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A Quality of Experience-based Recommender System for E-learning Resources

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Abstract— Web services are a rapidly developing and generally acknowledged technology across all areas of management. Independent software systems that can be shared and called from anywhere online. The creation of educational tools (such LMSs, MOOCs, and e-learning) now typically makes use of web services. Having these learning tools readily accessible online is a great method to acquire and disseminate information. The primary objective of this paper is to describe how web services can effectively manage educational resources by leveraging Quality of Experience and to develop an effective E-learning recommender system in the context of web services that help the user choose a course based on his needs in terms of availability, cost, and reputation.

Keywords- E-learning, Learning Management Systems, Quality Of Services, Quality of Experience, Web services

I. INTRODUCTION

Web services (Gleason, 2002) are accepted software standards that allow the secure exchange of data and services over the web. Web services can be created and published in a registry, and anyone can invoke the service by agreeing on general contractual agreements. These interactions usually happen between the service requestor and the service provider. Web services use the core components of XML (Web Services Architecture,2004), which is used to tag the data, WSDL (Christensen Et.al,2001) used to describe web services, SOAP(Papazoglou,2012) used to transfer the data, and UDDI (Uddi Executive Overview,2004) is used to describe what are all the services available in the registry. As there are too many services addressing for single functionality in the registry, the process of selecting an appropriate service for specific functionality is a tedious task (Senthil & Lakshmi,2016). So, to select the best service, the user has to rely on the QOS extensions provided by the service provider. However, the web service broker justifies the conformance of the QOS to be published the specification. We can find the QOS information through the static information (Al-Masri & Mahmoud,2008) provided by the service providers. Since the information is not periodically updated in the registry, the information may be less reliable. A low-quality service will affect the selection and composition process and leads to failure. Therefore, a proper validation mechanism is needed to judge the QoS values.

An alternative approach to selecting the appropriate web service is based on Online reviews. The users express their satisfaction or their dissatisfaction with the service they have consumed, and the users share their experience of the services through these reviews. This paper finds the effectiveness of QoE attributes and how these attributes influence the service selection and discovery process. In the current scenario, the process of discovering and selecting an appropriate service according to the user (or) service requestor is a tedious task. Because there are similar services that address single functionality, the user doesn't know how to select the correct service that addresses his requirement. The only possibility is that he has to rely on the nonfunctional properties (papazoglou et al.,2006) associated with the services for service selection. The remaining of the paper is organized as follows: Section 2 covers the Quality of experience for web services. Section 3 covers the proposed model of the E-Learning system, Section 4 tells about the Quality of experience in Web services, Section 5 covers

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experiments and evaluation and Section 6 concludes the future work.

II. QoE for Webservices

In this paper, we have considered an alternative approach called as QoE (Bipin Upadhyaya et al.,2015), in which the user reviews are collected and processed based on the satisfaction (or) dissatisfaction expressed by the users at the time of review. To measure QoE's effectiveness, we will imply this to a learning management system. Nowadays, numerous e-courses are available in various web portals, and multiple service providers sometimes offer the same course. In such cases, the user may be confused to opt which course to select from which University. The description provided by the offering University about the course is not sufficient to judge, and even the QoS descriptions may vary from course to course.

In such conditions, the user may not be sure of selecting the right course according to his requirements. In a few cases, the course may be available at the time of selection, but the commencement of the course-related information is updated in the web portals are irritating to the user (i.e.) to be announced, On-demand and upcoming, etc. so we need a proper recommender system that collects the reviews based on the user query from the various learning portals and processes the reviews and to provide the best course to the user based on the ratings.

III. E-Learning Recommendation System

We have designed a web service recommendation system specifically for E-Learning and LMS, which suggests the best course based on the user ratings and recommends the top-rated courses to the user. It collects the requirements from the user and analyses whether the course is available in the E-learning portals; then it compares the rating, service provider reputation, cost and duration of the course and suggests the best course which has a high rating with good service provider reputation and low cost.

Since there are some universities that offer free courses, In such cases, our recommender system suggests the course with high ratings and a good service provider reputation. In the proposed E-Learning recommender system, we are going to collect user reviews from the E-Learning portals that offer courses in the area of computer science and engineering, such as Coursera (www.coursera.org), udemy(www.udemy.org) and edx(www.edx.org), etc. to collect the reviews expressed by the user based on the particular course.

Our recommendation system will also suggest the availability of the course, the reputation of the service provider, and the cost of the course offered by the University. (i.e.) If a user wants to do a course in database management systems, he will be searching manually in the e-learning portals, and he will pick the course according to his needs, and it's time-consuming.

The practical difficulty in the course selection in spite of the availability of the desired course; the service providers may not offer the course at the time. (ii) The cost may be higher (iii) the course is offered free of cost and the reviews are not good (iv) the coverage of the content may be small, but the duration is high (v) the Working experience (or) expertise of the instructor. In such a situation, the user needs to select a reputed faculty and his interesting course at a nominal cost with good reviews.

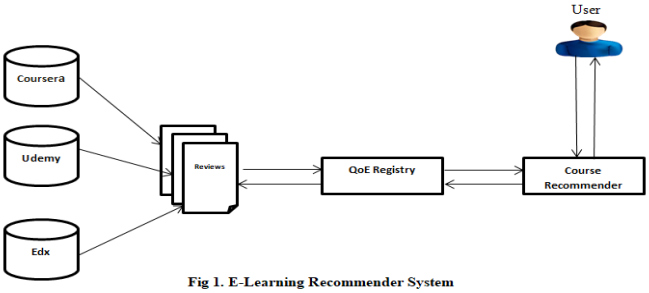
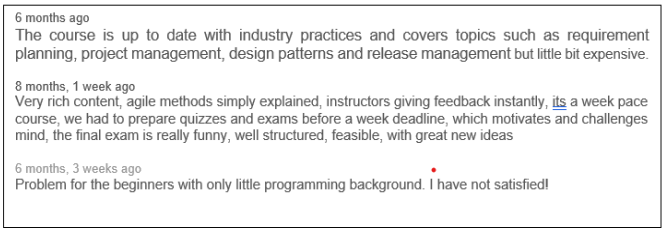


Fig 1. E-Learning Recommender System

IV. QoE in Web Services

Quality of experience, or QoE, is a user-perceived metric representing service satisfaction. The user tells what he thinks about any part of a service. Each part of the experience added to the overall quality. QoE measures the quality from the user's point of view. These QoE can be found in online reviews. Since many people share their opinions through reviews, it is seen as the best way to measure QoE.Fig 2. Shows reviews from three different users from coursetalk.com. The reviews contain the information provided by those who took the software engineering course. In these reviews, the users express their satisfaction and dissatisfaction with the course and the instructors. The QoE attributes can be identified using these reviews.


6 months ago
The course is up to date with industry practices and covers topics such as requirement planning, project management, design patterns and release management but little bit expensive.

8 months, 1 week ago
Very rich content, agile methods simply explained, instructors giving feedback instantly, its a week pace course, we had to prepare quizzes and exams before a week deadline, which motivates and challenges mind, the final exam is really funny, well structured, feasible, with great new ideas

6 months, 3 weeks ago
Problem for the beginners with only little programming background. I have not satisfied!

Fig 2. Sample reviews of an online course

A. *Extracting QoE for Webservices*

Users provide feedback in reviews and more over the user expresses more than one quality attribute in the reviews. So, the primary thing is extracting the reviews and finding and aggregating QoE attributes from the reviews from the selected domains, e.g., Coursera, EDX, and UDEMY. Second, we store the QoE attributes in a database. Finally, we have created an interface in which the user interacts with our database to find

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the best courses offered by the top service providers with minimal costs.

B. Crawling and Processing online reviews

To check the effectiveness of QoE attributes, we have minimized and concentrated on a few vertical domains. The reviews are crawled related to the field of computer science domain and stored in a review database, and then we extracted the QoE attributes by the following process.

C. Identifying PoS and tags in reviews using the Trigram approach

An individual may express both positive and negative ideas in a review; for instance, in Fig. 2, he expresses his satisfaction with the software engineering course but also uses the phrase "to be slightly expensive," which refers to the course's price and Degree of difficulty. Therefore, it is necessary to provide the target attribute and opinion for each evaluation. We've parsed the entire review into sentences and assigned each one a positive or negative rating based on the user experience. Words in a sentence can have their parts of speech (pos) defined with the help of NLP.

According to English grammar rules, a POS can be a conjunction, an Interjunction, a preposition, a noun, an adjective, a verb, or an adverb. We used a pos tagger to figure out how the sentences are put together. After pos-tagging, we used the standard trigram method to determine linguistic closeness. An n-gram of a word, like a trigram, is an example of this (Dimalen & Roxas,2007). The word "reviews," for instance, can be broken down into the trigrams _re,evi,iew,ws_. Word claims, character set claims, and sentence claims form the basis of the metrics.

D. Extracting QoE attributes and opinion

The reviews have been extracted, and the output has been preprocessed to extract attributes and opinions. The method is as follows:

- The QoE characteristics extracted from the review's body by evaluating its POS
- We implemented the trigram method to determine the linguistic similarity
- On the basis of the preceding procedure, the attributes and opinions are identified.
- The frequency of attributes and opinions is calculated.
- Rating and sentiment scores are calculated for each review
- The total review score and service rating are evaluated.

E. Clustering

User experience was given in different phrases in the reviews. We need to find related attributes which are given in different phrases and assign a representative(or) suitable title for each group of similar candidates (i.e.) we need to collect similar phrases, and we have to relate with a suitable title for each group.When a user expresses his view related to the phrases like operation, fast, upload, and download, he means to say about the performance. So the opinions come from different phrases that should map with a representative title called performance. Similarly, we have to find representative titles for different attributes which come from the various reviews. We have used a k-means clustering algorithm (Hartigan & Wong,1979) for similar clustering kinds of QoE attributes and captured the opinions for the finalized QoE.

V. EXPERIENT AND EVALUATION

First, the recommender system collects the user's query (or) course information. Second, it will check the availability of the course from the respective domains. Third, it will collect the user reviews from each domain, process the POS tagging with the trigram approach, and list the attributes and opinions.

We have collected the reviews for web services from three different domains 1. Coursera 2. Udemy, and 3. Edx, after finding the attributes, will find the overall review score for each course and the site score and service rating.

The service rating is compared to the three courses, and the course which has the highest service rating is suggested to the user with cost details.

We have implemented the service invoker using JDK 8.0, Eclipse 3.6, and HTTP Client. HTTP client is used for invoking RESTful services. We have monitored the response time and availability of the services. Cost and course details are collected from the service provider description. We have created a database using MYSQL. Service information, ratings, and cost details after the final rating is stored in the database. On the top, we have created an Interface for searching process.

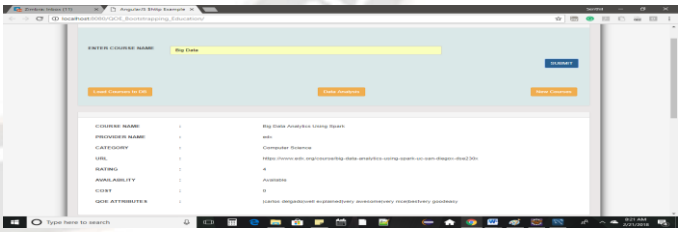

Fig.4 User interface

Fig 4 shows the user interface screen. The user submits his query in the user interface; based on the query, the available courses fetched from the domains and listed out the following details.

(i) Course name with the highest rating (Compared to three domains) (ii) Service provider name (iii) Category of the domain (iv) Service URL (v) Overall rating (vi) Availability of the course. Sometimes the courses may be commenced late or to be announced (vii) cost details (viii) QoE Attributes

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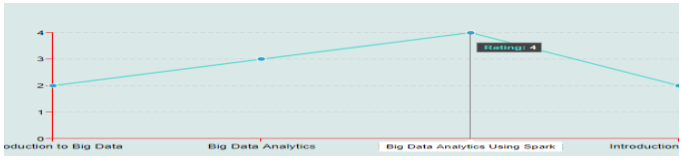

Fig 5 Rating score

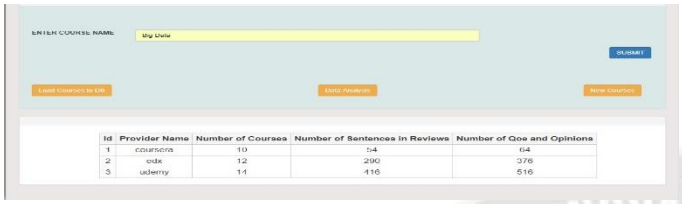

Fig 6 Data Analysis

VI. CONCLUSION AND FUTURE WORK

This paper presents a method for automatically extracting the quality-of-experience aspects from user feedback. We've built a recommendation engine that gives users suggestions for the best courses based on their ratings to test how well QoE works. Our recommendation engine processed all the reviews extracted the attributes and opinions, and rated the service based on the aggregated review score. The best course was recommended after comparisons were made across three criteria: cost, quality, and availability. Notable progress has been made using our method to extract and categorize QoE attributes from customer feedback.

Because of the number of services that provide essentially the same features, it might be difficult for the user to decide which ones to install from the registry. Either the user must randomly select the services from the register, which is a time-consuming and tedious operation, or they must trust the QoS claims made by the service provider, which are not always reliable and may contain incorrect information. For the purpose of addressing this, In the near future, we want to implement a recommender system that keeps tabs on accessible online services and derives QoS and QoE metrics. We may then recommend the most relevant service to the customer based on their query (or request), but there is a significant difficulty in properly rating any new services that enter the registry.

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