Facilitating Knowledge Sharing and Reuse in Information Service Using Information Retrieval Technique

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ABSTRACT
Information service is an important assistive tool in the knowledge sharing process. The knowledge sharing process covers a wide range of operations ranging from a course registration process to flight ticket buying. A good service could help both the service providers and the service users. The service users could get the right information at the right time and at the right place; whereas the service providers could reduce the amount of work created by uninformed users. In this paper, an electronic service framework (e-service) is proposed to assist the information service. This framework is based on an information retrieval technique to discover information. As a result, the information can be accessed at any place and any time. Furthermore, the issue of information quality is also a part of this framework. Each piece of information will be provided with tags and a weight. The tags will be used for categorization while the weight will be used to determine the quality of the information. Ultimately, the information will be evaluated by the users whose comments and scores will later be used to improve the system.

CCS Concepts
• Information systems → Information systems applications → Enterprise information systems →Enterprise applications.

Keywords
Information service; e-service; software framework; information retrieval

1. INTRODUCTION
The objective of this paper is to propose a tool for Information Service (IS) using the ontology-based information retrieval system. The aim of this application is to reduce the number of inquiries which ultimately leads to the reduction of resources. In addition, the users gain the benefit of ubiquity allowing them to search the information archives anywhere.

Generally, information service is an intersection between people and data, providing supports to the operations. The most common information service is a tourist information kiosk. The users of this service have to personally go to the service counter in order to make an inquiry. The topics of inquiry can be varied ranging from a location of an attraction site to a police station or even information about a bus route. The service allows the users to gain access to the information which leads to the satisfactory of the users. Despite the benefits of information service, a large number of human resources are required to maintain the availability of the operation.

This article addresses problems occurred with information service. Since normal information service is maintained by people, problems arise when there are too many inquirers. There might be some delay in the delivery of service or some of the inquirers might not even get serviced at all. Moreover, the inquired information is often similar. A common solution to this problem is to migrate the service to an online portal. The goal of online information service is to allow users to be able to electronically access the information. Consequently, human resources for this task could be reduced since the information can be accessed online; therefore, there is no need for a large number of human resources to manually operate the service. Furthermore, the availability and the mobility of the service could be increased. The users can access the service at any time and at any place. Information service is not only limited to the library. It could be extended to other types of industries. Some of the operations are healthcare information [1], [2], product lifecycle management [3], taxi service [4] and disaster information [5]. The basic implementation of online information service is to create a static HTML (Hypertext Markup Language) and the users have to use the search function of a browser to find the information. The static HTML provides a large number of information at the same time. The static website might be able to provide the information to the users without queuing but the quality of the information and the related information are not included.

This work presents a framework of e-service design for information service. The organization of this paper is as follows. In this section, the motivation and the overview of the problem are provided. Section 2 provides the review on related material. In Section 3, the details of the proposed method are provided. Finally, the conclusion and the future work will be provided in the last section.

2. LITERATURE REVIEW
In this section, the literature review on information service regarding the existing application of the concept is presented.

The term “e-service” is normally used to describe an internet-based interaction [6], [7]. The core idea of e-service is that customers have to interact with the organization using technology as a tool. The tool is not limited to only website. It could be information kiosks or even mobile application. There are many

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forms of e-service to support a wide range of activities; such as, government operation [8], business operation [9], or even learning process [10]. The emergence of this field of study is a result from technological advancement which allows users to access both information and service by themselves using the internet as a means. The users will have a different experience from a traditional approach because of the interactivity [11]. Hoffman and Bateson stated that customers consumed not only the service from the organization but also the experience [12]. An example of the traditional approach is mail order or postal service for which there is no feedback loop of information. As a consequence, it would be very hard to customize the service to maximize user's usability and satisfaction. The other restriction of the traditional approach is the availability. Customers have to access the service at a certain location and at a specific time period. This is not the problem in e-service. Since e-service is located on the internet, it could be accessed anytime and anywhere as long as the customers have all of the equipment. Despite the benefit of e-service, some researchers believe that e-service has a huge limitation: the lack of face-to-face communication [13], [14]. Consequently, the relationship between the customers and the organization would not be well developed.

One potential application of e-service is information service. Information service is a process of information exchange between customers and an organization which resembles the component of e-service. In consequence, the compatibility between customer's expectation and actual provided information is very important because it leads to customer's satisfaction [15]. There are many forms of the information service, such as, product comparing service.

3. PROPOSED METHOD

In this section, details of the proposed method will be discussed. First, the overall concept of the proposed method will be provided in Section 3.1. Then, the architecture and lifecycle of the proposed method will be provided in Section 3.2 and Section 3.3.

3.1 Overall Concept

As mentioned in Section 1, two important obstacles of online information service are the enormous amount of information and the structure of the information. In this section, each problem will be analyzed and the solution for each corresponding problem will be provided.

- The large amount of information – Normally, information service is used as a repository of data. As a result, there is a large number of information stored inside the repository. When a user needs certain information, he/she needs to go through the data in order to find the needed data. Therefore, a system that can help filtering and targeting the relevant information would be beneficial.
- The absence of information structure – For the traditional information service, the information will be put together in one single page. The information is linked to the predecessor or the successor. However, the structure of the information varies. For example, the course enrollment in the university relates to registration periods, pre-requisite courses, and semester fee payment. The structure of data will help the navigation of the information.
- The quality of information – The traditional information service provides the information from the providers' perspective not from the users'. There could be some missing gaps between the providers and the users. To fill this hole, the feedback on the relevancy of the provided information should be used to improve the service.

3.2 Knowledge Sharing Framework Using Information Retrieval Technique

In this section, details of the proposed framework will be provided.

Based on the requirements identified in the previous section, the components of the framework could be identified as follows.

- Information - A piece of information in this framework must be atomic. It should not be able to decompose any further. In other words, the information must be single responsible. One technique to verify if the information is atomic and has single responsibility is to write the purpose of the information. If a conjunction is needed to describe the responsibility of the information, it means the information is not atomic. If a piece of information is used to represent the enrollment, it should provide only the information of the enrollment on a certain aspect.
- Tag – Each piece of information must be with tags. Unlike the traditional information page, the tag will allow the complex relationship between pieces of information. As a consequence, the users could go through the information as they see fit. For example, the user could start at the enrollment process. Then, he/she could decide to check out the date and time for enrollment without checking the fee of each course.
- Rating – While the tag provides a mechanism to classify the information, the rating is used as feedback information from the user. Unlike the traditional information service, the proposed framework is a two-way communication for which users can instantly provide the evaluation on the given information. The rating will be later used as a weight in the information retrieval process. When two pieces of information attached with the same tag are retrieved from the repository, the one with the higher rating will be ranked higher.
- Information retrieval engine –This is the most important component of the framework besides the information. The engine works as a mapping between the user's inquiry and the information in the repository. Moreover, it also ranks the relevancy of the information.

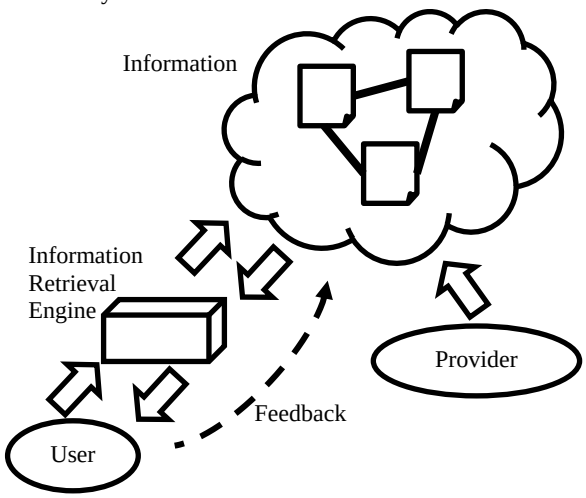

Figure 1. The architecture of the proposed framework.

However, this paper only focuses on the framework for the service, not the development process. The visualization of the framework is given in Figure 1. In this diagram, the information begins when the information providers setup the information repository. The construction of the repository depends on the tool employed by the providers. Some of the available tools are the knowledge engineering or knowledge creation theory depending on the target service system. The format of the information in the repository must follow the aforementioned criteria. Then, the users can start using the information through the information retrieval engine. The keyword will be put into the engine and the engine will retrieve the relevant information for the users. Moreover, the users can give rating back to the information in the information repository. The rating will be later used to tune up the system.

3.3 Proposed System Lifecycle

In this section, we will go through the lifecycle of the proposed framework. The lifecycle of the traditional IT system is as follows.

- Feasibility Study – In this step, we investigate the feasibility of the project which is not limited to only the financial aspect but also the functional aspect and the technological aspect.
- Analysis – The current state of the system will be examined; while the requirement from the users will be gathered and analyzed at this point. The requirement will serve as the potential characteristics of the new system.
- Design – Based on the needs of the users and the problems which need to be solved, the design of the new system will be constructed.
- Implementation – Using the design from the previous step, the developer will create the program.
- Testing – To guarantee that the program will function correctly, the result program will be subjected to a testing process. Normally, the test involves two aspects: the first one is the correctness and the second one is that it meets with the user requirement specification.
- Installation – After the testing process, the result program will be installed at the work site.
- Documentation – The manual and the software development document will be created along the development process.
- Evaluation and Maintenance – Since the software is for humans to use and is developed by humans, they are bound to contain some errors, or some features may not match with the requirements. As a consequence, this process is to adjust the program to correct the fault or to improve the performance.

This is a textbook process for the software development. The development of the framework still relies on the same Software Development Lifecycle (SDLC). However, the proposed framework has a distinct feature, adaptability, which requires additional steps to the SDLC. In addition, the SDLC solely focuses on the delivery of the functional aspect of the target system. The proposed framework involves with the construction of information repository which requires a different skill set. In this paper, the lifecycle of the framework can be divided into five stages: readying process, development, deployment process, refining process and disposal process. The detail for each process is given as follows.

- Readying process – This process is the first process of the lifecycle. The purpose of this stage is to create the knowledge repository. In this step, the information will be gathered from all of the stakeholders of the service providers' side. The service receivers will not take part in this process. The general tools for this step are the knowledge engineering for complex information and the knowledge creation theory for the tacit knowledge. The result of this stage is the structured information ready to be inputted into the repository.
- Development process – This process is the traditional SDLC. The purpose of this stage is to develop the software itself. The service providers and the service receivers will take part in this stage. The service providers will provide the requirements on their side while the receivers will focus on the expected features from the system.
- Deployment process – This stage will overlap with some part of the development process which is the installation. The purposes of this stage are twofold. The first one is to input the information into the repository. Secondly, the purpose is to publish the software to the service receivers. When this stage ends, the software should be fully enriched with the data and the users are aware of the online service.
- Refining process – This step will take place after the deployment stage is started. Since the users start to provide the feedback to the system, the system needs to adjust the system to improve the service receivers' satisfaction. There are two aspects to improve. The first one is the content itself. The content which receives the negative score will be evaluated by the audits. The scope of poor information is varied, ranging from the mis-tagging to the clarity of the information. The second aspect is the information retrieval engine. The negative feedback could come from the searching process which poorly guides the receivers to the mismatched information. In other words, this stage is a fine-tuning stage.
- Disposal process – There are many reasons to terminate a service; for example, the information becomes obsolete. However, the knowledge on the information design from the feedback is still useful. The feedback will allow you to separate a good information design from a poor information design for the service.

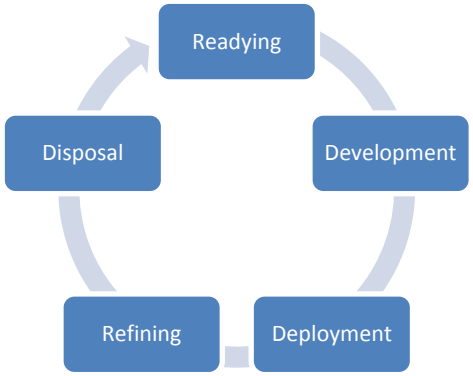

Figure 2. The lifecycle of the proposed framework.

In Figure 2, the summary of the lifecycle is given. The framework begins in the readying process to establish the information. Then, the information and the user requirements will be combined to create the software. Using the result software, the information will be inputted and the service receivers will be made aware of the e-service. As the service is employed, the users will provide the feedback information back to the system. The feedback will be used to adjust the system to maximize the users' satisfactory. When the information service is no longer needed, the knowledge

from the feedback information can still be used to construct a new electronic information service.

4. CASE STUDY

The proposed framework was applied in a real world scenario in a department of a faculty in a university, from which we did not receive the permission to publish the affiliation. In this department, there was a department's officer who worked as an administration and an information provider. The department's officer often dealt with a series of repeated questions from the students, which was a time-consuming process. Moreover, some students were not aware of some formal processes of the system, which ultimately created the unavoidable tasks. In this work, the gathered information was served as a repository.

The development started when the knowledge officer using knowledge engineering methodology to gather and formalize the knowledge. As a result, there were three groups of information:

- Admission – This class of information was involved with potential students. This type of information included admission channels, applicant's qualifications, studying plans, important dates, and fees. The target users of this information were parents, high school students and school guidance teachers.
- Current student – This information was the most frequently asked question. The target users of this information were current studying students. Many of this information could be found on the registration page of the department's website. However, the website was a traditional HTML website in which information was very difficult to find. Moreover, some of this information was not up-to-date. This information could be further drilled down into three subcategories.
  - Enrollment – The information in this category included registration process, fee payment, credit transfers and course withdrawals. The information also included tacit knowledge into the document such as a list of courses to be registered during the pre-enrollment process.
  - Attendance –The students needed to know the regulation regarding classroom attendance such as the allowable number of missed class.
  - Examination – The students needed to know the regulation regarding the examination such as the uniform to wear and the allowable time to leave the examination's room.
- Termination – This class of information would provide the termination of a student's status. This class would include both the regulation, such as a minimum GPA to resignation, and case study.

Then, the software was designed using the lean IT principle. There was only the relevant information on the system. In Figure 3, the wireframe for the homepage of the system is given. There was no unnecessary information on the page. The page contained two user interfaces: a search text box and a search button. The user had to punch in the key word(s) and press the button. The system would retrieve the information from the repository and display. The information retrieval engine of this system employed the elastic search technology (https://www.elastic.co/). The information page is shown in Figure 4. In the information page, there were two interfaces. One was for displaying the information and the other was for the rating. The rating could be multiple in case that there were more than one tag for a certain page.

The total score of rating for this system was 100 units for each tag. The initial score was 50 units for each tag. The rating was five levels based on the relevancy of the tag: poor, fair, medium, good, and great. The medium would not change the score. The step of each change was five units. Poor and fair ratings would reduce the score by ten units and five units respectively; while good and great ratings would increase the score of the tag by five units and ten units, respectively as well.

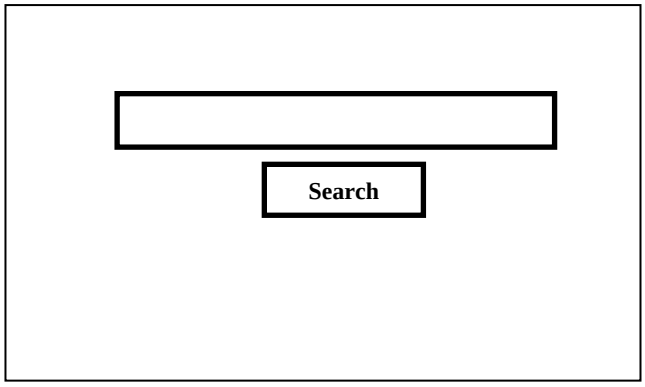

Figure 3. The wireframe of the homepage.

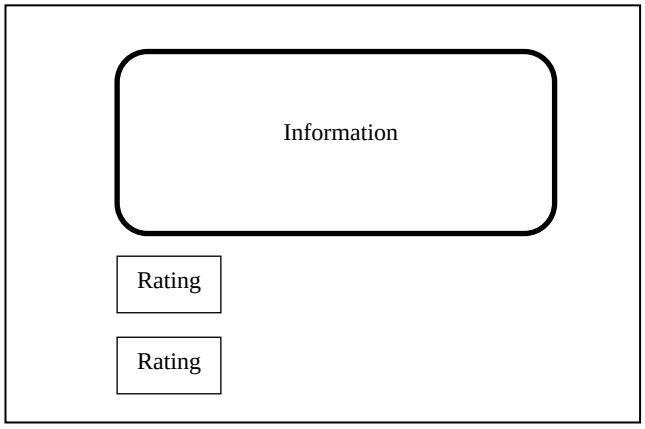

Figure 4. The wireframe of the information.

However, the implementation of the framework was in its early stage. Therefore, the feedback information was too small to analyze.

5. CONCLUSION AND FUTURE WORK

In this paper, a framework for electronic service is proposed. The framework is intended to solve problems for information service. The addressed problems are 1) the amount of the information, 2) the structure of the information and 3) the quality of the information. By solving these problems, the human resources for the task will be reduced and the availability of the information will be increased. Ultimately, it will lead to the increase of the competitiveness of the organization.

The proposed framework is based on four key elements: information, tag, rating and information retrieval engine. The information is the most atomic component of the framework. Each information in the framework must be atomic. The tag is a mechanism to allow non-linear relationship between information. As a consequence, the users do not need to go through the unwanted information. They can just make a jump to the target information. Then, the rating is a mechanism to allow the users to give the degree of relevancy and the quality of founded information. The advantages of the rating are twofold. The first one is that the providers can evaluate the quality of the information. Secondly, the users can take part in the service

providing process. The rating will be later used for information ranking. Therefore, the information that users give a higher degree of relevancy will be ranked higher. Finally, the information retrieval engine is a mechanism allowing the users to go through the information.

The lifecycle of the proposed framework is also different from the traditional one. Since the proposed framework deals with humans, it requires addition skill sets, such as information architecture, knowledge engineering and even marketing skills. The skills will serve in the new stage of the lifecycle. There are five stages in the lifecycle:

- Readying process – prepare the information,
- Development – develop the software,
- Deployment process – populate the information and publish the software,
- Refining process – adjust the system and
- Disposal process – terminate the software usage.

The proposed framework was developed and put to use as electronic information service for administration work in a department in a university. The existing problem of the service was that the service receivers made repeated inquiries for the similar information. The structure of the information was given. The process of this system followed the lifecycle, except the last two stages. The system was deployed within less than a year. The system was not refined due to the small number of feedback. Thus, the cycle was not completed.

The application of the proposed framework is not limited to information service. It could be used with other electronic services. The benefit of the proposed framework is to allow quick access to the target service. Therefore, it makes a suitable tool to bypass a large number of irrelevant information. The users can quickly get the service.

The next step of this research is to gather users' satisfaction on the software and the content. Despite the benefits of the providers, the receivers are also important stakeholders in the system. The information on the perception and the satisfaction of the service receivers must be gathered through surveys and interviews. The acquired information will be used to improve the rating update formula and the experience design of the user.

6. ACKNOWLEDGMENT

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