Can Information Visualization Techniques be used to Support Web Service Discovery?

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Abstract—The number of available web services on the Internet is increasing rapidly. As a consequence, the need is becoming greater for effective web service discovery techniques to support a user in finding suitable web services. Current web service discovery techniques provide lengthy textual lists that the user is required to manually explore to find relevant web services. Limited evidence has been found regarding the application of information visualization (IV) to web service discovery. This research will identify the problems with existing web service discovery techniques and investigate whether IV techniques can be applied to support web service discovery.

Index Terms—web services, web service discovery, information visualization

I. INTRODUCTION

Web service discovery provides a method of searching for web services that are specific to the requirements of a consumer. Existing web service discovery techniques provide long textual lists that the user is required to explore to select appropriate web services to use. Minimal information is provided to distinguish between web services of similar functionality. Thus, these methods can result in time-consuming and ineffective web service discovery.

Little evidence has been found regarding the application of Information Visualization (IV) techniques to support web service discovery. The objective of this paper is to investigate the problems with existing web service discovery techniques and determine whether IV techniques can be applied to effectively support web service discovery.

Related work will be discussed in Section II regarding web service discovery and information visualization. Several web service discovery criteria are identified and a comparison with existing web service discovery methods is given in Section III. Conclusions will be made in Section IV and future work will be outlined in Section V.

II. RELATED WORK

A. Web Service Discovery

Various methods exist to discover web services [1]. These methods include the UDDI (Universal Description, Discovery and Integration), search engines and publication sites. These web service discovery methods differ in terms of functionality and in the information that is displayed for each web service.

The most well-known method is web service discovery based on the UDDI standard. There are several limitations with this standard. The two most notable issues are that UDDI was not designed for web service discovery and the standard's inability to provide quality-of-service (QoS) parameters for web services contained in the UDDI repository [1]. Publishing sites such as XMethods and RemoteMethods provide another method of web service discovery [2]. Many of these publishing sites provide only long textual lists that a consumer is required to browse in order to find the most suitable web service. A third web service discovery method includes the use of web search engines to search for web services based on WSDL (Web Service Description Language) files [2]. A significant limitation of using search engines for web service discovery is that search engines are not concerned with the type of information that describe web services [3]. Another limitation is that the web service search results are displayed in textual lists similar to a web page search [1].

B. Information Visualization

IV has been used successfully to assist in minimizing information overload [4]. IV is especially useful for data with large data sets, such as the Internet. The purpose of representing information visually is to illustrate the data in a visual manner and enable users to interact with the information.

IV tools and techniques have been used to improve the visualization of web-based search results, but have not been widely applied to visualizing the results of web service discovery. Visualization of the results of web service discovery is a novel approach in service oriented computing (SOC) [5]. Sabou and Pan [6] identified several problems with web service repositories and proposed the presentation of ontology-based metadata to overcome these problems. A Cluster Map visualization technique was used to present web service metadata. Figure 1 illustrates the implementation of the Cluster Map visualization technique.

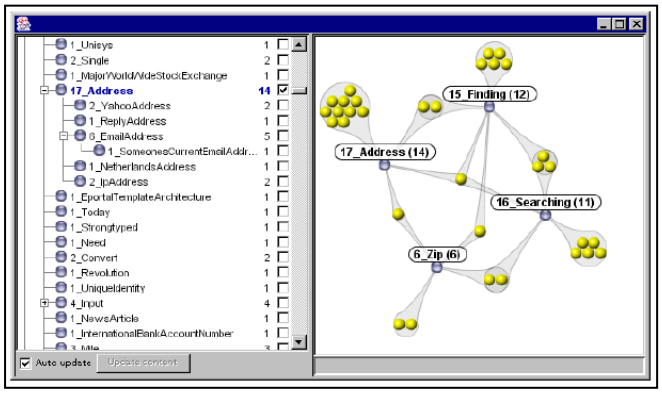

Figure 1 The Cluster Map Visualization Technique

Stollberg and Kerrigan [7] presented a goal-based visualization and browsing technique for web service discovery. This technique focuses on the consumer's goal and arranges the web services in a graph structure based on the semantic correspondence between similar web services. The purpose of this web service discovery technique is to assist the consumer in forming his/her goal and provide visual assistance in discovering web services that are most appropriate to this goal.

A common limitation of the above techniques is that only one visualization technique was used for web service discovery. No evidence is provided regarding the display of functional and non-functional properties of each web service. Web service results are also not ranked to identify the most suitable web service to use. Further research is required to identify appropriate IV techniques that can be applied to support effective web service discovery.

III. Requirements for Web Service Discovery

A. Criteria for Web Service Discovery

To support effective web services discovery the methods or techniques used should meet certain criteria. The following criteria for web service discovery are therefore proposed:

- *Functional Web Service Properties:* The functional properties of web services describe the capabilities of a web service i.e. what the web service can accomplish [8].
- *Non-Functional Web Service Properties:* Non-functional properties describe the characteristics of a web service to meet a user's goal i.e. how the web service can accomplish what it is capable of [8]. Non-functional properties are described in terms of QoS properties.
- *An Effective Graphical User Interface:* Providing an effective graphical user interface (GUI) so that the user can easily find and understand the available web services is essential.
- *Classification Capability:* Providing an effective classification method to categorize web services is necessary to aid in the discovery of web services.
- *Search and/or Browsing Facility:* If the number of web services contained in a dataset used for web service discovery is large, search and browse facilities should be provided to aid the user in finding suitable web services. Filters may provide an additional component to the search facility to enable users to easily refine their search.
- *Ranking Function:* If a search mechanism is used for web service discovery then providing a ranking function to identify the relevancy of web services in the search result list can provide a useful method to aid the user in web service selection.
- *Result List Sort Capability:* It may be useful to allow the user to sort the web service search result lists in the order he/she would prefer to rank the resulting web services.

B. Comparison of Methods

The existing methods identified in Section II were compared using the above criteria. Only publication sites currently provide support for non-functional web service properties. All of the web service discovery methods do not adequately meet the GUI criterion.

C. Survey

A survey by means of questionnaires and/or interviews will be used to establish how web services are currently being utilised by software developers in South Africa. The aim of the survey is to identify problems with current web service discovery methods and determine if IV techniques could be used to address the problems.

IV. Conclusion

This paper has identified the problems of web service discovery and highlighted the need for an improved method of visualizing web service discovery search results. The envisaged contribution of this research is to determine how IV techniques can be used to support effective web service discovery and utilization.

V. Future Work

The next phase of this research will involve the completion of the survey. Suitable IV techniques will then be identified and compared to determine which technique(s) will be the most suitable to adapt for web service discovery. A prototype will then be developed incorporating these visualization techniques and evaluated to determine the usefulness of IV techniques to support web service discovery.

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