ÉCHO: A Configurable Remote Training and Monitoring Real-Time Environment

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Abstract — Internet and multimedia technologies have brought major changes to the field of e-learning and telelearning. It is now possible to hold virtual workshops in a synchronous computer based environment, to share documents and to participate live via video in a scientific experiment, or even manipulate a scientific device collaboratively from a distant site (virtual laboratory). A team made up of researchers from various universities has recently developed an original solution that makes it possible to use open and distributed e-learning environments in near real time. The SYNCHROMÉDIA project and ÉCHO software are currently being tested by members of a joint team from Quebec and Mexico.

The current paper presents some preliminary results of this experimentation and analyses the pedagogical potential of this type of environment for training and monitoring students enrolled in Open and Distance Education (ODE). First we will examine the types of pedagogical situations that can be used and enhanced via these environments. Then, we will see if these environments have an impact on how the professor intervenes on a pedagogical level. Lastly, we will focus on the actual management potential of these environments in regard to remote training, by presenting a few examples to illustrate the actual management potential of these environments in regard to remote training, by presenting a few examples.

Index Terms — Computer Mediated Communication (CMC), Computer supported collaborative learning (CSCL), Synchronous learning, e-learning, distributed learning environment, distributed cognition.

INTRODUCTION

ÉCHO, a distributed computer application, is a Collaborative Teleworking Environment that allows for real time transactional and interpersonal communication services via Internet [1]. With this environment, designed to facilitate teleworking, one can hold remote multipoint work conferences involving several users, give interactive presentations or attend on-line training seminars and view conferences, thus reducing travel and scheduling constraints. This software has built-in chat features as well as document, video and voice sharing. With such a combination of media within a single environment, one can offer basic consultation services and interactive exchanges required for any group work. The software also allows for adding other communication or management features within the user environment.

There are numerous potential applications for the ECHO environment in a wide range of areas such as e-commerce, e-learning, telemedicine, telemarketing, remote sensing and on-line laboratories to name only a few. Based on interpersonal exchanges, group communication and shared work functions in real time, this ECHO software represents a real and enormous cost reduction potential for educational institutions, given the economics of scale and costs associated with hiring highly qualified teachers and researchers. It can be used to create a distributed collaborative learning and working environment that copes with the institution’s traditional systems technology, enhanced by the value added capability of sharing knowledge and expertise through computer networks. The environment can be directly integrated into university Intranet and Extranet networks and provides added dialogue, exchange, animation and communication features in synchronous mode.

Specifically the groupware represents two major advantages for training institutions. (1) First, as pertains to media, this groupware makes it possible to use functions in a combined and complimentary way: application, chat, voice, video and image sharing; On-line training can include a whole range of new training services based on interpersonal interventions. These services can take many and diverse forms of exchanges: virtual workshops, videoconferences, seminars, demonstrations, on-line experiments, group animation and monitoring of students. By integrating all these capabilities into a single universal medium, thanks to computer networks such as Internet, training institutions can benefit from a second advantage, since students can be easily reached in their homes or in their workplace, thus minimizing scheduling constraints. (2) Secondly, in regard to teaching, the environment lets one make the most of
Virtual Interactive Learning teaching situations that are similar to face-to-face teaching given on campus, situations which allow for more direct interaction and exchanges, more spontaneous professor or tutor reactions and feedback. By allowing the main actors involved in remote training to focus on on-line interventions, one can streamline the teacher’s authoring process related to content via a real time, interactive and dynamic involvement similar to that in a classroom setting. By making totally spontaneous human communication in a synchronous teaching mode possible, the groupware provides remote training with a whole new range of teaching approaches which, up until now, were more difficult to achieve due to technological constraints. With the groupware presented here, it’s easier to develop shared workspaces and exchanges, thus providing for many potential applications connected with team-based training activities, group animation and monitoring of the learning process.

System Features

The ECHO [2] has a user-friendly interface which includes a number of exchange and communication features that are part and parcel of the software. For example, features include:

1. application sharing;
2. downloading documents and document consultation in real time (texts, tables, images, slides, charts, X-rays, etc.); all document formats can be displayed, including Web pages;
3. white board (annotations, drawings) Fig. 1;
4. chat (private or public chatrooms);
5. point-to-point and multipoint videoconferences;
6. video-on-demand (streaming) Fig. 2;
7. incorporating video images;
8. complete management of conferences, schedules and contacts;
9. two-way sound conversation (akin to two-way telephone voice communication);
10. Web site sharing (synchronization function);
11. brainstorming, voting;
12. shared Web access;
13. forums
14. document printing and backup.

All these features can be used in combination to increase interaction between partners. Table 1 below presents video features that are part of the ECHO software.

<table>
<thead>
<tr>
<th>Video Mode</th>
<th>Broadcasting</th>
<th>Audiovisual Equipment</th>
<th>Number of Participants</th>
<th>Recommended Links</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video Playback</td>
<td>Animator None</td>
<td>Participant None</td>
<td>Unlimited</td>
<td></td>
<td>The more high speed the link, the more instantaneous the broadcast.</td>
</tr>
<tr>
<td>(Streaming)</td>
<td></td>
<td></td>
<td></td>
<td>Minimum 56 Kbytes/s standard cable modem</td>
<td></td>
</tr>
<tr>
<td>Live Video</td>
<td>One-way</td>
<td>Camera + Headphones with built-in microphone</td>
<td>None</td>
<td>Unlimited</td>
<td>Idem</td>
</tr>
<tr>
<td>Two-way</td>
<td>Camera + Headphones with built-in microphone</td>
<td>Camera + Headphones with built-in microphone</td>
<td>Two pairs of individuals</td>
<td>Idem</td>
<td>The animator’s station remains active; the other active station has access via a request-reply system. (Main).</td>
</tr>
<tr>
<td>Point-to-point</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two-way</td>
<td>Camera + Headphones with built-in microphone</td>
<td>Camera + Headphones with built-in microphone</td>
<td>Number depending on server capacity</td>
<td>Cable Modern</td>
<td>Allows for a maximum of 8 participants per videoconference.</td>
</tr>
<tr>
<td>Multipoint (video-conference)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The interface (Fig. 3) includes four fields.
• The Menu Field, located in the upper segment of the interface, includes a Menu Bar and a Toolbar. These two bars provide quick access to software functions. The Toolbar can be freely configured by the user, that is, the user can add his own current applications (bookmarks, favorites, Email software, search engines, etc.).

The Collaborative Workspace is divided into four work fields. Each field can be displaced and resized according to user priorities:

• An initial field, the Main Field, that manages IP address display and the active user list. Via this field, one can switch over to another user via a request-reply system and identify the presenter and participants.
• A second field for video broadcasting.
• A third field, the Chat Field, for chatroom access linking conference participants.
• Lastly, the White Board Field, for displaying shared applications or documents. This board provides a Toolbar for managing on-screen text display and document backup and printing.

The Management Palette for conferences (Fig. 4) is geared to three categories of individuals, namely the lecturer, the participant and the guest. It automatically shrinks in size when not in use. This palette is a truly virtual manager, with over 30 different features such as:

• conference creation and management;
• keeping an updated list of conference participants and schedules;
• conference display;
• conference title page display;
• sending a written personal confirmation to each participant;
• a recall function for the date and time of the conference;
• a search function of conferences and participants;
• a search function of the current status of those involved in the conference: lecturers, participants, guests.

With the Management Palette, one can hold two types of conferences: public and private.

The system allows for document synchronization for all client stations. As well, each application keeps functioning independently, so the system can be upgraded and quickly modified. With a client/server architecture, one can switch to the per-to-per (P2P) business model for person-to-person consultations without having to be connected to the main server. Thus, each user has access to a local server on his Personal Computer, which can act as server for consultations with other users.

System Structure

ECHO is a client/server application. It exploits the H.323 protocol in order to get the best of its video streaming functionality. But one can get a multicast mode with geographically dispersed participants viewing and hearing one another simultaneously. While multicasting is enabled only over a Local Area Network (LAN), we're using a Virtual Private Network (VPN) [3] for participants from outside. Any Multiple Conferencing Unit (MCU) system can also be freely used with the groupware.

PEDAGOGICAL ASPECT

Current State of the Art

The shift from traditional to virtual teaching is a complex phenomenon whose ramifications have an impact on numerous aspects of teaching: social, pedagogical, and cognitive aspects, as well managerial and even political aspects. It has an impact on the actors involved, on objects, on methods and models. In short, educational models based on technopedagogy are complex and sophisticated. Tools designed to facilitate exchanges and communication between actors (human/human), known as Computer Mediated Communication (CMC) and Computer Supported Collaborative Learning (CSCL), should lead to synergy within a group, a distributed cognition, what some call “collective distributed intelligence”, where the group’s contribution as a whole enhances the personal reflections of the individuals involved.

Asynchronous Approaches

Over the last decade, a number of on-line remote training platforms have been developed, such as WCT and Backboard. According to Thot¹, there are as many as 225 such platforms in existence worldwide. Up until quite recently, these remote training platforms proposed an asynchronous approach. Research done on media environments tends to demonstrate that on-line training environments based on the single asynchronous mode of communication remain

¹http://thot.cursus.edu/rubrique.asp?no=12074
incomplete from a pedagogical point of view. In fact, the asynchronous nature of such systems only encompasses a segment of the many needs related to teaching [4]. This type of environment is built around a very linear, very hierarchical information access model (via hyperlinks) which doesn’t allow for much flexibility as to the choice of teaching approaches and procedures. The model doesn’t allow for the spontaneous interaction one encounters in a classroom setting on campus. These asynchronous models are more oriented to an individualistic learning approach geared to self-teaching.

**Synchronous Approaches**

A synchronous mode, still a rare component of remote training, can open up new and fresh pedagogical possibilities which, up until now, didn’t receive much favor because of the technical problems, constraints and costs associated with communication technologies.

With synchronous approaches, especially the most sophisticated (audio, video), one can establish a type of interaction, quite similar to natural conversation, within pedagogical situations (conference, seminar, virtual workshop, team work, virtual laboratory, on-line help services and telecoaching) that are similar to face-to-face teaching methods, while maintaining the strengths inherent to the remote training model. When used along with other asynchronous means, one can benefit from mixed and plurimedia environments which are very different from the traditional knowledge transmission model, since we’re dealing with an adaptive pedagogical model, based on cognitive learning, which makes it possible to create training activities based on the mutual building of knowledge, that is, on mutual training [5].

**Expressed Needs**

One of the most common criticisms expressed about remote training is that in most cases, the learner feels isolated. He doesn’t have a sense of belonging to a group, unlike the student pursuing his studies on campus. This lack of interpersonal contacts either with the group, or with his tutor, is often mentioned in research studies as one of the factors linked to dissatisfaction for this type of training. Such weaknesses in regard to human relationships, such a lack of spontaneity add to the impersonal nature of remote training. Others criticize its complicated authoring process along with its rigid procedures. This criticism usually applies to courses currently offered on the Net [6].

In order to remedy the situation, the solution seems to be to develop mixed training environments where all the social and pedagogical components of training are present. Thus, the synchronous mode is seen as complimentary to the asynchronous mode, an added value to the remote training model, since it opens up new pedagogical possibilities. This pedagogical approach is based on real-time interpersonal and transactional services such as seminars, conferences, virtual workshops, group work, telecoaching, laboratories. But, up until now, all such training methods were excluded from remote training because of a certain number of constraints connected with the development and costs of such technologies.

**Student Monitoring and Follow-up**

In spite of the many efforts made to provide quality student monitoring and follow-up, many learners still feel very isolated. This is the case in spite of the fact that most remote training teaching models include a monitoring and follow-up framework where facilitators (tutors) intervene to monitor and provide follow-up to students and where communication technologies (E-mail, forums) are available. Remote training is generally criticized as leading to depersonalized teaching since human interaction is downplayed, and there’s more emphasis on purely media-based interaction.

Research carried out on remote learner models and on how tutors are perceived [7] has shown that human “mediation” in remote training is a key component to the student’s success for this type of training. Having a sense of belonging to a group is also seen as a key factor that helps motivate the learner to participate in remote training activities. Student monitoring and follow-up play a key role in successful outcomes for this type of teaching.

**Telepresence**

With “synchronous, real-time” [8] interaction, remote training is more balanced, since it introduces a group dynamic based on sharing, exchanges, live interventions, dialogue, live decision making and scenarios that promote the group’s mutual building of knowledge. It also provides the collective and social aspects of learning, thus doing away with students’ feeling of isolation.

The ECHO groupware provides more direct and spontaneous teaching interventions in real time, based on a human communication model. Thus, remote training can get rid of its correspondence course image and offer the same level of potential interventions as the face-to-face teaching model, while maintaining flexible scheduling and reducing travel constraints [9]. With synchronous technologies, one has access to a wide range of communication tools, and monitoring and follow-up of geographically dispersed students takes on a whole new meaning.
EXPERIMENTATION

First, the ECHO software was tested on a clientele made up of trainers and tutors. For a whole week, designers of the CÆRENAD program were able to test the ECHO software environment. Following an initial period where they became familiar with the interface, designers were able to test various pedagogical scenarios. Each of the five teams had to develop pedagogical strategies where certain software functions were used. The other teams played the role of students. Findings from these experiments demonstrated the tool’s pedagogical value for remote training. More particularly, several scenarios made it possible to run experiments on collaborative work, on case study problem solving under the supervision of an expert, on the possibility of holding face-to-face meetings while pooling resources. Several scenarios enhanced the potential for co-producing documents via application sharing, live decision making and voting, the dynamic presentation of documents, including live comments. Participants felt very comfortable with this teaching mode. Several participants seemed to find the approach more natural, more users friendly and found that it met their professional expectations to a higher degree than the on-line asynchronous training model. Being able to preprogram presentations via the presentation tool helped improve the trainer’s preparation. Trainers felt that this function was an essential added value. As well, live video remains an interesting function, but trainers felt it was less important than the voice function. The following grid shows the comparative value of the various objects used in the ECHO environment [Figure 8]. A number of objects, such as the video function, were considered as important social interaction components, but they don’t have much value in terms of teaching effectiveness.

This same test was run with tutors likely to have to work with this type of environment in programs offered at Télé-université. The objective was to observe how these tutors used the various ECHO software functions for student monitoring during the learning process. The initial period where tutors became familiar with the software environment didn’t entail any major adaptation problems. According to tutors, mastering the interface functions was simple and user friendly. They found the conference management tool very comprehensive and useful. A number of participants really liked the hands free function and were pleasantly surprised by the voice quality. Contrary to what we expected, tutors didn’t feel that being able to view participants via video was essential. At best, live video helps establish contact with other members of the group and thus enhance a sense of belonging. The voice function, considered by tutors as being a more important tool for student monitoring and follow-up, provided the means to explain things and convince participants. In the same way, tutors seemed to really like the chat video function, both as a group on-line help tool and as a means of reducing the feeling of isolation.

During the fall of 2003, we’re going to test the ECHO software on a target population, namely two classes of students in a real teaching situation. This benchmark test will provide us with a more complete picture as to the tool’s pedagogical potential and as to the importance of ‘telepresence’ in a remote training situation.

CONCLUSION

We believe that integrating the “synchronous, real-time” mode will have a major impact on developing a worldwide educational system. This is the case for a number of reasons. This approach is more natural, more similar to the standard classroom presentation teaching model still used by many professors. Therefore, the following question comes to mind: Could this model be the one selected by the major clientele made up of professors whose professional approaches are more similar to the synchronous mode, than the asynchronous distribution model that’s currently associated with remote training? With its enormous pedagogical potential, the synchronous, real-time mode makes the remote training model more flexible and spontaneous. It also adds a more natural feel and flavor to the asynchronous mode, which is often seen as having a more rigid pedagogical framework and a more awkward authoring process. In fact, we’re currently heading towards a mixed learning mode which combines the advantages of both synchronous and asynchronous modes.

REFERENCES


CÆRENAD Centre d’application, d’étude et de ressources en apprentissage à distance, a consortium of universities in Brazil, Canada (Télé-université), Chile, Costa Rica, Mauritius and Senegal.
FIGURES AND TABLES

FIGURE 1 : WHITE BOARD

FIGURE 2 : MULTIMEDIA PLAYER TOOL

FIGURE 3 : ECHO USER INTERFACE
FIGURE 4: MANAGEMENT PALETTE

FIGURE 5: ECHO NETWORK DIAGRAM

FIGURE 6: Network Diagram with a Multiple Conferencing Unit (MCU) system.
FIGURE 6: NETWORK DIAGRAM WITH A MULTIPLE CONFERENCE UNIT (MCU) SYSTEM