

A Web Tutoring System using Video Chat and Pen-Paper devices

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Abstract: This paper describes a web-based tutoring system using pen-paper devices, which enables a student living in the provinces to take remote lessons from a competent teacher working in large cities with the feeling that the student takes personal lessons from the teacher sitting beside the student. In addition to the video chat between the student and the teacher, they communicate with real-time handwriting using pen-paper devices, so that they can communicate by speech and by handwriting which can easily express figures, formulas, and so on rather than being restricted and bothered by using keyboards. One of the largest prep schools has been using this system for more than a year.

Introduction

Children's education is one of the hottest and most urgent issues, due to the world-wide mega-competition in the knowledge society and declining birthrate in Japan. In public junior high schools, the ratio of students who commutes to prep schools as well as the high schools reaches 75% (MEXT 2007). It is difficult, however, for students living in the provinces to attend comprehensive classes by competent teachers because many of those teachers are teaching in schools in large cities.

This paper proposes a web application for a student living in the provinces to take remote lessons from a competent teacher with the feeling that the student takes personal lessons from the teacher sitting beside the student. In addition to the video chat between the student and the teacher, they communicate with real-time handwriting using pen-paper devices to make natural communication. Therefore, they can communicate by speech and by handwriting which can easily express figures, formulas, and so on rather than being restricted and bothered by using keyboards. This environment is no way inferior to the actual class since the student can enjoy personal lessons without worrying about classmates from a distant place.

Technote

The pen-paper device that we employ is Technote [1]. One can write anything on a usual paper placed on it with the attached pen. It is a digital note pad that can either sample pen-tip coordinates and send them to a PC or record them into built-in flash memory, which are read-in later when connected to a USB port. We employ it as the former style. The mental load of the student and the teacher of using the system is reduced to a minimum, because the written feeling is the same as writing with a usual ballpoint pen on paper (Fig. 1).

[1] Technote is the trademark of Kairen Co., Ltd.



Figure 1: Technote.

Development Environment and Implementation

Fig. 2 shows software architecture of the web tutoring system developed in the Adobe Flex 2 framework. The system is composed of Adobe Flash Media Server 2 to manage information on connecting multiple clients and relays input among webcams or Technotes of the clients and a web server. For each client, required is only a web browser with Adobe Flash Player 8 or later plugged in and no additional software or plug-ins are required to use the system since the system is developed in the Adobe Flex 2 framework.

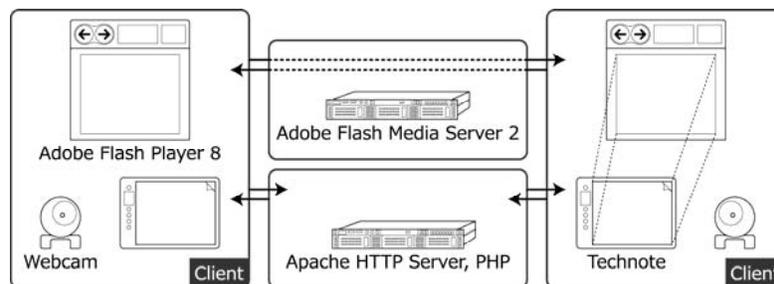


Figure 2: Software architecture of the web tutoring system.

Adobe Flash Media Server 2

It is the web server that delivers audio and video to Adobe Flash Player, which is widely spread. Web applications providing with video on demand, live web-event broadcast, MP3 streaming, video blogging, video messaging and multimedia chat can be developed by using the streaming function and flexible develop environment of Adobe Flash Media Server 2. Moreover, a new video codec added by Adobe Flash Player 8 is supported as well as database connection, directory systems, advanced load-balancing, fail over, clustering function.

Exclusive Access Control of Users

When a user connects to the system, a unique identifier is automatically allotted, and it is registered in the remote shared object that manages users. If the user login as a teacher, properties like his/her name and photograph, etc. are added. The session management table which shows current connections between teachers and students prohibits a new student from interrupting the current sessions.

Remote Transcript Sharing

A student and a teacher in a session share handwriting in real time by exchanging messages via Remote Shared Object. Not only coordinates of the handwriting but also the thickness and the color of the pen are exchanged.

Loading and Sharing of Images

Imported images are uploaded to the web server once, and downloaded to the relevant teacher and student. Images are synchronously downloaded by messages via Remote Shared Object (Fig. 3). The supported image format is GIF, JPEG, PNG and TIFF. Although TIFF is unsupported by Adobe Flash Player 8 or later, it is converted to PNG by using ImageMagick on the web server.

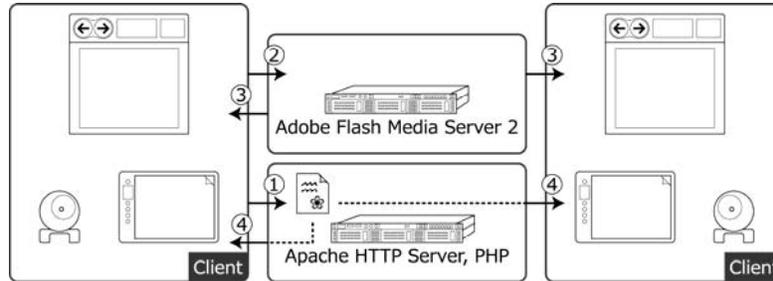


Figure 3: Sharing of image files via the web server.

Flow of a Session using Web Tutoring System

Fig. 4 is an initial screen of a client. In the subsequent sections, the flow from the beginning of a session to completion is described.

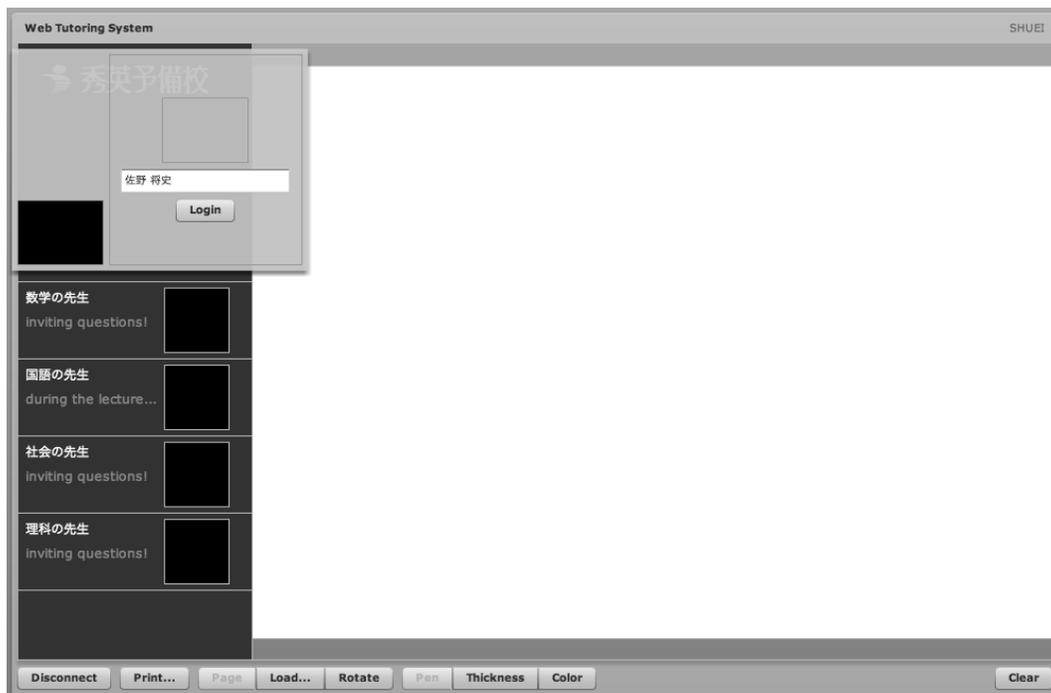


Figure 4: Initial screen.

Preparation for starting a session

When a user is a teacher, the preparation for accepting questions from a student is made by clicking the “Login” button after inputting his/her name. The photograph to be displayed in the list can be taken with the webcam if necessary (Fig. 5). When the user is a student, the session is started only by choosing a teacher from the list (Fig. 6).



Figure 5: Login window.



Figure 6: A list of teachers.

Video Chat

The whole area for the Login window in Fig. 5 changes to the screen of the video chat for a session, and the video of a webcam of each other is displayed. The video of the user’s webcam is displayed in the area under the left as it is.

Transcript

The thickness and the color of the pen can be easily changed on the screen though there are only two kinds of pens attached to Technote. If the color is set as the same as the background color, it works as an eraser (Fig. 7, 8).



Figure 7: Sliding pen thickness.

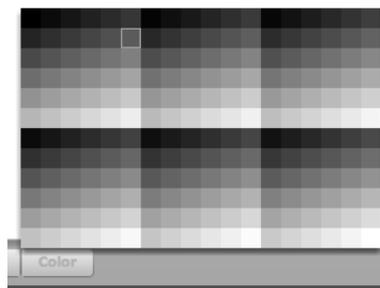


Figure 8: Selecting pen color.

Sharing of Learning Materials

In the actual classroom, learning materials such as question sheets printed on paper are distributed among students by hand. Similar distribution can be made electronically by preparing learning materials as image files beforehand and distributing them through networks.

The size of learning materials may vary and the orientation might be up side down or 90 degree rotated from the right position. Therefore, the web browser automatically adjusts the size to the drawing area and allows the user to rotate the images by 90 degree when clicking the “Rotate” button (Fig. 9).

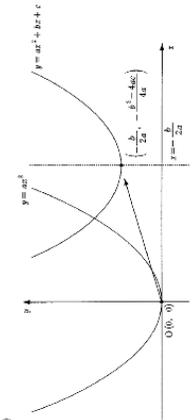
Web Tutoring System SHUEI

第1講 2次関数の決定・グラフ

基本事項

【1】平方完成とグラフの平行移動
 2次関数 $y = ax^2 + bx + c$ を平方完成すると

$$y = a \left(x + \frac{b}{2a} \right)^2 - \frac{b^2 - 4ac}{4a}$$
 となるので、頂点の座標は $\left(-\frac{b}{2a}, -\frac{b^2 - 4ac}{4a} \right)$
 軸の方程式は、 $x = -\frac{b}{2a}$ となる。

(例) 

($a > 0$ の場合の図)

(例) 一般に2次関数 $y = f(x)$ のグラフを x 軸方向に p 、 y 軸方向に q だけ平行移動したグラフの方程式は

$$y - q = f(x - p)$$
 したがって、 $y = ax^2 + bx + c$ のグラフは $y = ax^2$ のグラフを x 軸方向に $-\frac{b}{2a}$ 、 y 軸方向に $-\frac{b^2 - 4ac}{4a}$ だけ平行移動したものである。

- 2 -

Disconnect Print... Page Load... Rotate Pen Thickness Color Clear

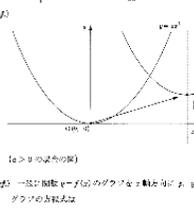
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Disconnect Print... Page Load... Rotate Pen Thickness Color Clear

Figure 9: Automatic sizing and manual rotation of downloaded learning materials.

Completion of a Session

The session completes if the student or the teacher clicks the “Disconnect” button. It returns to the state to accept questions from students when the user is a teacher, and it returns to an initial screen when the user is a student.

When the record of the session are needed, clicking the “Print...” button triggers printing of whole materials and handwritings on the drawing area. This allows the student to review the session because not only handwriting but also the shared learning materials such as the question sheets are printed together.

Demonstration Experiment

The system has been operated for more than a year on the intranet that connects between schoolhouses in Shuei yobiko (prep school). Operation on the Internet that connects the home of each student to one of schoolhouses has begun this year. It is being used not only for the intended purpose but also for unexpected usages, which includes course consultation, guidance etc.

Conclusion

The web-base tutoring system for students living in the provinces to take lessons from competent teachers working in schoolhouses in large cities was developed by combining the video chat and Technote. It provides with remote private learning environment and remote communication channel by speech and handwriting, which allows verbal and non-verbal communication between a student and a teacher as if the teacher were sitting beside the student. One of the largest prep schools has been using this system for more than a year and has shown that the system is useful not only for ordinary lessons but also for course consultation and guidance. Statistical evaluation of the system remains to be made.

Acknowledgements

We would like to thank Shuei yobiko (prep school) for their support and giving us the chance to work on this real problem. The basic study, formalization and presentation of this research was partially supported by Grant-in-Aid for Scientific Research under the contract number (B)17300031.

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