Towards Quality of Experience driven Service Composition

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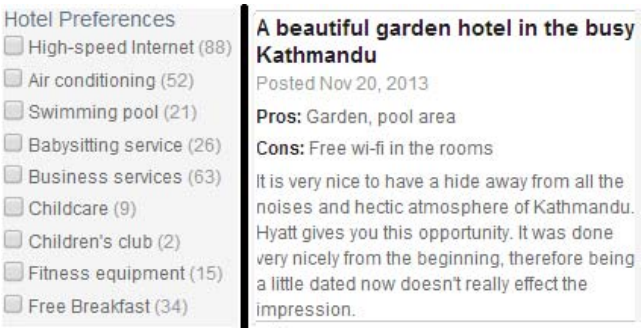
***Abstract*— Web service composition enables seamless and dynamic integration of applications on the web. Generally a user has to find services, select proper services and form a flow to create a service composition. The performance of the composed application is determined by the performance of the involved Web services. Current work in web service selection and discovery are based on non-functional, quality of service (QoS) aspects (such as, response time and availability). However, QoS information does not reflect an end user's perspective on the quality of services. An end user's perspective of a service is a credible source of information, covers diverse platforms and geographical locations. In this position paper, we provide an approach to extract a user's perception of the quality of services from user reviews on services and use such information to compose services. We provide a mechanism to select a particular service from a pool of services and recommend the best service execution path in a composite service.**

Keywords- service composition, QoS, quality of experience

I. INTRODUCTION

The web is a fundamental infrastructure to help a user without extensive technical skills to search and perform different activities, such as purchasing flight tickets, and shopping on-line. Recent progress in Web services makes it possible to publish, locate, and invoke services across the web. The Service-Oriented Architecture (SOA) uses loosely coupled Web services as basic constructs to build more complex systems in a flexible and rapid way. In particular, single service generally cannot fulfill the functionality required by users. Hence, one or more services are combined to fulfill the user's goal. However, multiple services providing similar functionality make service selection task non-trivial. The large number of services returned from a discovery engine [1]. It is difficult to select an appropriate service solely based on its functional characteristics. Various QoS based selection systems [3, 4, and 5] help to filter out irrelevant services. However, the process of obtaining QoS information [8] is largely overlooked. The QoS information may not be updated frequently to reflect a specific environment and platform. Moreover, the QoS information published by service providers is often limited and cannot respond to various user concerns about service quality. [2]. For example, Figure 1(a) shows a list of hotel preferences in a service broker (*i.e.*, hotel booking) website. The pre-defined preference list is static and determined when the application is designed. However, user experience with a service frequently changes as the service provider improves or degrades the service. Quality of experience (*i.e.,* QoE) [6, 9] measures customer's satisfaction with a service in to reveal user's satisfaction and disappointment in the services. However, not all the QoE attributes are included in QoS measured by service providers.



(a) (b)

Figure 1: (a) Hotel preferences (b) user's reviews

Online reviews often reflect the changes in user experience in service quality. For example, Figure 1(b) shows a user review on a hotel. QoE attributes are dynamic and cover wide geographical regions. During a service composition, one has to choose a service among a set of

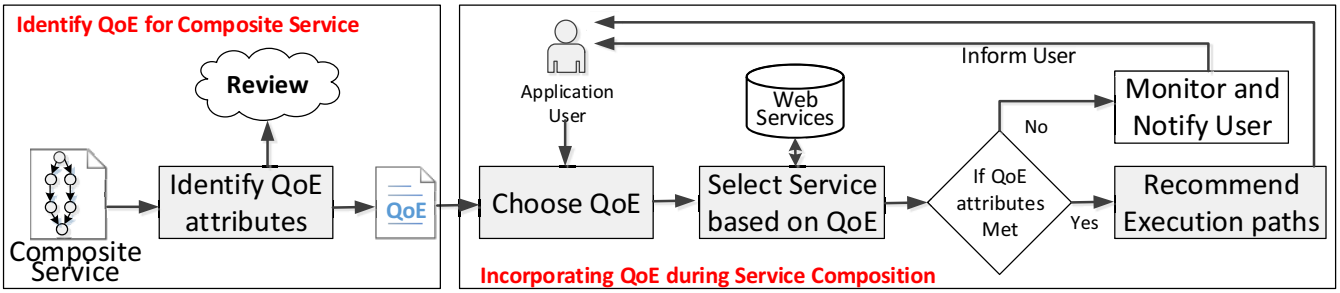


Figure 2: Overview of our approach to QoE driven service Selection

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functionally similar services. We use QoE attributes to guide service selection to generate an optimal execution path that meets a user imposed QoE constraints.

The remainder of this paper is organized as follows. Section II presents our approach to identify QoE attributes and incorporate QoE attributes in service composition. Section III shows an example scenario describing a business process and execution path recommendation based on selected QoE attributes. Finally, Section IV concludes our paper and explores the future directions.

II. Overview of Our Approach

Our approach is divided into two steps as shown in Figure 2. First step is to identify QoE attributes from user reviews based on our work in [2]. Figure 3 shows six different QoE attributes identified by analyzing user's reviews on the dropbox service. Each QoE attribute has a corresponding value representing a user's sentiment on the service. For each QoE attribute, user's opinion is ranked between -1 to 1. -1 denoting the lowest score and 1 representing the highest score.

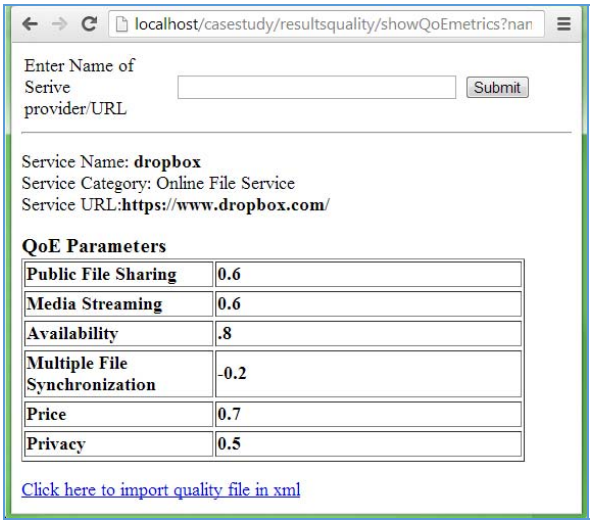

Figure 3: Interface to query QoE attributes of a service

In the second step (*i.e.*, incorporating QoE attributes to service composition as shown in Figure 2), a user specifies his preferences for a service composition. A user preference is represented as a tuple (QoE attribute, comparator, value and priority). A comparator (such as equal, less than and greater than) compares QoE attributes of a service with the values of QoE attributes specified by a user (*e.g.*, *cost* equals $50). A user can connect two or more preferences with the logical connectors: OR and AND. Figure 4 shows an interface that allows a user to select his preferences. For each QoE attribute chosen by a user, a user can specify the priority and a value for a QoE attribute. The selected QoE attributes become the criteria for the service selection and the service execution.

Our approach finds the best service that matches the user's preferences. From a functionally similar set of services, we choose a service that can maximize the user selected QoE attributes. To choose an optimal path between multiple execution paths, we compute the overall QoE value for each path to recommend the best path that meets the user's preferences. Some of the preferences may not be met (such as the price of a product). We monitor the services and notify the user when his preferences are met. The notification contains the next state to perform along the service execution path.

Figure 4: Interface for specifying QoE attributes

III. Prototype

In this section, we describe the prototype of our tool. Figure 3 displays an interface to query QoE attributes for a service. A user can search by the names of services or provide the URL of a service. The lower part of Figure 3 shows the result of a query. Figure 4 illustrates an interface for a user to select a list of QoE attributes to include in service composition. Figure 5 demonstrates the process for a composite service to purchase a product. A user has two choices shown in Figure 5: 1) select a used product or a new product; or 2) select an express delivery or a regular delivery.

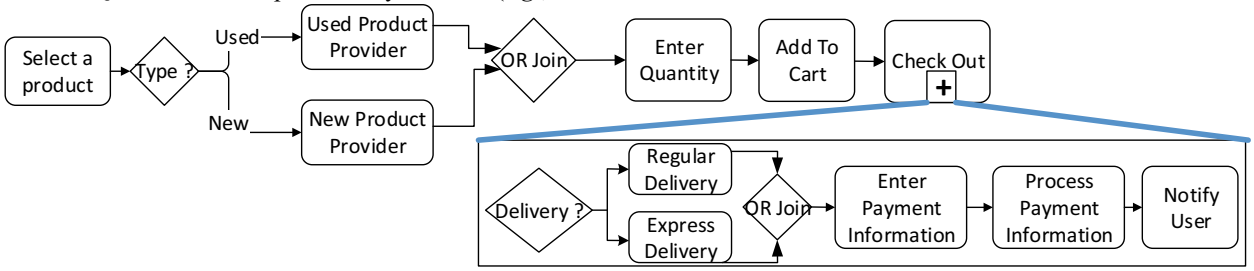

Figure 5: A composite service to buy a product

Figure 6: Scenarios showing execution path recommendation

Each choice executes the corresponding service associated with the choice. Based on the user preferences, our approach selects the best available services and recommends the optimal execution path to meet the desired QoE attributes. Figure 6 shows two scenarios (*i.e.,* Scenarios #1 and #2). In both scenarios, a user chooses *iPhone 3S* as a product. In Scenario #1, a user wants to buy *iPhone 3S* in a low cost. Hence, a user selects a QoE attribute *Cost* and assigns *low* as its value. Our approach first selects services that provide low cost *iPhones 3S* and recommends *Used Product* as shown in #2 of Figure 6. Similarly, we find services that deliver product at a low cost. Between *Regular Delivery* and *Express Delivery*, our approach chooses *Regular Delivery* as shown in #3 of Figure 6.

For Scenario #2, a user selects two QoE attributes *Cost* and *Time*. A user enters *low* as the value of *Cost* and *2014-04-07* as the value for *Time*. The scenario is run on the 4th of April 2014, and the user location was set in Kingston, Ontario. Based on the given QoE attributes, our approach suggests buy the used product and use express delivery. Even though the cost is low, express delivery is recommended to meet the time constraints.

IV. CONCLUSION AND FUTURE DIRECTIONS

Most of the previous work [4, 7, and 9] do not explain the sources of the user feedback and the ranking methods for feedback. In this position paper, we present an approach that analyzes user reviews to extract QoE attributes, selects the user desired services and recommends the optimal execution path to meet user's requirements. Our tool helps a user to view and select different QoE attributes related to a service. In the future, we plan to refine our tool to handle more complex process scenarios.

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