

# Web-Enabled Distributed Collaborative Learning Environment

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**Abstract:** This paper describes, in design, architecture and implementation level, a web based environment for co-operative teleworking and collaborative learning over TCP/IP networks, such as Internet. The implemented tool claims to be an efficient solution for a group of users/students that need a shared workspace containing various communication utilities, including on-line and off-line communication, with focus on transparent and secure interaction.

**Key words:** Computer Support for Collaborative Learning, Web-Based Collaborative Learning, Distributed Authoring, Shared Workspace.

## 1. Introduction

Multimedia telematics applications for communication and collaborative working give the opportunity for creative joint-work independently of geographical locations. Applications of this kind provide tutor and trainees with the ability of continual, close and efficient cooperation without any need for transportation and personal meetings. Furthermore, the environments for Computer Supported Collaborative Work (CSCW) may give the opportunity for virtual meetings, conferences and presentations without the limitation of physical presence in a common place.

On the other hand, the WWW (World Wide Web) has been spread world-wide as a standard of distributing multimedia/hypermedia information. There are many applications based on the WWW, such as video on demand, distance learning, home shopping, etc. Particularly distance learning is available by exchanging instructional information via network among students and instructors at a distance.

Several tools appear now, implementing various features needed by an environment for collaboration and distant learning. Well known tools are Microsoft NetMeeting and Netscape Conference. However, the tools mentioned above do not sufficiently combine the centralized control, the wide variety of files in exchange, the broad use of the tool over any operating system and the simplified access to the application through a web browser.

One of the greatest problems of an interactive learning and working environment among remote users is the vast amount of information and files that has to be exchanged in order to ensure a secure and unambiguous interaction. This paper introduces a flexible solution to the above problem through a generalized idea of a group of users working together in a shared workspace that provides them with the means of communicating in various ways.

The implementation of the CSCW environment has been based on the concept presented above and supports a shared workspace with file exchange, as well as off-line and on-line communication. Therefore, it aspires not only to satisfy the collaborative demands of a working team but also to facilitate remote tutoring and distance education.

The CSCW environment is available to the potential user through his web browser and his Internet or dial-up connection with the web server, without any additional installation in his local station.

## 2. General Architecture of the CSCW Environment

The basic concept of the CSCW environment is *the session* and it implies basic architectural principles of the CSCW environment. A session includes the participants, as well as files of any format (e.g. txt, doc, gif, etc.) manipulated by them.

For the development of the collaborative environment a web server is necessary, where all the session-relevant information will be placed so that it can be easily retrieved. The application consists of html pages, cgi scripts written in Perl language, and Java applets. Cgi, Java and JavaScript have been used to overcome the disadvantage of WWW passive protocol, HTTP.

The client of the application is obviously a web browser. The html pages of the application, as well as the session related files uploaded by the users, are stored in the server. However, due to the need of extra information and statistics for the sessions and the files included, and the necessity for definition of privileges and permissions of users on the session files, various control files have to be kept in the server where the application is installed.

The file structure in server follows. There is the basic directory "Collaborate" where the initial pages of the application are placed. There are subdirectories, one for every session created. In each of these subdirectories all the control files as well as the ones uploaded by the users are properly structured.

A graphical representation of the general architecture and the file structure in the server appears in figure1. The advantages of the architecture adopted is its great flexibility as far as the possible extensions are concerned. A lot of new features can be easily added, modifications are not time consuming and the whole file structure is efficient and clear. Also, widespread accessibility is achieved as every user, including the person responsible for the specific group, has a uniform interface.

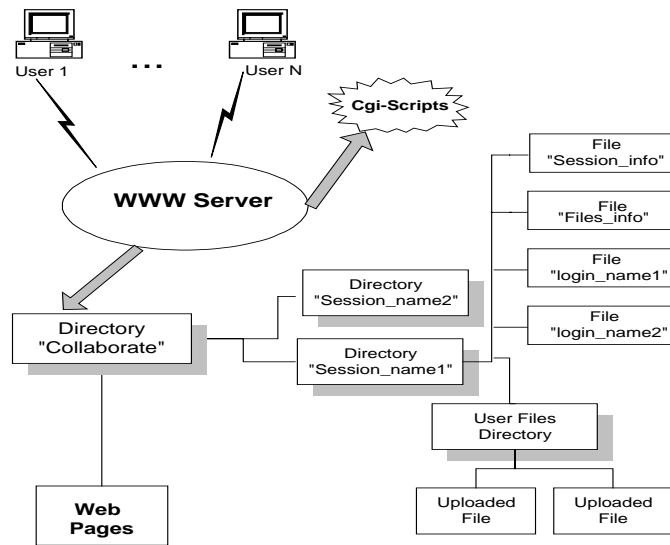


Figure 1: General Architecture

### 3. Functionalities of the CSCW Environment

The main functionality is the management and centralized control of a number of files of any format that are stored in the server. This functionality is enhanced by means of interactive communication between the users/students, so as to fully satisfy the real-time needs of a group. The user of the CSCW environment may exploit its communication features independently of the file exchange, rendering it a powerful way of co-operation, adjustable to many distance learning and working scenarios.

As mentioned earlier, the application is built upon the idea of a "session", a group of users/students and files controlled by a person responsible for it, the administrator/teacher. A standard procedure is the downloading of files from the server to the local station of the user, the modification of files, the insertion of new files, the updating of already existing ones and the ability to comment on them.

The functionalities can be seen in detail below.

- **File Exchange:** The files located in the server can be easily fetched by the collaborator. The file transfer is managed by the HTTP protocol that is used for most web-based applications. A user may save the file in his local disk, or open it automatically with the application of his preference, provided that his Web browser is appropriately configured to do so. The application supports asynchronous file writing, that is, a user (e.g. a student) creates a file, saves it in the server, another user (e.g. a teacher) downloads it, comments on it, corrects it and uploads it again for his collaborators to see it.
- **Modifiable Configuration :** Every session is accompanied by a unique configuration, defined by the administrator. This configuration is flexible as it can be dynamically altered. The collaborators joining a session are selected by the administrator and every one of them is identified by his login in the session. The login and the password of the collaborator comprise the unique "key" through which the collaborator is recognized by the server. The use of login name in the session ensures security of files, in the context of what the user can see and serves the centralized control of all files by the server of the application.

- **File and Session Handling:** In order to assist the procedure of file exchange and co-operation and to avoid loss of precious time and confusion, supplementary information about the files is provided. Avoidance of conflicts on changing the files is accomplished by enabling the user to reserve a file of his choice so as to change it. That is, if a user wishes to change locally a file and intends to upload it later, in the server, he can temporarily reserve the file, discouraging the other users from tampering with it. A file becomes available again only if the user that has reserved the file uploads it. All the participants are informed about the status of the file, whether it is available or reserved.
  - **Registration:** Not every Internet surfer is able to use the CSCW environment, as the Web server of the application requires a username and a password to provide permission for browsing in the pages of the CSCW environment. By filling out and submitting a special form, one stage before entering the first page of the CSCW environment, a user may request permission to use it.
  - **Browser Supported Mail Service:** The administrator's e-mail address is a link, where, by clicking, a user may send an e-mail to the administrator of a session (e.g. asking him to join his session). This mail procedure takes advantage of the browser's capability of sending mail and is open for extension.
  - **Bulletin Board:** The existing bulletin boards in the Internet support electronic announces in a simple text format, which is chosen as the most appropriate format to be used for the bulletin boards in the CSCW environment. The bulletin board of the CSCW environment is an "off-line" way of communicating among the collaborators. The participation in a session is considered as an automatic way of subscription in the session's bulletin board. A message in the Bulletin Board contains the collaborator's name, the date, the subject and the body of the message. A user can see all the messages and their follow-ups posted so far to the session's bulletin board.
  - **Chat:** Chat is an on-line way to conduct a conversation among the collaborators of the same session. It is used by the collaborators that are simultaneously using the session, to send messages or other textual content to other users. Unlike an audio conference, the Chat service consumes few network and computer resources.
  - **Suggested connection with NetMeeting:** The user of the CSCW environment is urged to using NetMeeting, concurrently with the main CSCW environment in order to use some of NetMeeting's features that are to be implemented in a later version of our CSCW environment. It is noted that the CSCW environment is able to tie in with any potential version of NetMeeting.
- The functionalities of NetMeeting that supplement the current version of the CSCW environment are:
- ◆ *Whiteboard:* Whiteboard resembles a paint tool, where drawing of several shapes is possible. It is a WYSIWIS (What You See Is What I See) tool, where a user draws and the others watch.
  - ◆ *Audio and Video:* Audio and Video Communication can be used within the confinements that NetMeeting itself sets.
  - ◆ *Application Sharing:* It is a WISIWYS ability, where a user runs an application from his local disk and every other collaborator watches the application in his own screen, even if he has not installed this application in his disk. All collaborators are allowed to write on the document, providing a shared-editing-like opportunity.

## 4. User Interface

The co-operation and learning environment has been designed, so as to provide a great degree of flexibility, without causing navigational difficulties and cognitive overload for users. The workspace has been carefully divided into sections that interact with each other, avoiding distraction. The careful design of the user interface, together with guidance from the help section, in hypertext mode, render it fully operable for every co-operative and learning goal.

The initial working space, the one first seen by the user when he enters the application, is an HTML page that comprises two frames. The left frame provides the user with choices that act on the sessions of the application, such as creating a new session, opening an already existing session, deleting a session (if he is the administrator) or Teleconferencing, through the use of NetMeeting.

The basic page of a session consists of three frames (see Figure 2). The upper frame of the application includes a table with the names of the files available for the particular user and retains this information throughout the use of the session. The file names are links to the files themselves, and the user is able to download the file as soon as he clicks on the respective link. Each file is accompanied by the necessary control information. In the lower frame, the actions on the files take place. That is, the choices that have impact on the file list above, which are: *Add File*, for file uploading, *Update File* for overwriting a file with its newest version, *Delete File*, for removing a file and *Attach Comment File*, for attaching comments to a file. The supplementary actions that take place in the session are distinguished in those available to all users, such as Session Info, Bulletin Board, Chat, Help and Exit, and in administrator

actions, such as Add collaborator, Delete Collaborator, Define Session Properties, See Log File, Clear Comment File.

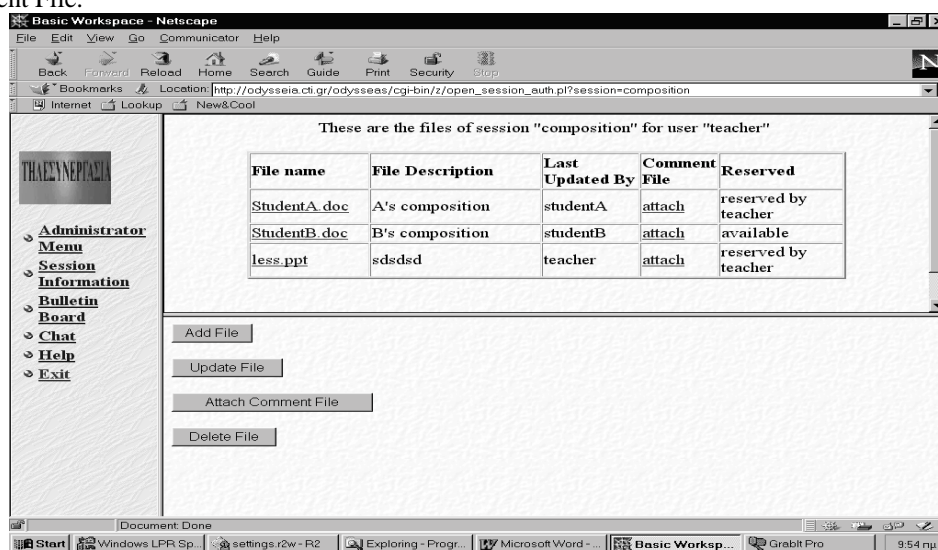


Figure 2: Basic Workspace of session “composition”

## 5. Future Work and Conclusions

The design of the CSCW environment as well as the platform that was chosen for the development provide the means for a relatively easy and quick enrichment of the interface and the services that this application of Computer Supported Collaborative Work has to offer. More thorough use of technologies such as Java and JavaScript could enhance the functionalities of the CSCW environment. Features that would contribute to a more integrated environment of collaboration are: Integrated Mail service, A *Whiteboard*, Multimedia communication among the users (sound and video) and shared editing of files. This CSCW environment, including the improvements mentioned above, can be viewed as a complete solution to the problem of remote collaboration, remote tutoring and examination. Specifically, the whole idea of a dedicated workspace for learners, or work group in general, with all the services provided along with the effortless installation and small learning curve (based on the widely known use of a browser) make it an efficient working and learning tool for remotely located users.

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