SIC'ED: A Collaborative Intelligent System For Distance Learning

Mahieddine Djoudi
IRCOM SIC Laboratory
Bat SP2MI - BP 179
86960 Futuroscope Cedex Poitiers, France
+33 549 01 96 64
djoudi@sic.sp2mi.univ-poitiers.fr

Abdelmadjid Zidani & Said Talhi
Computer Science Department
University of Batna
05000 Algeria
+213 3380 43 54
azidani{talhi}@univ-batna.dz

ABSTRACT
This paper presents the collaborative distance learning system SIC'ED embedding concepts that are essential for collaborative learning and group interaction over the web. We are developing tools particularly tailored to address the needs of students. SIC'ED is intended to be a flexible education or auto-education plat-form and defines an educative server to which several tools are being progressively integrated such as, a shared editor, navigation and intelligent authoring assistance.

To effectively draw nearer students and teachers, we defined a collaborative communication service based on a new metaphor called "Telephone-Ring". In this paper we passed the system's software architecture with it's integrated tools in review and discuss its main features.

Keywords
Cooperative work, collaborative distance learning, educative technologies, collective intelligence

OVERVIEW OF THE SIC'ED ENVIRONMENT

The main goal of our system is to provide intelligent assistance as well as to enable collaboration among several distant students learning together with their teacher. Over a two-year period, we are developing tools particularly tailored to address the needs of students. To overcome the system complexity, we have used an approach that has significantly reduced the design and implementation efforts. It consists to progressively extend an existing system core with new components supporting intelligent assistance and collaboration functionalities.

We firstly started with distance learning framework composed by an educative server to which new components are being progressively integrated. The SIC'ED architecture as shown on figure 1, consists of:

- Data layer: includes all information required in collaborative training contexts such as multimedia courses documents, information about students/teachers (identification, presence, current activity, location, etc.), shared documents content (related to documents parts being simultaneously edited by students and/or teachers).
- Process layer: consists of four autonomous software components driven by the governor. We distinguish a communication manager tool intended to support conversation between geographically distant interlocutors. Another component called Group Tasks Manager[1] devoted to manage dynamic training activities in cooperative situations and supporting multi-user edition functionalities. Map drawer is a component especially intended to provide navigation assistance for students, and thus allowing them to better exchange their mutual experiences. Finally, an autonomous component providing intelligent assistance to students, and allowing them to appreciate their own learning ability. Teachers may complete this process through more pointed evaluation with detailed solutions.

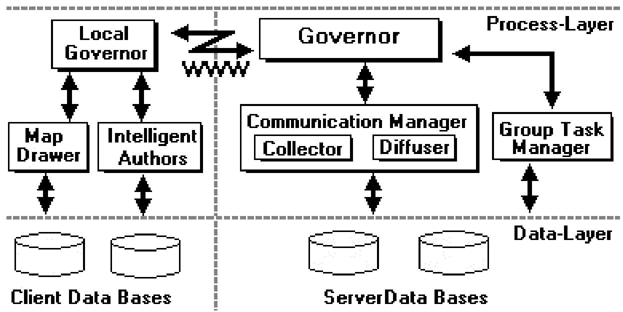

Figure 1. System Client/Server architecture

System Organization

The web makes distance learning activities often ideal candidates because of their distributed and asynchronous nature. However, such applications still suffering from facts

[1] Group task manager supports asynchronous shared editing as well as group awareness based on an event notification mechanism.

related to the very intensive bandwidth required [5]. Consequently, we have departed from the conventional web based system architecture. Instead of centralizing all implied processes at a central server, we used a decentralized basic approach allowing courses management to be performed centrally but course materials are served up locally through software components that run on clients computers, such as: navigation graphical map, editing tasks and intelligent authoring.

System data bases are replicated on different students computers, however the most recent document's versions are available at the central server. Local stored documents are uploaded on request since users are notified on parts evolving. The server also allows participants to communicate between them, while exchanging messages. Through sharing mechanisms integrated, persistence of modifications achieved on common objects is ensured. When late comers connect to the server, their entrance is automatically notified to the others. Collaboration processes may then naturally take place through awareness widgets made available within shared workspace and messages exchanging.

SIC'ED INTEGRATED TOOLS

Students need the ability to work simultaneously on shared documents, that they annotate and record their thoughts for future reference or to share them with the others. Furthermore, while navigating on the Internet, students need assistance such as that provided through concept mapping tools. In this section, we present SIC'ED integrated tools and discuss their main characteristics.

Educative Server

The server is structured into educational workshops, whose contents are individually or collectively built by teachers. Each course has a modular structure, including a presentation page, which contains links to a table of contents, glossary words, an on line bibliographic list, etc.

For a start, students must execute a formal registration that should be transmitted to the server for authentication and options selecting (i.e. novice or expert mode, etc.). The underlying mechanisms are Java interface and interactive HTML forms. Such forms are automatically transmitted to the server and will be processed. After which, another page of information is returned to the learner for review.

Navigational Aids

Standard web browsers are used more and more often to access information. Despite they provide useful historic and bookmarks facilities, they still show some insufficient assistance particularly for educational contexts. For such environments, disorientation and cognitive overload are the two most challenging problems to overcome. Several navigation assistance systems are available today, such as Nestor [10], Broadway [6], Hypercase [9] and Letizia [7]. A comparative survey of these tools is detailed in [6].

To enable users with time and space orientation, we designed a virtual navigation assistance tool (NaVir [1]). It is implemented with Java and may be used with any browser. Its functional core includes two important modules; the first one is intended for URLs addresses retrieval. The second module is designed for navigation map construction and interaction as well as navigation time management. User has also access capability to a glossary gathering frequently web found terms that may be misunderstood by novice users. SIC'ED Navigation map is mainly inspired from the principle used in conceptual maps [3]. The map is displayed under an oriented graph shape, whose nodes are labeled with pages addresses (URL), pages titles, time spent on pages, etc. Graph nodes are joined by links showing explicitly user transitions through visited pages.

In addition to map graphic layout generation, interaction is also provided through links creation/deletion, open/save and print operations, etc. In collaborative training settings, graphic map enables drawn information sharing among a group of learners [10] [6]. Thus, any user may benefit from others navigation experience. Furthermore map legibility is enhanced with zoom facilities. While using several zoom levels, user may display specific web addresses domain extensions (.com, .fr, .edu, etc.). This contributes to a better understanding of the Internet hierarchy, enables user with self-orientation and reduces his cognitive overload problems.

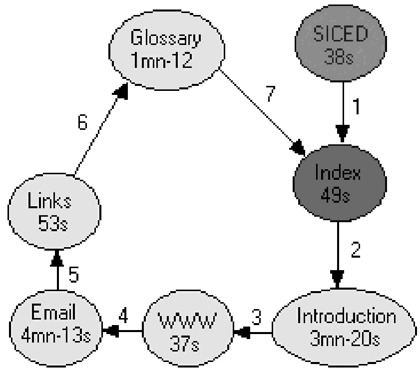

Figure 2. Page Mode display

Three displaying modes are used to facilitate navigation understanding. The first one, Extension mode gathers and sorts sites according to their extension. The two others modes are Site mode and Page mode, they are accessible through a simple click on the wished heads. Graph heads as illustrated by figure 2 represent visited pages and time spent on them. Furthermore, a coloration convention is applied, green color indicates the first site (or page) visited, whereas the last one is red and intermediate sites are yellow. When the first visited site is also the last, the associated head is gray.

Management of Collaborative Learning Activity

Interaction possibilities within a group allow individuals to adapt their behaviors to face various groupwork situations.

This functional interrelationship implies the existence of a common reason, such as the problem to solve. Collaborative problem resolution is a cyclic process, which stops when the common objective is reached. Such way of looking at the problem allows a big flexibility, because any solution is imposed. Modifications within the environment will involve feedback on group's behavior. Thus, individual mistakes are not excluded and become rather generator of new solutions for the group.

Since most kinds of work nowadays into educative organizations involve document editing. We particularly attach a great importance to collaborative edition. Consequently, we made a study on collaborative editing context, which has allowed us to highlight its characteristics and specifications in order to provide effective group work for distance learning situations. We have developed a shared editor[2] supporting asynchronous as well as synchronous interaction and several cooperation modes through which, users may interact for writing, annotating and commenting parts of a common document (JamEdit[11]). A document is decomposed into several parts on which users may work individually or together. Feedback on users actions is achieved through a notification mechanism, which provides to each one information concerning as well the others (identity, current activity, etc.), that each document part state (locked, free, etc.). Furthermore, telepresence concept is well managed through the repercussion of users position on their screens.

Learner Assistance

Learner assistance is provided in SIC'ED of two different but complementary ways. First, students may learn and solve problems they will meet with the assistance of a human teacher. Second, assistance may be virtual through intelligent integrated assistants. A typical scenario of use leads a student to ask for teachers help whether he has an impediment to carry out his work. Such assistance may be asynchronous, mainly through e-mail or synchronous through a direct dialogue between learner and teacher. In the case of teachers online unavailability, learners may ask for intelligent assistance. Intelligent assistants knowledge bases are based on the curriculum structure, learner model to provide the suitable help and also include a pedagogical expertise. Such expertise is derived from our study and is aimed to meet several important objectives such as learning objectives negotiation, curriculum sequencing, intelligent analysis of learner solutions, automatic problem generation, interactive problem solving, etc.

COMMUNICATION MODEL

Exploring real world metaphors as well as graphical facilities allows to build more complex interaction models, such as those required for group activities. However, despite the availability of several communications models, their ability to enhance group work productivity has not been proved. In fact, our studies on the subject led us to assess that building efficient communication models does not represent a technical prowess. In contrast, it is important to use the most common and usual communication way. Consequently, using interaction metaphors extracted from users daily life may be a very likely approach to draw them nearer. Furthermore, this will effectively unload users of the software-training phase, while telephone is the most fluently used tool for communication between people.

Telephone Ring Metaphor

Telephone Ring is a long connection that can be interrupted by a double opposition such as for the glance metaphor used in CRUISER [2]. Telephone Ring allows establishing a communication with a correspondent who is notified by a ring. It is a reciprocal connection between two users, one is the caller and the other must agree it. It is therefore similar to OfficeShare's metaphor used in the RAVE [4] and is characterized by three basic elements: reciprocity, feedback and privacy.

Communication Support Using TR Metaphor

The system software architecture is organized into layers around a server. Communication component within process layer manages connections such as a switchboard. Server Governor component manages access control and feedback information. Here are basic concepts around which the system is centred:

- Telephone ring action may be assimilated to a collaboration request expressed by a distant student. While he has no call, any user may achieve his work or a task for the community.
- According to recent telephone technology, we will first time suppose that one cannot call someone that is already speaking. In next phases, we will allow user to speak in alternation with several persons, and even establish a multiple connections as for CAVECAT [8].

Applying to Training Situations

Designing an efficient collaborative interaction model leans on the way interaction modes between users are selected. Such modes have to be natural and without less constraints. Therefore, we defined for SIC'ED the following learning collaboration modes:

- Star training: teacher interacts individually with students, supervises them and provides assistance and advises to those whom need it. Communications among students are disabled and teacher has catch up shifts between them. The main goal of such interaction mode is to increase students individual ability.
- Collective problem resolution: it is a typical situation of cooperation. Teacher poses a problem to the whole of learners whom will cooperate to solve it. Collaboration

[2] The collaborative editor JamEdit has been experimented at the university with teachers some conclusions are described in [11].

among students may be regulated through roles assignation. This mode is essentially intended to increase students ability to work within a group.

EXPERIMENTATION

A first experiment of the current SIC'ED system version has been conducted in real practice context for educational activities, with teachers and students[3] collaboration. It is there about a limited experience and we aimed through it two essential objectives. Firstly, collecting information on SIC'ED integrated tools to understand how they are perceived by users, their usefulness, etc. Secondly, exploring telephone ring metaphor within educational contexts. It follows that:

- Learners according to teachers advises (including server documents and web links documents), accessed easily courses.
- Despite some display limits, navigation map was very useful graphic support for students and allowed them collecting and structuring information.
- The combination of SIC'ED tools allowed us to show more complete and rich displays on students screens, such as dividing user screen into two parts showing browser's window and succession of visited sites.
- As for teachers, they found graphical map as a very adapted support. Discussions with them revealed that it has allowed them to apply a thorough revision to academic syllabus, courses support, etc. And the elaboration of a rich guided search ways provides essential and contribution for learner's initiation.

CONCLUSION

The SIC'ED environment described in this paper is still in its early development stages. The implementation of intelligent agents and collaborative functionalities complete integration are being achieved. Assistance provided for students based on our communication model allowed teachers to better understand students wishes.

The modest experience we achieved in the campus offers some encouragement for further developments. Teachers report that students have improved their skills and become more self-confident in taking initiative. Telephone Ring communication metaphor appears to run well from the students perspective.

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[3] Student are about thirty, aged of 19-22 years and are registered in second academic year of earth sciences at the university.

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