Educational-Resources Recommending System for Web Based Learning

Youji OCHI*, Yoneo YANO*, Riko WAKITA**

**Faculty of Engineering, Tokushima University*
2-1 Minami-josanjima, Tokushima, Tokushima 770-8506, Japan
Tel: +81-88-656-7497, Fax: +81-88-623-2761
E-mail: ochi@is.tokushima-u.ac.jp, yano@is.tokushima-u.ac.jp

***Faculty of Education and Regional Studies, Fukui University*
3-9-1 Bunkyo, Fukui, Fukui 910-8507, Japan
Tel: +81-776-27-8741 E-mail: oriko@cup.com

Abstract

We are focusing on an approach which handle a general Web as a resource in order to support self-directed learning for a student. Then, we are developing a Web based learning environment "Web-Retracer" for utilizing Web as teaching materials by a user's Annotation. Although the learner can share the Web resource that the others utilized in this environment, Web resources unsuitable for a student's needs becomes hindrance about her/his self-directed learning.
In this paper, we propose a recommending method of the resource united with a student's needs on the basis of a student's learning and Web browsing history. This method analyzes the feature peculiar to a resource, and extracts the resource with which the needs of the feature and a student agreed.

Keywords:

Web based Learning Environment,
Web resource,
Resource recommending

1. Introduction

In recent years, after finishing the curriculum in a school, people who desire a certain study are increasing in number. The learning style is often called Life long learning. Life-Long Learning is one of the policies being actively pursued in all over the world and one of the most important research topics in computer assisted education. In the educational approach, diversification of the learner's needs has been a problem. Therefore, a self-directed learning as a technique corresponding in order to the problem of diversification of the learner's needs is advocated. Self-directed learning focuses on the process by which learners take control of their own learning, in particular how they set their own learning goals, locate appropriate resources, decide on which learning methods to use and evaluate their progress [1]. The self-directed learning makes it important for a student to manage his learning and advances learning positively using an opportunity.
However, Nowadays there are two main problems of actual interest in this learner centered approach [2]. First, the learner has to determine how to provide access to real, relevant and truly useful educational material. Second, we need to motivate the discovery and use of knowledge by the learner, and make her/him share it with others. A traditional learning style (e.g. classroom based learning or the conventional textbook centered learning) cannot correspond to the self-directed learning as far as qualitatively and quantitatively be concerned.
On the other hand, there is a resource oriented learning method to support foreign language learning [3]. The method introduces something that utilizes as a teaching material in a learner's daily-life to the language-learning classroom. Resource is classified into three kinds.

(1) Material resource

(2) Human resource

(3) Society resource

Ayala [4] focuses on the World Wide Web as the main source of knowledge and information that contains the real, frequently used, current and popular language patterns, words, expressions and kanji compounds of the Japanese language, all of used and them situated in a real context.
We think that on WWW that are on the Internet in order to support not only language learning but also life long learning (self-directed learning) as a material resource. There are many WWW contents in the Internet and a learner can access them easily using WWW Browser. Okazaki [5] makes the existing Web a resource and has tried introduction to the lesson. Moreover, there are many people who use the Internet. If they can communicate each other, they become a human resource or society resource in order to support their learning. Nelson [6] proposed that a hypertext framework called "Transclusion". The framework allows the users to interact with any hypertext document. However, a current WWW system provides the users to

browse the document. The Web pages presented statically in Internet. The users can not interact with the web pages because the links information on the pages are embed statically and the users can not modify the other's pages. It is necessity to provide a framework where the user can customize and annotate the general Web pages in order to use the pages as Resources. The current WWW has ignored his concept.

We are developing Web Annotation environmental Web-Retracer that supports self-directed learning as a learning resource for general Web. Web-Retracer has a resource-customizing function [7] and resource-filtering function [8]. This paper describes the recommending technique of our system in order to pick up the learning resource in a general Web.

2. Web-Retracer

2.1 Problem of Self-directed Learning using a general Web

In general, the World Wide Web has a high potential as a platform for educational systems. The following conditions are required of resource type teaching materials in order to support self-directed learning [4].

1. Preparing variable resource
2. Clarification of the learning purpose
3. The improvement by learner

Since a huge quantity exists on Web and the Internet, the conditions (1) are fulfilled. However the learner has to determine how to provide access to real, relevant and truly useful educational material from Internet. Moreover, other two points are not fulfilled. Since most of general Web contents are not made for the learning, they do not have an interaction to solve the learner's question. It can be mentioned that the hyperlink that cancels a student's question does not exist as one of the factor. Therefore, it is the necessity for teachers to make it teaching-materials. However, it is difficult for a teacher to prepare a link beforehand supposing all students' needs in the self-directed learning. The processes give the burden on the teacher. If the learner can modify and improve them, the teacher's burden is decreased. However, Web browsers and servers that implement the protocol HTTP are mostly limited to provide reading access to Web documents. Then, the Web author only creates and changes documents locally and uploads them to a Web server. There is a possibility of following, sticking and coming in a suitable resource to a deadlock.

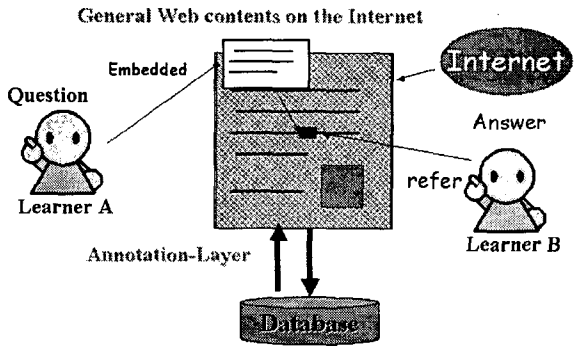

Figure 1 Outline of Web Retracer

2.2 Outline of Web-Retracer

We are developing Web-annotation System that is called "Web-Retracer"[7][8]. Web-Retracer allows clients to perform remote web content annotating operations. Web-Retracer has the following three environments in order to solve the problem stated for the foregoing paragraph.

(1) Annotation environment

A student can embed notes information at arbitrary Web pages. This realizes the resource improvement due to the student. Especially, Web-Retracer has "Q and A System" as Annotation environment. The annotation is linked to the Web contents dynamically. This framework is called "Adaptive Link Generation", which supports an environment suitable for users [9]. We have implemented it in Dynamic HTML. Web-Retracer has an annotation layer over the Web contents to embed the annotation on the WWW.

(2) Knowledge resource sharing environment

A student's annotations are treated as "Knowledge Resource". Web-Retracer records the knowledge resource from all students. Web-Retracer embedded the "Question Icon" that is hyper-link to the student's question. Clicking the icon, the students can accumulate Annotation information embedded in Annotation environment, and own jointly among students. By this approach, the learning purpose clarifies and the limit of individual learning is canceled.

(3) Web resource sharing environment

Web-Retracer accumulates as Web pages that the student had treated. The system treats the pages as "Web resource" and shows them in Web Resource List. By sharing accumulated Web resource among students, a system supports reuse of Web resource.

Web-Retracer supports self-directed learning of a student according to these three environments.

2.3 User interface

The system's interface has been designed in such a way as to be as user-friendly as possible, even for people who are not expert computer users. Figure 2 depicts a user interface of Web-Retracer. It is based on HTML and Java Script technology on Microsoft Internet Explore. Main window consists of an HTML page with three frames.

- The address-frame contains the address-input field for the student to input a URL
- The menu-frame contains the controls icon to manage the user interaction for system function.
- The main-frame shows the Web pages that the student select to learn different services and it changes depending on the service selected. It can also display the information of any of the links contained in those pages, such as the lessons registered in the network.

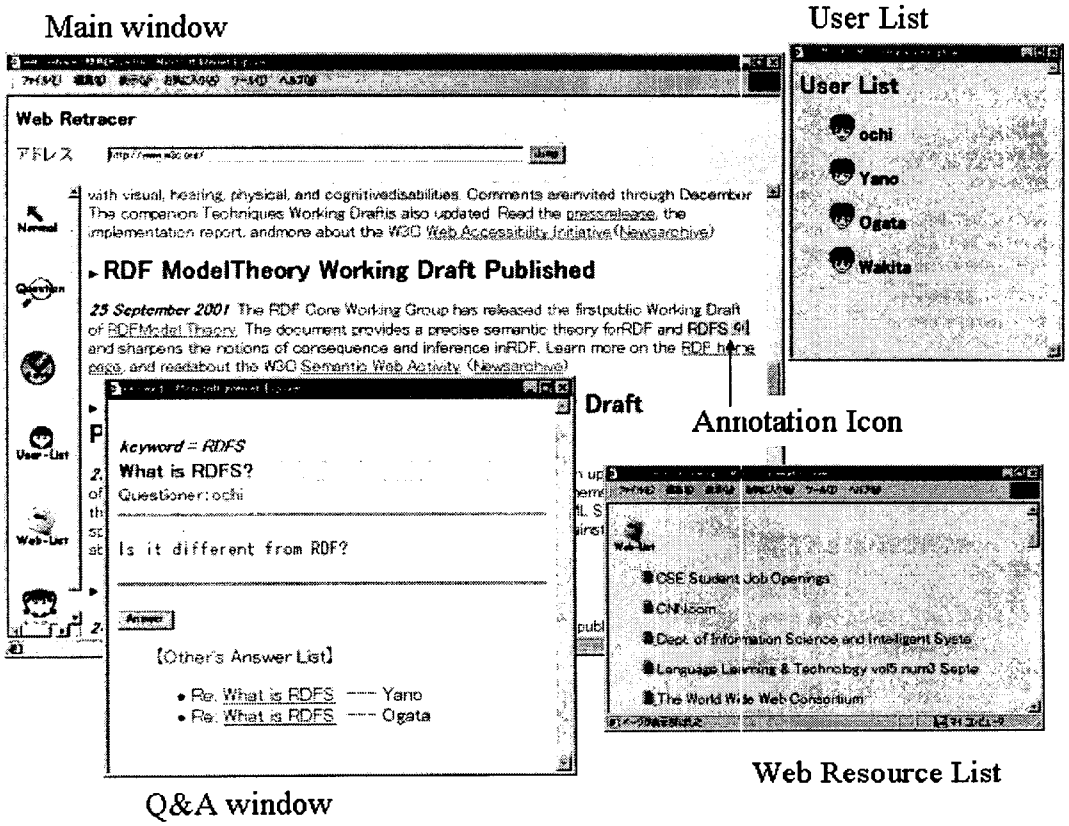

Figure 2 User Interface of Web-Retrace

The "Web Resource List" shows the title of the Web that the students have accessed. The "Q &A window" show the student's question like a BBS. It appears when the student selects the keyword or Question icon in the Web page. The "User List " shows the icon of other students who have accessed the Web page. When the student clicks the icon, the main window shows her/his annotation. Therefore the student is able to know the other's question in the Web page.

3. The Resource Recommending

3.1 The purpose of resource recommending

When the learning advances in the environment stated in Chapter 2, the resource currently accumulated and shared increases. The learner has to determine which Web resources are real, relevant and truly useful educational material for them. When the list of all resources currently shared is shown to a student, there is a possibility of becoming the hindrance of the learning. This problem is made into a resource share excessive problem by this research, and it is set as the purpose of this research to improve this problem.

Moreover, Although Q&A function is effective, it is not necessarily answered to all questions. In order to know the contents of a question, a student needs to access the Web page where the question is embedded. If the method of displaying all the contents of a question is taken, a lot of question information will be displayed regardless of the existence of its interest, and it will become the hindrance of study.

Retrieval by keyword can be considered as the technique of presenting the information that met the demand of a user. However, retrieval by keyword has the tendency to show an unnecessary reference result. [10]. Therefore, in order to narrow down a reference result, the suitable keyword

showing a target is needed. However, it is difficult to express the matter that the student makes the current learning target by the suitable keyword. Therefore, it is necessary to compensate the learning needs with a system side. In this research, it is thought that the learning needs are in the contents of Annotation that the student embedded in the learning history and the past of Web resource. Then, we propose resource recommending in order reflecting a student's needs on the basis of the view of cooperative information filtering. [10]

3.2 Outline of Resource Recommending

The student can continue the self-directed learning by answering positively to the question where the student was embedded in Web-Retracer. Therefore Web-Retracer provides a student with the following recommending environment as a means to support the student's self-directed learning. This is a new framework which a student's individual study supporting and her/his cooperation study support have based on a student's study

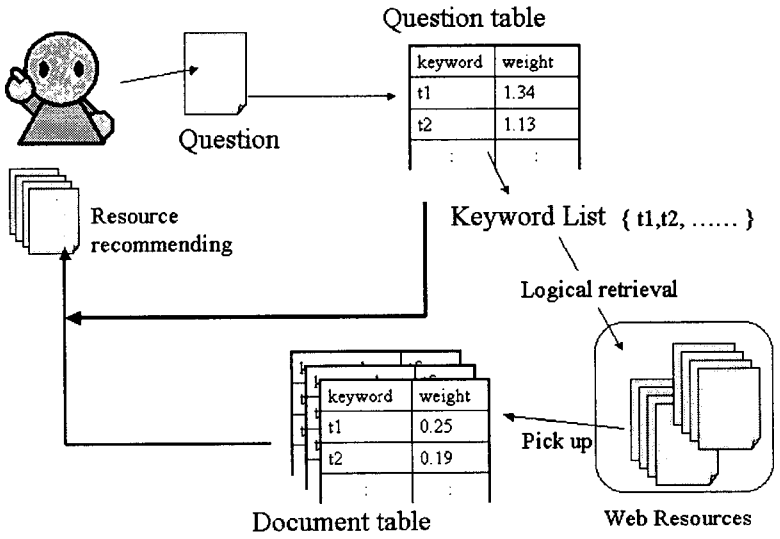

Figure 4 Process of Resource Recommending

needs and interest (Figure 3).

(1) Web Resource Recommending

Web-Retracer searches for Web resource relevant to Web resource under the current learning out of a share Web resource, and shows a student it. This recommendation supports the self-learning where a student solves his question by himself.

(2) Knowledge resource recommending

When it depends only on self-teaching of a student, her/his study may stagnate. The approach of self-directed learning differs from one of individual study. We think it required to also utilize a human resource rather than to depend only on a material resource, and to recommend study cooperatively. Therefore, our system introduces the function (reply request function) to recommend the contents of a question to a student so that a student may answer positively.

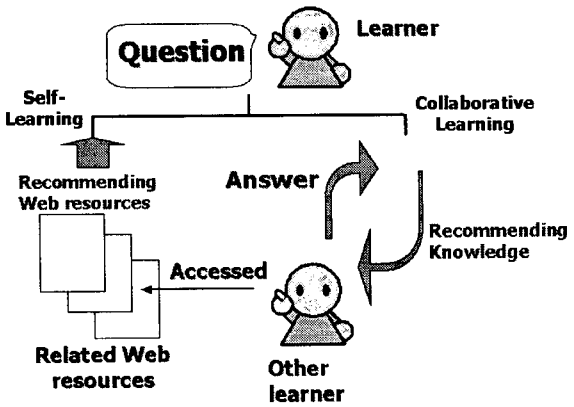

Figure 3. Outline of Resource recommending

4. Implementation of resource recommending

4.1 Using a vector space model

In this research, a vector space model is used as the recommending technique to be suitable for the student's needs and interests. A vector space model is one of the effective techniques for information retrieval.
First, morphological analysis is performed to Question document that the student is embedding to. Then it divides into a word. It generates for Web resource which

had the vector which made the dimension the divided word and used the appearance frequency of a word etc, as the ingredient accumulated. The cosine value of the angle that the generated vectors make is carried out whenever between resources similar (by formula (1)). In this model, it is assumed that it is similar so that cosine value is close to 1 [11].

$$\sigma(d_x, d_y) = \frac{\sum_{i=1}^{T} x_i \times y_i}{\sqrt{\sum_{i=1}^{T} x^2{}_{ii} \times \sum_{i=1}^{T} y^2{}_i}} \quad (1)$$

dx: Question document.
dy: Web resources in our system.
xi: The weight of keyword "i" in dx.
yi: The weight of keyword "i" in dy.
T: The total of an index word.

4.2 Decision of Web/Knowledge Resource priority

In a vector space model, when generating a vector, a priority of the ingredient of each dimension influences a result. By the proposal technique, the priority based on the concept of "tf (term frequency)" and the "idf (inverse document frequency)" method [12][13] is performed. "tf" is relative frequency. "idf" is which the words and phrases incline at the document, and has appeared and an index.
In our research, it applies as follows (by formula (2) (3)).

$$w_t^d = \frac{tf(t,d)}{\sum_{s \in d} tf(s,d)} \quad (2)$$

d: one document.
t: keyword in documents.
s: The number of all keyword in d.

$$w_t^d = \log \frac{N}{df(t)} + 1 \quad (3)$$

N: the number of all documents.
df(t): the number of documents that contain t.

The Process of resource recommending using the vector space model is shown in Fig. 4. When the student inputs her/his question, our system picks up the keyword as a keyword in order to retrieve the resources. Our system has a keyword weight table in advance. Using the table, our system orders the keyword in order to make a keyword lists. Then our system runs a logical retrieval in order to pick up the resources that consist of the keywords. Our system has already prepared the index table for each resource in a relational database. Therefore our system can retrieve the resources easily. The index table represents the weight of each keyword in each resource. The value is computed by tf-idf method in advance. Computing the value of keyword table, our system set the resources. Finally, our system shows the resources in order of the weight over threshold. Knowledge recommending is implemented by same method. After the resource recommending, our system retrieve the students who have embedded their annotation into the resource. We think that they must have the knowledge about the resource. The system informs other's question to them asynchronously.

4.3 User Interface for Recommending

Web-Retracer makes Web resource with which the knowledge resource was embedded with this share knowledge resource as the starting point related Web resource, and shows a student it. In that case, the degree of similar of the present Web resource is calculated, and only Web resource more than a threshold is shown by the list. When Web resource more than the threshold does not exist, a system also considers the knowledge resource that the degree of relation s low, and does not visualize it (Figure 5).

5. Discussion and further work

Our approach is a new framework which a student's individual study supporting and her/his cooperation study support have based on a student's study needs and interest.

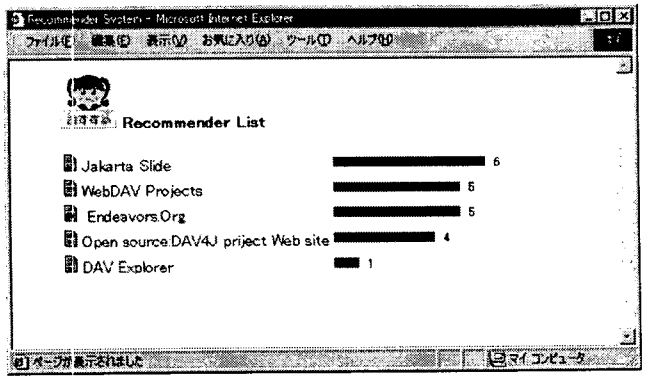

Figure 5 Recommender List

By introducing our system to a classroom can reduce a teacher's burden to select the teaching materials for the learner. The teacher can select a content of the teaching material without considering each learner's level. On the other hand, Q and A information is the student's level and ability. Therefore, if the student model can be built from her/his annotation information, our system can set not only by her/his interest but also by her/his understanding state, and can recommend the resources suitable for her/him.
In further work, we focus on "WebDAV" to develop our system. The protocol WebDAV (World Wide Web Distributed Authoring and Versioning) is developed as an extension of HTTP by the WebDAV working group of the Internet Engineering Task Force (IETF). By using WebDAV the communication protocols of our system are simple and the annotation information can be distributed and managed [14].
Finally, we have to take into consideration also about the analysis processing time for recommending resources in

order to make a trial of our system. Making the vector space takes may time, so it is difficult to deal with the student's request by real-time processing. We are considering introducing the cluster-retrieval method into our system.

6. Conclusion

We are developing a Web based learning environment "Web-Retracer" for utilizing Web as teaching materials by a user's Annotation. Although the learner can share the Web resource that the others utilized in this environment, Web resources unsuitable for a student's needs becomes hindrance about her/his self-directed learning.
In this paper, we propose a recommending method of the resource united with a student's needs on the basis of a student's learning and Web browsing history. This method analyzes the feature peculiar to a resource, and extracts the resource with which the needs of the feature and a student agreed. If the student model can be built from her/his annotation information, our system can set not only by her/his interest but also by her/his understanding state, and can recommend the resources suitable for her/him.
In our future work, we focus on "WebDAV" to develop our system. Then we will consider the method of computing the weight of the keyword in order to recommend the resource quickly, as we can. Finally, we will verify the validity of Web resource recommending by trial of a system.

Acknowledgements

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