide weights for QoS parameters having specified QoS constraints while others assigned arbitrary value of zero to the weight(s) of parameter(s) not specify in the constraints by requesters. All these have the tendency of generating bias results. This research work proposes an enhanced method for selecting optimal service for requesters using Enhanced QoS-based Web Service Filtering Model. The approach of this work differs from the previous approaches in that user's preferences are taken into count, and the weights are derived from the constraints specified by the user. The methodology used involves exploiting requester's specified QoS constraints to remove those services that failed in meeting those constraints from the list of services that match his functional requirement. The QoS of the filtered services are normalized using min-max method. The QoS score for each service is computed, and finally, the services are ranked in order of their QoS performance. The service with the highest QoS performance is then returned as best service to the requester. Experiments are conducted using Quality of Web Services datasets and the results confirm the model's ability for selecting best web service based on requester's preferences while out performing previous approaches. The outcome of this research could be adopted for solving service-oriented selection problems.

ABSTRAK

Halatuju dalam pembekal perkhidmatan web, pengguna dan perkhidmatan web memberikan cabaran di dalam penerangan, penemuan dan pemilihan perkhidmatan web. Walaupun kerja-kerja telah dilakukan dalam bidang penemuan perkhidmatan web, pemilihan masih menjadi bidang yang mencabar. Oleh itu, usaha yang mendalam telah ditumpukan kepada bagaimana untuk mencari perkhidmatan yang optimum yang dapat memuaskan keperluan fungsian dan bukan fungsian bagi pemohon. Kebanyakan pendekatan-pendekatan sediaada samada menghiraukan peranan keperluan tidak berfungsi pengguna atau meletakkan bebanan yang tidak perlu kepada pemohon untuk memberikan pemberat kepada parameter-parameter QoS yang menentukan kekangan-kekangan QoS apabila lain-lain diberikan nilai-nilai sifar yang tidak wajar kepada pemberat parameter-parameter yang tidak ditentukan oleh kekangan-kekangan pemohon. Semua ini mampu memberikan keputusan yang berat sebelah. Kajian ini memperkenalkan sebuah kaedah yang dipertingkatkan untuk memilih perkhidmatan yang optimum kepada pemohon-pemohon menggunakan model penyaringan perkhidmatan web berasaskan QoS. Pendekatan kerja ini berbeza dengan pendekatan sebelum ini di mana pilihan-pilihan pengguna diambil berat, dan pemberat-pemberat ditafsirkan daripada kekangan-kekangan yang diberikan oleh pengguna. Perkaedahan yang digunakan melibatkan pengeksploitasian kekangan pemohon QoS yang ditetapkan untuk membuang perkhidmatan yang gagal dalam menemui kekangan daripada senarai perkhidmatan yang sesuai dengan keperluan berfungsi. QoS bagi perkhidmatan yang disaring dinormalkan menggunakan kaedah min-max. Markah QoS untuk setiap perkhidmatan dikira, dan akhirnya, perkhidmatan tersebut dideretkan mengikut pencapaian QoS. Perkhidmatan dengan pencapaian QoS tertinggi dipulangkan sebagai perkhidmatan terbaik kepada pemohon. Eksperimen dijalankan menggunakan set-set data Kualiti Perkhidmatan-Perkhidmatan Web dan keputusan mengesahkan kebolehan model tersebut dalam memilih perkhidmatan web terbaik berdasarkan pilihan pemohon dengan mengatasi pendekatan sediaada. Hasil kajian ini boleh digunakan untuk menyelesaikan masalah pemilihan berasaskan perkhidmatan.

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LIST OF ABBREVIATIONS

DTD	Document Type Definition
FTP	File Transfer Protocol
HTTP	HyperText Transfer Protocol
IIOB	Internet Inter-ORB Protocol
JMS	Java Message Service
OWL	Ontology Web Language
OWL-S	Ontology Web Language-Semantics
QoS	Quality of Service
QWS	Quality of Web Service
SMTP	Simple Mail Transfer Protocol
SOAP	Simple Object Access Protocol
UDDI	Universal Description, Discovery, and Integration
URL	Uniform Resource Locator
WSDL	Web Service Description Language
WSDL-S	Web Service Description Language-Semantics
WSMO	Web Service Modeling Ontology
WWW	World Wide Web
XML	Extensible Markup Language

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Service Oriented Architecture (SOA) is an infrastructure that enables exchange of data between diverse applications as they partake in business procedures (Rajendran and Balasubramanie, 2010). SOA provides means by which distributed applications can be created which allows publishing, discovery and binding of web services for the purpose of building complex composed services. Therefore, applications are more flexible owing to their interacting abilities with any implementation of any contract (Papazoglou and Van Den Heuvel, 2007).

The basic building block of SOA is the service. A service is a self-independent software module which performs a specified task. W3C Working Group (2004) defines web service as a software module which is implemented through standard XML-based technologies such as WSDL and SOAP. Web Services are self-independent application that exhibits modular and distributed concepts (IBM WSAT).

In web service architecture, service provider presents web services that offers tasks or business procedures which are set up over the internet, in the hope that they will be invoked by clients; a web service user (requester) defines requirements for the

purpose of finding web services. Publishing, binding, and discovering web services are three major tasks in the architecture.

Discovery of web services entails locating web services that satisfy specified requirements. It is a crucial task in web service architecture towards optimal selection of services by requester.

The web service architecture in Figure 1 illustrates the service requester, providers, and discovery system with their interactions.

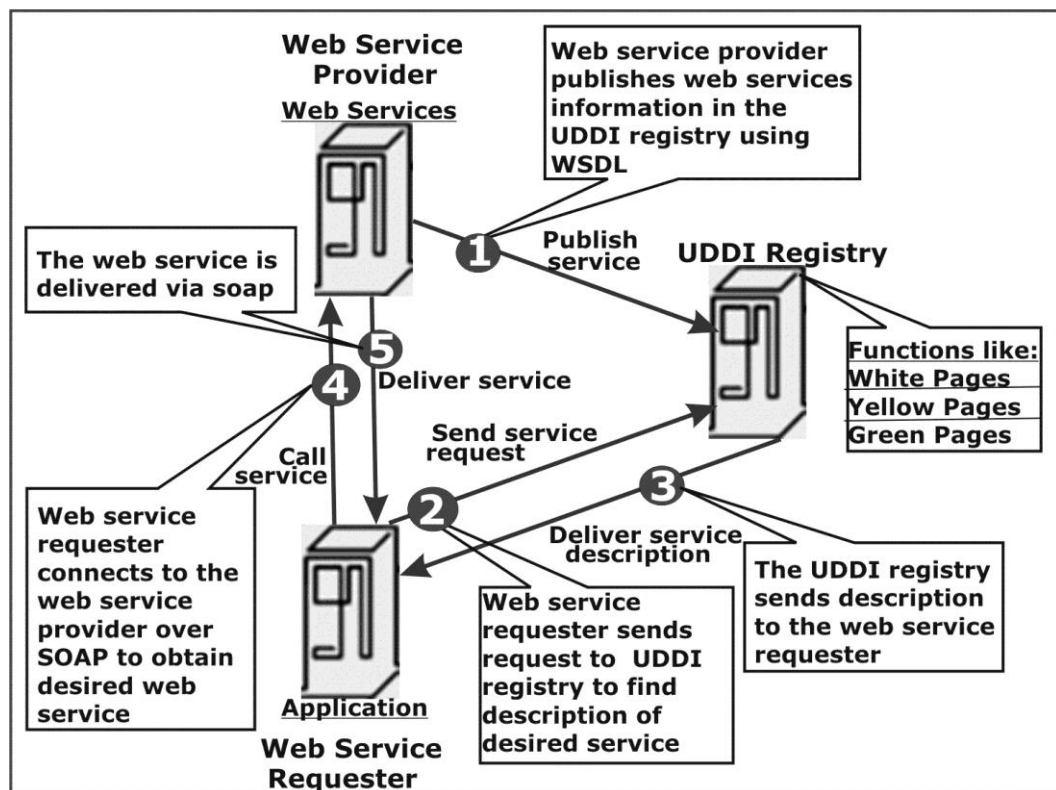


Figure 1.1: Web Service Architecture (Govatos, 2002)

As illustrated in figure 1.1 above:

- i. The service providers build web services that offer specified functions for users' which is made available on the internet for their consumption.
- ii. The Web service requester is any user of the web service who describes and submits requests for the purpose of finding a service.

- iii. The web service registry is a centralized directory of services where service providers publish their service information. The specified information is kept in the registry and examined on submission of request by requester. Universal Description, Discovery and Integration (UDDI) is the registry standard for Web services.

1.1.1 Quality of Service (QoS) and Web Service Discovery

There have been various definitions of QoS and diverse metrics measurements which are often confusing. As a way out, of this undesirable confusion, the World Wide Web Consortium (W3C) gives a summarized guide about defining QoS and its metrics.

“Quality of Service (QoS) is a set of non-functional attributes that may influence the quality of service provided by a web service which may include performance, reliability, scalability, capacity, robustness, exception handling, accuracy, integrity, accessibility, availability, interoperability, security, and network-related QoS requirements.”

(W3C Working Group, 2003).

Quality of Service focuses on non-functional requirements for distinct Web services. The QoS description is an ontology that harmonizes services request with service quality specification. The semantic matching enables the discovery agent to match requester’s service request to advertised services of providers using QoS provision and the consumer's preferences. According to Chaari; Badr; and Biennier (2008), quality of service (QoS) plays an important role in automatic web service selection. It is mainly used to establish valid and reliable web service and identify the best web service systematically from a set of functionally identical services. QoS parameter gives requester assurance and confidence to use a service. The QoS requirements for web services are essential for service providers as well as consumers.

In view of the increasing number of web services offering identical functionality, additional features, such as quality of web services (QoS) e.g response time, availability, etc. are required in order to locate and select the appropriate web services, and these needs have to be taken into consideration in the discovery and selection process. The size of the UDDI registry is increasing significantly, hence, locating and retrieving all matched web services and present them to requesters is becoming more difficult.

1.1.2 Benefits of QoS Usage to Web Services

Some of the advantages offered by QoS include:

- i. It helps in ranking services in order to select the one which best responds to the clients' needs among all the services responding to the clients' functional demands.
- ii. It enhances the fulfillment of customers' optimal selection.
- iii. It paves way for monitoring web services based on QoS properties.

1.2 Problem Background

The upward trends in web service providers, web service consumers as well as web services have posed remarkable challenges in the area of web service description, discovery and selection. Issues concerning effective methods and procedures to locate and select the most appropriate web service for consumers remain an active area of research.

In the UDDI registry, discovering web services are founded on using keyword-based search techniques, which may not return suitable results to clients' requirements. In order to resolve these problems there are proposals and research works to extend either

the UDDI or WSDL standards with QoS information. There are also works on adding a new role -a broker, to fill this gap, but the challenge of how to find the most optimal service for the consumers using QoS of the services is still an area of research. Determining the extent to which web services can provide the preferred functionality through a combination of Quality of Web Service (QWS) parameters is a major factor, principally in differentiating between services competing in identical domain. QWS incorporates a combination of quality parameters (including throughput, availability, response time and reliability) that can help distinguish web services' general behavior. Getting the service of interest depends on how well the web service offers these functionalities with respect to QWS.

In practice, service discovery and service selection go hand in hand. In the discovery stage, a requester discovers the service using the functional aspect of the service i.e. what the service is intended to achieve which can be viewed in terms of the input and output entities as well as the outcome. This stage ensures that the returned services meet the requester's basic (functional) requirements. The selection stage is the identification of the optimal service for the current task; this stage requires nonfunctional information, such as QoS about each service returned in the first stage. This second stage has become an important research area in the domain of web services discovery and selection. Hence, there is the need for efficient mechanisms for effective selection of suitable web service instance with regard to quality and performance factors at the moment of web service usage.

The bottom line is, when a discovery agent returns a number of candidates that offer the same functionalities to a client's request, which of the candidates should the client select? Since various users may have different inclinations on QoS for desired service, therefore, it is imperative to represent QoS from the perspective of requesters' preferences. For example, a requester may have preference for only response time owing to tight time constraint. Another requester may be mainly concerned with availability and successability, regardless of the response time and yet other service selection may be focused completely on reliability regardless of any other criteria. In the light of these, a single candidate cannot satisfy all the requesters because of different inclinations of the

various requesters. A QoS model should be robust enough to allow users to specify their preferences according to their diverse expectations and a selection mechanism should not only return appropriate service to a requester in line with his/her requirement, but also include measures that ensure selection of rational service for the requester regardless of his preferences.

When a requester submits his/her request for a service of interest with specified functional attribute such as “flight service” or “weather information service” the discovery agent use the functional property to return array of services that match requester’s functionality. In order to narrow down the results from the discovery agent, the returned services will have to be filtered based on their QoS properties.

The aim of a rational consumer of web service is to enjoy better service performance e.g. minimum waiting time, low cost, maximum reliability and availability (among others) to use services of interest, however, previous research works failed in one way or the other in satisfying requester’s constraints. For example, majority of the existing approaches either ignore the role of user's non-functional requirements or place unnecessary burden on the requester to provide weights for QoS parameters while others assign arbitrary value of zero to the weight(s) of parameter(s) not specified by the requester in making his request. This has the tendency of generating biased results. As a solution, an Enhanced QoS-based Filtering Model (EFM-Q) for selecting best web service among discovered services with consideration for user’s preferences is proposed.

1.3 Problem Statement

Based on the problem background presented above, the main question drawn is:
Which approach(s) can be utilized to improve the efficiency and quality of web service selection?

In order to proffer answer to this main question, the following issues need to be considered:

- i. What are the problems of the existing web service selection?
- ii. Which method is the best to be applied in this research?
- iii. What is the performance of the proposed method compared to the existing approaches?

1.4 Research Aim

The aim of this research is to design and develop web service selection model for selecting an optimal web service for requester in line with his/her specified constraints.

1.5 Research Objectives

In order to achieve the aim of this research, the following objectives have to be fulfilled:

- (i) To study and analyze existing research works on Web Services Discovery and Selection methods in order to detect areas requiring further investigation.
- (ii) To design an enhancement of web service filtering model to provide automated selection of web services.
- (iii) To demonstrate the applicability of the proposed model using an upgraded prototype tool (WSDis).
- (iv) To evaluate and validate the performance of the proposed model with benchmark models on users' specified constraints.

1.6 Research Scope

The focus of this research is to select optimal web services in response to requester's query and is limited to the following area:

- i. This research focuses on the enhancement of web service Filtering Model alone.
- ii. The enhancement of the proposed Web Service Filtering Model is based on QoS support for service selection.
- iii. Quality of Web Service datasets will be used in this research work.

1.7 Significance of the Research

In this research, the accuracy of web services selection in response to user's query will be enhanced. Moreover,

- i. An enhanced QoS-based filtering model for selecting best web service among discovered services will be developed which could be applied to solve service-oriented selection problems.
- ii. A prototype application for implementing web service selection will be upgraded to enhance its capability.

1.8 Contribution of the Research

- i. Provision of enhanced QoS-based filtering model for web service selection which allows users flexibility in expressing their preferences.
- ii. Upgrade of prototype application for the purpose of implementing web service selection model.

- iii. Enhancement of requester's satisfaction with improved web service selection tailored to their needs.

1.9 Summary

In this chapter, the current issues relating to this research work are discussed. Besides, the aim of the research and background of the problem, as well as the outline for the purpose and objectives of this research are presented. In the next chapter, focus will be placed on the review of literatures that are relevant to this research work.

1.10 Dissertation Organization

This dissertation is organized as follows:

- i. Chapter 1 presents the background, problem statement, aim, objectives, scope and significance of the research as well as organization of the dissertation.
- ii. Chapter 2 describes some related literatures on web service discovery and selection, and the role of QoS for web services. Then, the chapter provides an overview of web services discovery and selection approaches implemented in previous researches and stresses the advantages and disadvantages of previous approaches. The chapter ends with a summary.
- iii. Chapter 3 illustrates the methodologies of this research in terms of data extraction, data preprocessing, design framework, and implementation procedure.
- iv. Chapter 4 discusses the design and development of the enhanced QoS-based Filtering Model. The nitty-gritty of the proposed model is presented.
- v. Chapter 5 deliberates on the results of QoS based web service selection experiments, baselines approaches, the comparison between these techniques and evaluation of the results in relation to web service selection.

- vi. Chapter 6 presents the general conclusion of the research and suggests area requiring further investigation.

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