

Functions of Distance Learning System: VIEW Classroom

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Abstract: In lecture-based distance learning system, various activities must be supported in addition to transmission of lecture contents. However, many conventional systems only support video image of the lecture. VIEW Classroom is a distance learning system supports various activities related with a lecture. For example, lecture record and self-study support function, on-line quiz function and discussion function are implemented on VIEW Classroom. In this paper, we describe the detail of these functions. These functions are designed to satisfy various requirements of teachers and students. They can improve the quality of distance learning remarkably.

Keywords: distance learning, lecture recording, self-study support, on-line quiz, discussion support

1. Introduction

With the rapid growth and spread of computer and network, computer-based distance learning systems have come to be used in actual education. There are many types of distance learning systems, such as web-based CAI, lecture archive or realtime distance lecture. In this paper, we focus the system to support realtime distance lectures. By realizing of realtime distance lecture, we can get many benefits, such as the increase of chances to take various lectures. Now, there are some realtime distance lecture systems using video transmission.

However, there are several problems caused by the system design in conventional distance lecture systems. These problems are as follows.

- **Lack of functions:** Many conventional systems only support the transmission of a teacher's explanation. As a lecture consists of various activities, such as Q and A, discussion or self-study, the system should support them.
- **Communication capability:** Many conventional systems mainly support the one-way communication from a teacher to students. At a lecture, interaction between a teacher and students is very important. We put emphasis to support communication among students.

To improve quality of realtime distance lecture, we must realize the system to solve these problems. Our *VIEW Classroom* is a distance learning system in which these problems are considered. Compared with the other systems, VIEW classroom has the following features:

- Supports various activities at a distance lecture.
- Supports flexible communication between a teacher and students or among students.

VIEW Classroom realizes these functions using database technologies. In this paper, three functions will be described the lecture record and self-study support function, on-line quiz function and discussion function. Using these functions, a teacher can provide a lecture of good quality and students can study the lecture efficiently.

2. Distance Learning System: VIEW Classroom

VIEW Classroom [5,6] is a distance learning system supporting various activities in distance education. In VIEW Classroom teachers and students are supposed to be at distributed location and individually have personal computers connected via the Internet. Using computers, they attend a virtual classroom through network. By CCD cameras and microphones, teachers and students communicate with each other in VIEW Classroom. Basically, teachers conduct classes using the following facilities.

HTML texts and whiteboard window: In VIEW Classroom, texts are written by HTML. A teacher and students see texts shown on a whiteboard window.

Input Utilities: Teachers and students can write over on the whiteboard window by several input utilities. When they drag mice, strokes are written on the window. When they type keyboards, characters become shown on the window. Teachers' inputs to the window are broadcasted and can be seen by students in real-time.

Notes: Teachers prepare notes before lectures and students can make notes of lectures. It can be controlled whether others can see their notes or not.

3. The Lecture Recording Function with Action Views for Self-Study

Lecture recording function in VIEW Classroom records teacher's explanation and presentation with actions of the teacher which can be used as an index for review. That is to say, inputs to the chalkboard window, an image captured by a CCD camera and a voice captured by a microphone are recorded.

2.1 Design of the Action History

VIEW Classroom adapts the Action History format [6,7] for recording lectures. VIEW Classroom records a teacher's explanation and other operations in different formats synchronously. Action History consists of a list of messages that are sent to the target objects and changes of attributes that the objects have. In case of VIEW Classroom, a target object is the chalkboard window and operations to the chalkboard window are messages. Operations to it are a change of slides, inputs by a mouse or a keyboard and so on.

We have designed Action History as hierarchical objects list structure shown in Fig. 1. HtmlPageHistory objects are basic objects in the highest rank in Action History. This object means inputs' history to the chalkboard window and each object corresponds to one slide. When a slide is changed, HtmlPageHistory object is created and added to Action History. HtmlPageHistory object has four attributes: StartTime, EndTime, the number of sides and a list of input Action History objects to the chalkboard window. There are two kinds of Input Action History objects to the chalkboard window, ChalkStroke objects and ChalkText objects. The former object corresponds to the mouse input, and the latter corresponds to the keyboard input.

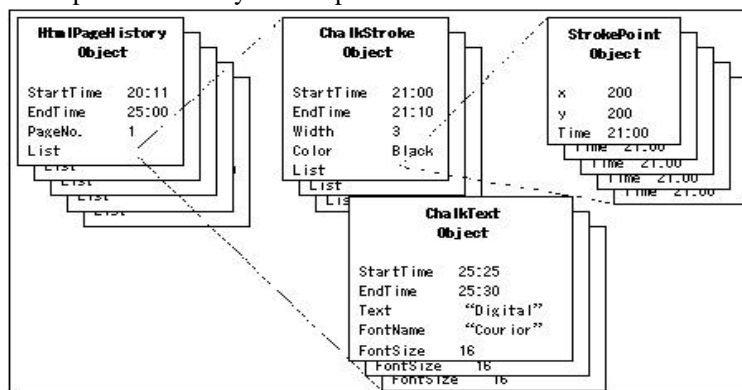


Fig.1. Structure of Action History

2.2 Design of the Lecture Recording Function

When a teacher input to the chalkboard window with a mouse or keyboard, an input Action History object correspondent to an input device is created. When a teacher input with a mouse, VIEW Classroom creates one ChalkStroke object. A ChalkStroke object has attributes: the width of a curve, a color, the time when input is started, and the time when input is end. When a mouse is dragged, a curve is drawn on the window. At the same time, a StrokePoint object is created and added to the ChalkStroke object. The StrokeObject has a mouse-dragged point and time of creation. When a teacher finished dragging a mouse, VIEW Classroom puts time stamp on the ChalkStroke object and adds it to the HtmlPageHistory object. When a teacher begins inputting by a keyboard, VIEW Classroom creates a ChalkText object. It has attributes: an input string, font information, the time when input is started, and the time when input is end. When s/he finishes, it adds this object to the HtmlPageHistory object.

2.3 Design of the Self-study Support Functions

Self-study support functions consist of two major functions: a playback function and a search function. In playing, operations to the chalkboard window recorded in the Action History format and a teacher's explanation recorded in the video format are played in different threads and synchronously each other. Action History can not be played automatically like video data, so the application plays it by the following mechanisms.

1. Make timer events occur every several minutes
2. At each timer event, the application gets time in playing of the video file.

3. The application shows Action History records to that time position.

In playing, a HtmlPageHistory object is a basic unit like in recording. When a HtmlPageHistory object is finished to record, the next HtmlPageHistory object is started to play. A user can play an arbitrary HtmlPageHistory object. In searches, a HtmlPageHistory object is also a basic unit. A HtmlPageHistory object corresponds to one slide and we think a slide is the most useful unit to search.

There are two types of search: a search for slides and a search for Action History. In a search for slides, the function searches slides including specified keywords or figures. It searches sources of slides written in HTML. When a search operation is finished and a specific slide is hit, the function searches for HtmlPageHistory objects that has an index of the hit slides as attributes. At the result, hit objects are added to a list of search results. In a search for Action History, the function searches HtmlPageHistory objects directly. There are searches for inputs by mice and for a duration of time. In the search for inputs by mice, the function searches specific colored strokes on the chalkboard window. The function searches a list of ChalkStroke objects in a HtmlPageHistory object and checks whether or not the color is agreed with the condition color. If the color is agreed, the HtmlPageHistory object is added to the list of search results. If no ChalkStroke object is agreed, the object is not added. In a search for duration time, the function checks the difference of the start time and the end time that are attributes of HtmlPageHistory objects. Fig.2 shows a screen shot of the self-study support functions.

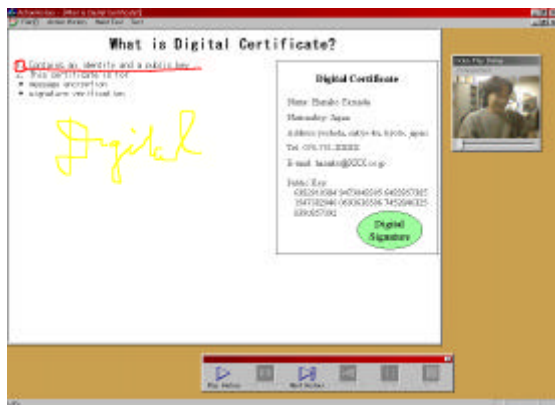


Fig. 2. Self-study Support Function

4. On-line Quiz Function

4.1 Basic Function of On-line Quiz

On-line quiz function supports a teacher to give a quiz to students in lecture. Teacher's aim of a quiz in lecture is to grasp students' level of understanding, and to guide them based on their understanding. On-line quiz function in VIEW classroom provides some functions to give a quiz reflecting this aim.

The process of on-line quiz consists of the follow three steps. The teacher gives on-line quiz along these steps:

Prepare problems: The teacher prepares problems of quiz based on his/her educational strategy, before or at lecture.

Give a quiz during lecture: The teacher gives quiz to students at appropriate points of the lecture.

Review results: After quiz, students' answers are gathered to a teacher and marked. Results of on-line quiz are presented to be easily understood by a teacher. To know students' understanding level precisely and deeply, the teacher analyzes results in various methods.

For students, the process of on-line quiz is simpler. A student only has to take an on-line quiz, and waits for the guidance from the teacher.

4.2 Functions to Support Guidance Based on On-line Quiz

Usually, a teacher gives a quiz during a lecture to use the results for guidance to students or improvement of his/her lecture. However, time and efforts are needed for a teacher to guide students based on results of on-line quiz. In VIEW Classroom, to support effective and efficient guidance based on on-line quiz, the following function is also provided.

Search Function: A query system to find out a set of students satisfying the specified condition is provided for a teacher. A teacher can find students whom s/he wants to guide easily using this function. Students can be specified by score, standardized score and/or the number of correct answers.

Dynamic Group Guidance: Dynamic group guidance is defined as guidance from a teacher to a group of students, grouped based on results of a quiz. These groups are automatically generated in real-time during a quiz. The criteria to group students are students' situation obtained by analyzing students' answer or their operation histories. This analysis is also performed automatically. A teacher gives interactive guidance to a generated group of students using chat. The image of dynamic group guidance is shown in Fig. 3.

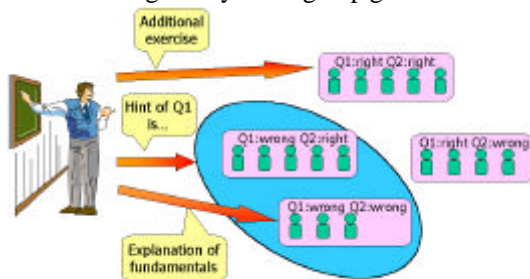


Fig. 3. Dynamic Group Guidance

5. Discussion Function

In conventional distance learning systems communication from a teacher to students is considered to be the most important function. Although communication from students to a teacher is also supported, most system ignore the importance of communication among students. Students can study through discussion among them. Current chat systems are not suitable for such purposes, since proper guidance of discussion from a teacher cannot be realized. A teacher has to observe the situations of discussion outline and to control the discussions among students. In this section we will introduce discussion function in order to satisfy these requirements.

A lot of students join distance learning, so our system divides them into some groups to discuss. Discussions' slides given by a teacher are shown in a window. They can write directly their opinions on the slides. The opinion consists of text and drawing data on the window.

5.1 Observe Function

A teacher wants to know situations of students and discussions, important topics of discussions and so on. Students want to know situations of discussions and the relation between their group and other groups. We support them to know this information by a proper visualization of the observe functions. They are used for not only during lecture but also after lecture. Table 1 summarizes what a teacher and students can perform by the observe functions.

Table 1. Observe Functions

	During Lecture	Lecture History
Students	<ul style="list-style-type: none"> • Relations among students • The number of the selected student's opinions • The activity of the selected student 	<ul style="list-style-type: none"> • History of the number of the selected student's opinions
Discussion Group	<ul style="list-style-type: none"> • Relations among groups • Topics of the selected group • The number of opinions in the selected group • The activity of the selected group • Members of the selected group 	<ul style="list-style-type: none"> • History of the number of total opinions in all groups or in the selected group • History of the topics of the selected group
Slides for Discussions	<ul style="list-style-type: none"> • The position of slides where discussions are related 	<ul style="list-style-type: none"> • Information and logs of the related discussions by the select the position of slides

5.2 Control Function

A teacher and students observe discussions by the above functions, control discussions and observe the result of control. A teacher can make discussions among students become effective as much as possible by interruption of discussion, help for inactive discussion and answer and hint for difficult questions. Students have some control rights. They can control number of their discussion groups, keep their discussion closed from other students and call for a teacher or selected students who do not join their discussion group.

6. Related Work

Classroom 2000 project (now renamed as “eClass” project) [1,2] at Georgia Institute of Technology is closely related to our research. This project copes with distance education as an experiment of ubiquitous computing. Ubiquitous computing is the idea to computerize casual things existing around people. One of its merits is that human activities can be recorded by ubiquitous computing technologies and recorded data can be reused later. This merit is similar to the idea of Action History. The system of Classroom 2000 has the functions of lecture recording, lecture search and so on. Classroom 2000 requires special computers such as a computer with an electronic pencil for a student. This point is different from VIEW Classroom. VIEW Classroom does not require special hardware. PERSYST [3] is a distance learning system similar to VIEW Classroom functionally. PERSYST is provided as a plug-in of WWW browser, and have the functions of lecture recording, Q and A between a teacher and students and so on. However, different from VIEW Classroom, PERSYST does not have flexible search functions for lecture archives, because a lecture is recorded as video data.

SEGODON [4] is a distance learning system whose features are electronic presentation and note system. Same as VIEW Classroom, SEGODON supposes teachers and students are in distributed location, and they have personal computers individually. SEGODON also supports exercise-type class and has functions for submission and return of reports. These functions are similar to our on-line quiz function. However, SEGODON does not have functions to record and reuse contents of a lecture.

These researches are closely related to ours.

7. Concluding Remark

In this paper, we have described representative functions of VIEW Classroom. VIEW Classroom can support various activities at a distance lecture. By using the functions mentioned in this paper, a teacher can provide a high quality lecture and students can study the lecture efficiently.

Although each function is individually tested, we need to make experiments for using the system under various conditions in order to improve these functions further.

We are planning to combine VIEW Classroom with standard technologies, such as Web browser.

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