Institut Eurécom

2229, route des Crêtes

BP 193

06904 Sophia Antipolis Cédex

FRANCE

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REMOTE TEACHING APPLICATION : ERGONOMICS & U.I. SPECIFICATIONS

Revital MAROM - Pascal GROS
Eurécom
Date 14/05/1993,

Telephone:	33 93 00 26 26	E-mails:
Revital Marom	33 93 00 26 13	Marom@eurecom.fr
Fax	33 93 00 26 27	Gros@eurecom.fr

ABSTRACT

The following document provides the ergonomic specification for the Betel teleteaching setups . The set-ups were designed utilizing a User Centered Design methodology. Number of configurations were tested with different groups of users. A detailed descriptions including the drawing of the physical set-ups for both the classroom and the professor's office is presented in this paper .

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Release 1.0

1 - Introduction -

The objective of the teleteaching application is to perform a **"conventional" practical exercise session in a distributed way,** namely with professor and students located in different places and sites. The teaching environment will enable usual behavior to be remotely reproduced by the different players. The fundamental point for that matter can be summarized in the concept of virtual presence.

Utilizing a user center design methodology, we designed and tested number of configurations which provided us with the spec. of the physical set up of the classroom and the professor's office. Each scenario was observed and analyzed using three subjects; two students and one professor. Each configuration determined the following criteria; **Audio/ Visual, Workspace, and Room Architecture.**

Using the same methodology we also observed and analyzed the student(s)' and the professor's action and interaction patterns under the different scenarios. This was done by creating a number of configurations consisting of the different set ups. Three subjects, two students and one professor were assigned a task which utilized the teleteaching system. The learning and teaching process was observed and analyzed.

2 - References -

Gaspoz J.P : "Remote Teaching Application : Technical issues"
intern EPFL report n°1-EPFL-003.2

Marom R., Goldberg, L., Gros P. : "Remote Technology Project Evaluation: An assessment of a teleteaching environment" *Research Report N° 93-003, Eurécom Dec. 1993*

Gros P. : "Remote Teaching Application : Dialog States and Transitions, Connections"
intern report EURECOM n°?

3 - Terminology -

In the proposed teleteaching environment the interaction occurs between the **Professor** and the **Students** in two setups: **the classroom** and **the office.**

Two types of audio visual communication link are proposed **Global** for global communication link and **Local** for local (private), communication link.
Global Link- The interaction occurs between the **professor and the whole classroom**
Local Link -The interaction occurs between **a student and the Professor**

The communication dialogue is divided into four states
Global Background State- A link exists between the classroom and the office but no interaction takes place only an awareness.
Global Teaching State- The professor interacts with the whole classroom.
Global Interactive State- The professor interacts with an individual student within the classroom context.
Local Interactive State- The professor interacts with an individual student on an individual basis

We will refer in this document to the following
Global- camera and monitor
Local - Camera and monitor
Global- Audio connection
Local- audio connection
Global Screen- Global computer connection
Sharing software- Local and Global computer connection

Analog Audio/Video Switch (Switch): A computer controllable audio/video switch which is able to connect any video (or audio) input to any video (or audio) outputs.

III server (IIIF): A software on SUN that controls the Switch for connections. The software listen to high level command on the Ethernet and sends low level order to the Switch accordingly. The Physical link between the SUN and the Switch is through a RS232.

Picture In Picture Service (PiP) : A video device connected to the Switch that allows to montage a small image on top of a different large one and produces a single output video signal.

Audio Mixer Service (Mixer) : A audio device connected to the Switch that allows to mix several audio input signals into a one audio output signal.

4 - General description -

4-1 Audio/video setup.

4.1.1 - THE CLASSROOM - (see figures 1 & 2)

Physical set up

Room Architecture

Two forms of students sitting positions are proposed: **U shape** and a **row**
We will refer to both simultaneously and will highlight the differences when applied.

Camera(s) and monitor(s) Positions: global and local

1. The **Global camera and monitor** should be placed in ***front of the classroom.*** In this position the professor will receive a general view of the classroom including gesture and face expression.

2. The **local monitor and camera** should be placed on the student's desk *beside the computer terminal.*

3. The **Camera(s) and monitor(s),** should be placed together in the *same position* , in order to avoid confusion:

A. The **Global monitor and camera** should be placed *closed to each other.*
B. The **Local monitor and camera** should be placed *one on top of the other* .

Camera Angle

1. The **Global camera** should have a *wide angle lens* in order to provide a *full view* , **long shoot view,** of the classroom.

2. The **Local camera** should have a *regular lens* and should provide a *close up* view of the student.

The **professor's image** should be *constantly displayed* on the **Global screen.**

Number of Monitors

1. A **separate local monitor** should be provided for each student in addition to the computer monitor for the local communication link. The computer screen should not be used for this purpose.

2. Only **one Global monitor** should be used for the global communication link.

Monitors size

The preferable **Global monitor** size is *28"*
when the *distance* between the monitor and the students ranges from *2-5 m.*

The preferable **Local monitor** size is *14".*

Audio

1. The **sound** has to be *localized* in order to avoid auditory/spatial confusion:

A. **Local audio link** should be distributed only from the *local speakers.*
B. **Global audio link** should be distributed only from the *global speakers.*

2. **Earphones** should be used for *both local and global* communication links. Local conversation will be minimally heard by all students, the "Background feedback noise".

3. Global **sound level** should be controlled by *the professor.*
Local sound level should be controlled by the *individual student*

4. The **unidirectional microphone** was far *more effective* than the *omnidirectional* for the local communication link.

Illumination

1. Local illumination is *effective* for the ***local view*** but ***distract*** the ***global*** one.

Global illumination distract the view from the **Global *Computer Screen.*** s
An effective illumination scheme need to be determined.

CSCW

1.**A whiteboard** placed ***behind the students*** only when sited in a ***Ushape position***, can serve as an option for the students to visually present information to the professor.

Dark color pens should be used when writing on the board.

2. Using the **Video projector, dedicated computer and sharing software** the professor will be able to display his ***computer screen*** to the classroom on the ***Global Computer Screen.***

3. Using a **sharing software,** each individual student will be able to share his screen with the professor.

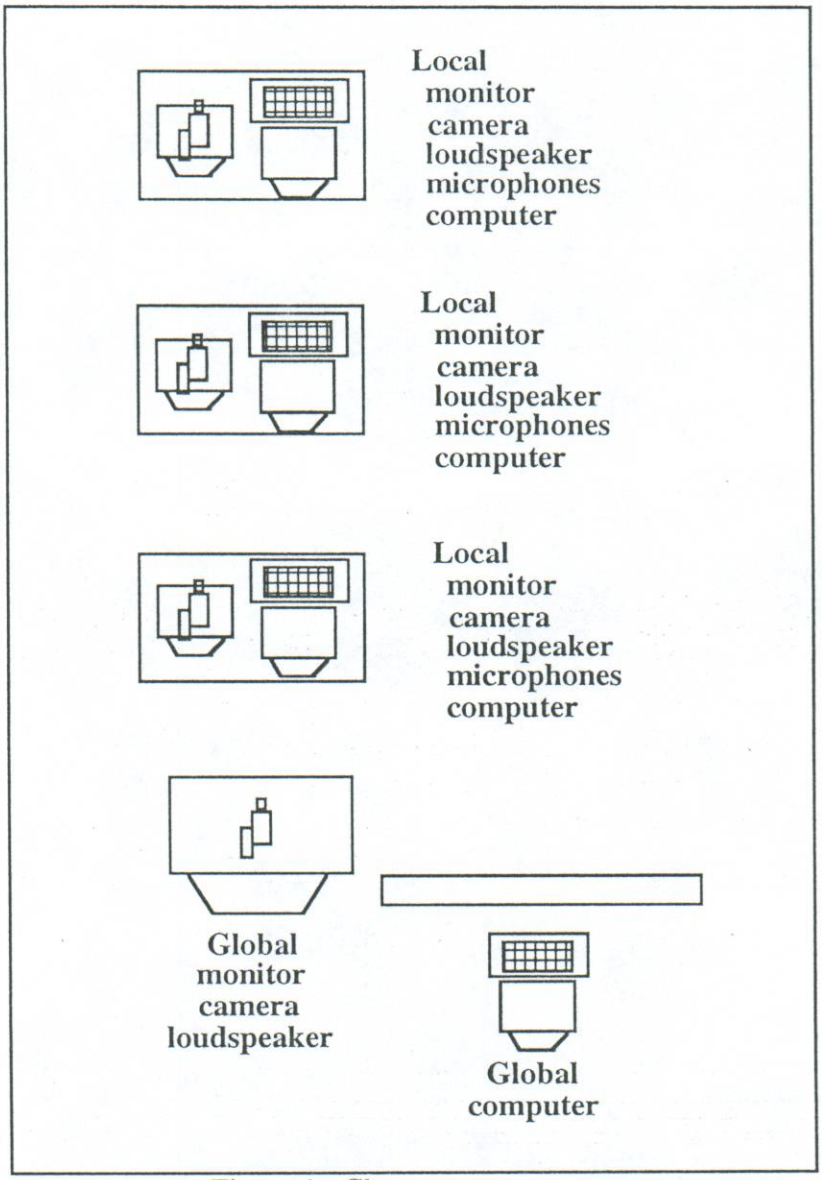

Figure 1 : Classroom row setup

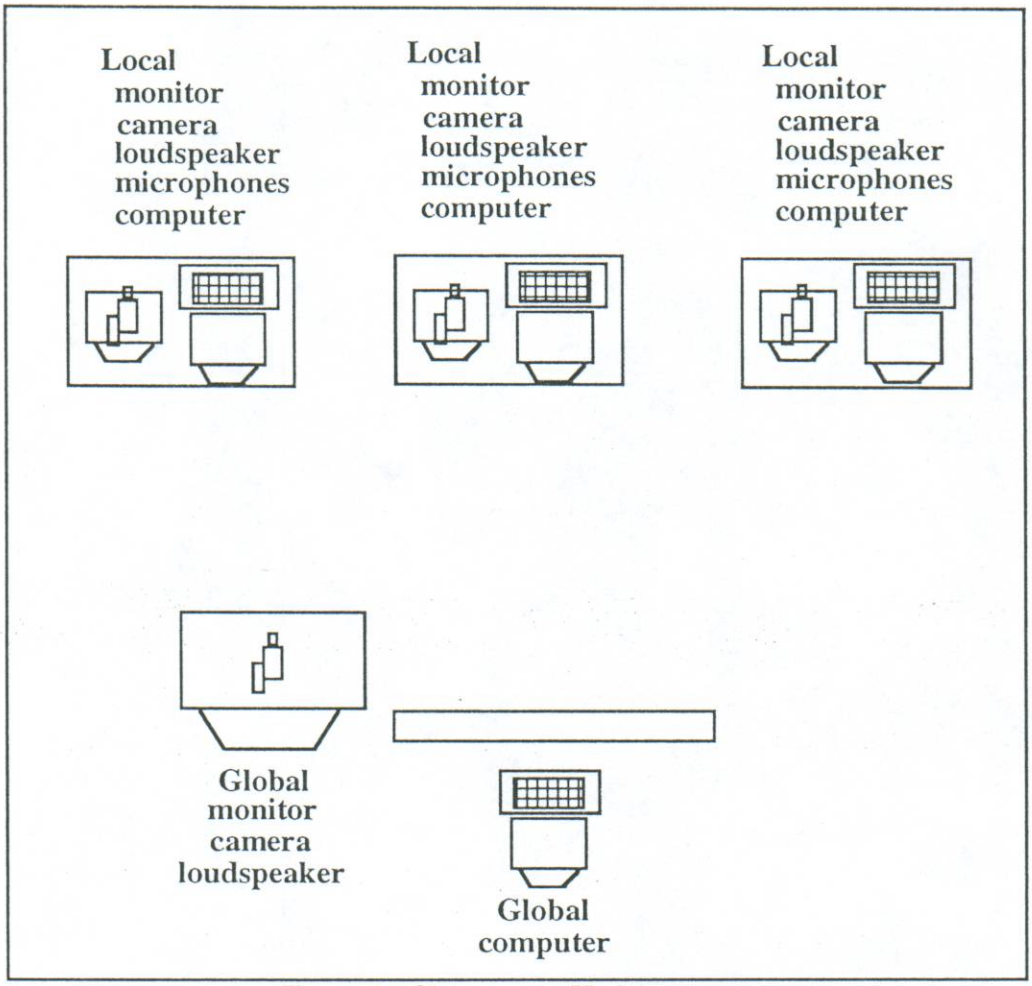

Figure 2 : Classroom : U-shape setup

4.1.2 - THE OFFICE - (see figure 3)

Room Architecture

1. The professor will be sited behind an **L Shape desk**. His private working area will be separate from his teaching one.

Number of Monitors

1.A **separate Local monitor** should be provided for the Local/Global communication link. The computer screen should not be used for this purpose.

2. **One monitor and camera** will serve both functions: ***Global and Local communication link.***

3. The **view of the classroom** must be ***continuously displayed*** on the professor screen. The use of the **PIP technology** is suggested for this function. It is very important for the professor to be able to see the classroom while engaged in a local communication link.

Monitor and Camera Position

1.The **computer screen** and the **monitor screen** must be ***lined*** with each other. If the computer screen obstructs the view, the WS must be placed beneath the workspace.

2. The **camera and the monitor** will be positioned together, ***one on top of the other*** , ***in front*** of the professor desk at a ***distance of 2mm***.

Screen Size

The **monitor screen** size should be **28".**

Camera Angle

1. The **camera** should have a ***regular lens*** in order to provide a ***medium shoot*** image of the Professor. This image is the most effective one for local and global ineraction. Close up is too intense and long shoot reveals too many details of the professor's environment.

Audio

1.A **Unidirectional microphone** will be used by the professor for both the ***global and the local communication link.***

2. Global **sound level** will be controlled by ***the professor.***

Illumination

1. The Professor office will be **illuminated** by a ***regular room light.*** This specification needs to be further investigated.

CSCW

1. **A whiteboard** placed ***behind the professor desk*** , within the students' field of view, will be used as an option to visually present information to the classroom.

Dark color pens should be used when writing on the board.

2. **Sharing software** will be used by the professor to present his screen on the ***Global Computer Screen*** and to view the individual ***student's computer screen***

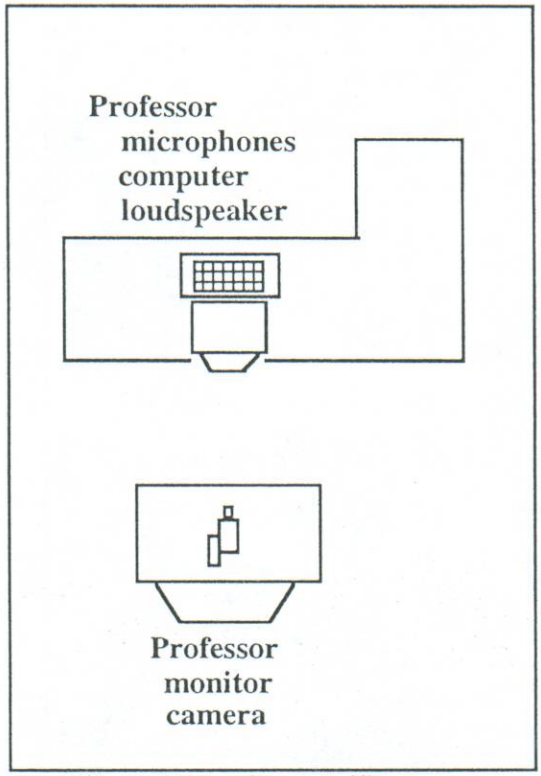

Figure 3 : Professor office setup

4-2 Audio/video connections.

4-2-1 OVERVIEW.

1. The connection between the office and the classroom is via a *bi-directional audio/video connection*. .

The design for both setup was done according to the following parameters :

- only one video signal and only one audio signal can be sent from the office to the classroom,

- only one video signal and only one audio signal can be sent from the classroom to the office,

When several video or audio signals are sent from one site to another, the multiplexing is done at the sender's location. The multiplexing will be done through the ***pip*** *for* the video and through the ***mixer*** for the audio. All these services will be connected to the ***switch*** and the appropriate connections will be done via the ***IIIF.*** In the classroom, the teleteaching system should demultiplex the audio and video to the appropriate device according to the state of interaction.

The audio/video configuration of each setup depends upon the state of the communication link in use (eg ***Global or Local***) and upon several options choosen by the user (eg hearphones). The users will switch from one configuration to another

according to the state of the communication link. This switching will be done via the UI. The UI will send commands to the ***IIIF*** in order to modify the connections.

4-2-2 CONNECTIONS.

GLOBAL LINK

When in global communication link between the office and the classroom the following audio/video connections are involved (see figure 4):

Video - Classroom to Office -

A general view of the classroom will be sent from the classroom global wide angle camera to the office monitor

Audio- Classroom to Office -

A global sound of the classroom will be sent to the professor office. The use of a global microphone leads to quality problems, so a refined global sound is obtained by mixing all the local microphones of the students. A mixer located in the classroom will be used for this purpose. A Muting function will be provided for each student as well.

Video - Office to Classroom -

A medium shoot view of the professor is sent from the office camera to the classroom's global monitor.

Audio -office to classroom -

The professor's voice is sent from his microphone to the classroom global loudspeaker. Due to feedback effects, when all students use the earphones this connection should be avoided. However, the professor must have the choice to send his sound to the global loudspeaker in the case that some students have removed their earphones.

Audio - Special Case - Student (s) plus professor to Student(s)

When students are using earphones, the voice of the professor and the mixed sound of the classroom should be sent to each student earphones.

LOCAL LINK

When in local communication link between the office and the classroom the following audio/video connections are involved: (see figure 5 and 6) :

Video - Classroom to Office -

Both classroom views, local and global, will be sent to the professor monitor. This can be done by combining the two views via a *PiP* which is located at the classroom site. Using the *PiP* service, one image appears as a small window on top of the large one. The professor might control the image positions i.e. which image will appear on the large screen and which one in the small window.

Audio - Classroom to Office -

The local sound is sent from the classroom to the office. As an option, a "lower level" mix of the audio communication between the professor and a student could be sent to all other students. The professor should be able to cancel this option.

Video - Office to Classroom -

A medium shoot view of the professor is sent from the office camera to the local monitor of the student. This view is displayed on the classroom global monitor. A message that the professor is engaged in a local communication. can be displayed on this monitor.

Audio - Office to Classroom -

The professor's voice is sent from his microphone to the student local loudspeaker or earphone.

Audio - Special Case -

When a student is using earphones, the sounds of all the students except the one in local communication link are mixed together and sent to him.

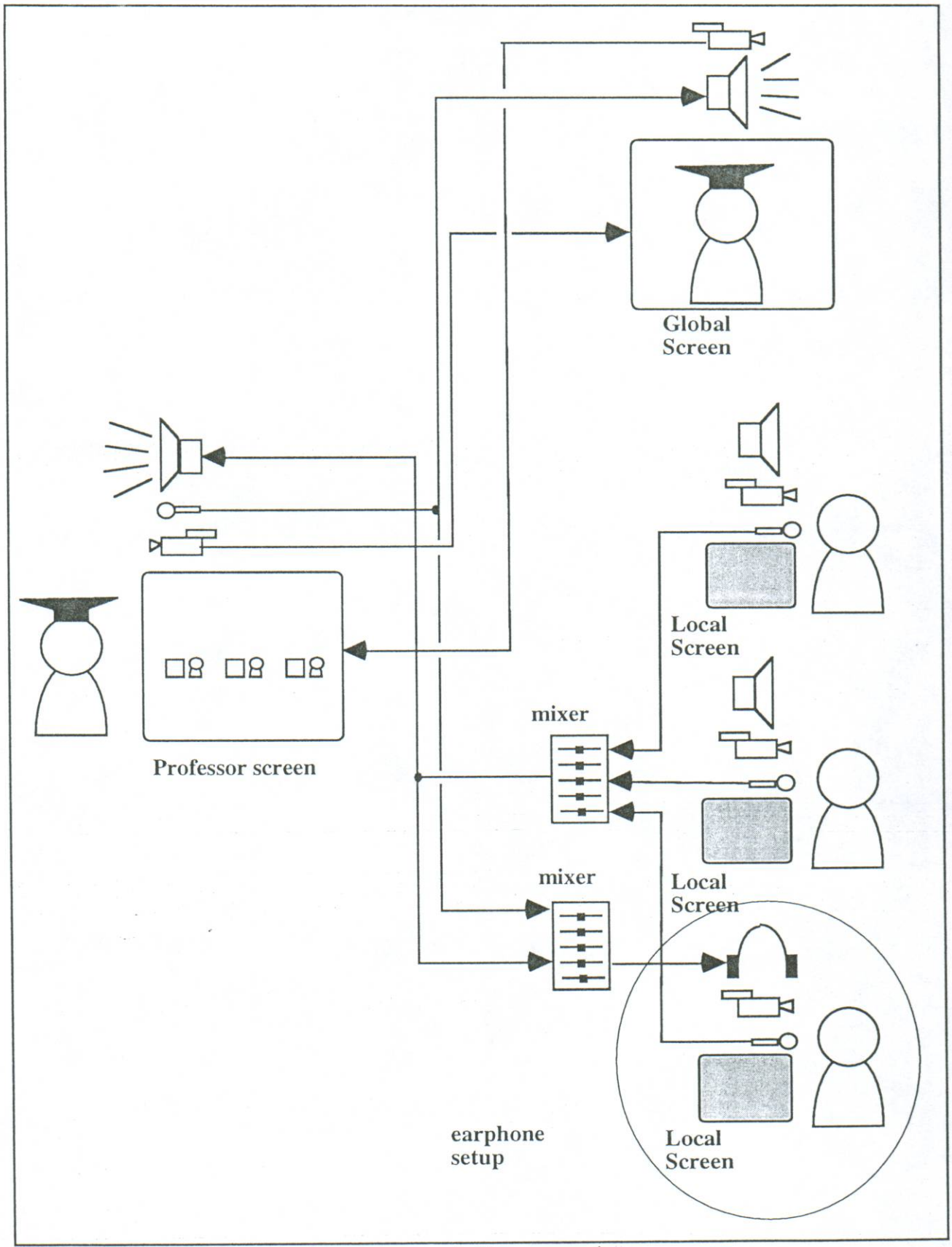

Figure 4 : Global communication connections.

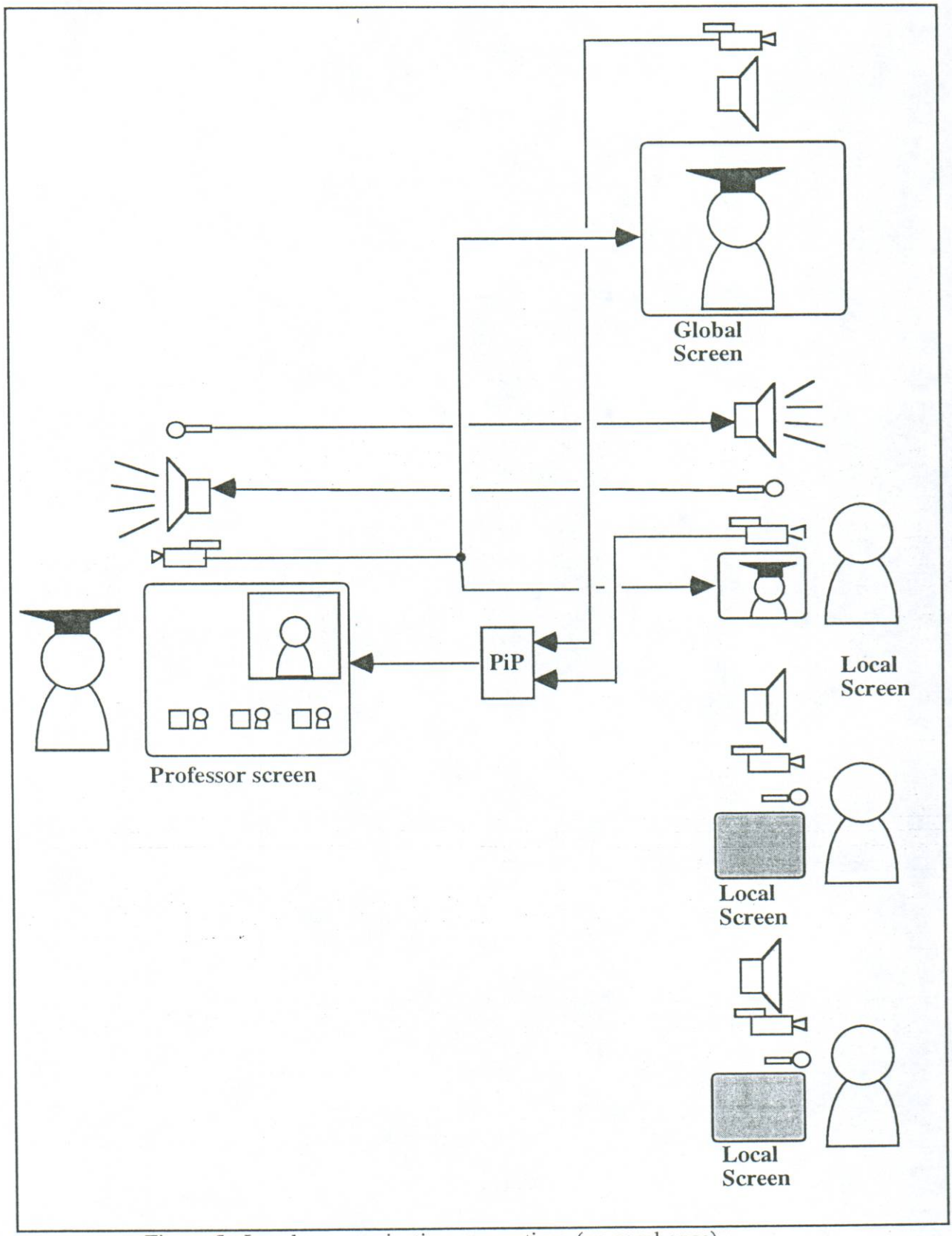

Figure 5 : Local communication connections (no earphones)

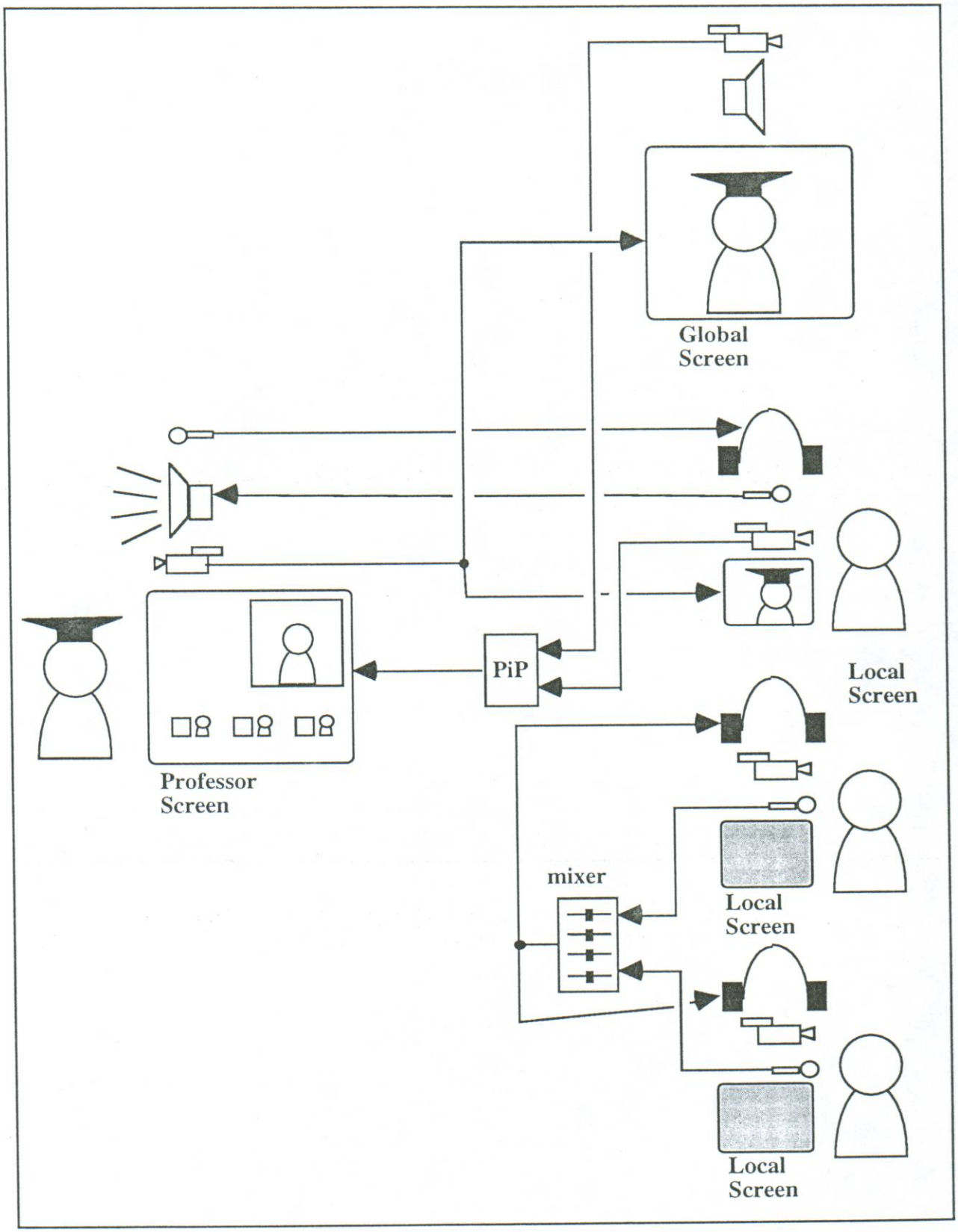

Figure 6 : Local communication connections (with earphones)

4-3 USER INTERFACE.

4.3.1 USER INTERFACE DIALOG DEFINITION

The dialogue is divided into the four states; *Global Background State, Global Teaching State, Global Interactive State, and Local Interactive State* . ***Transitions*** allows the system to change from one state to another.(see figure xxxx)

The transition between the states should be kept as simple as possible. The interaction should make use of the UI only when required. The state of the dialog should be apparent through the interface so that all participant know in what interaction state they are located

For this purpose all the transitions between the three global states are expect to be done through the audio connection. In this case, the professor will not have to manipulate the computer for the transition.. Thus, the audio/video and CSCW connections have to remain the same for these three states.

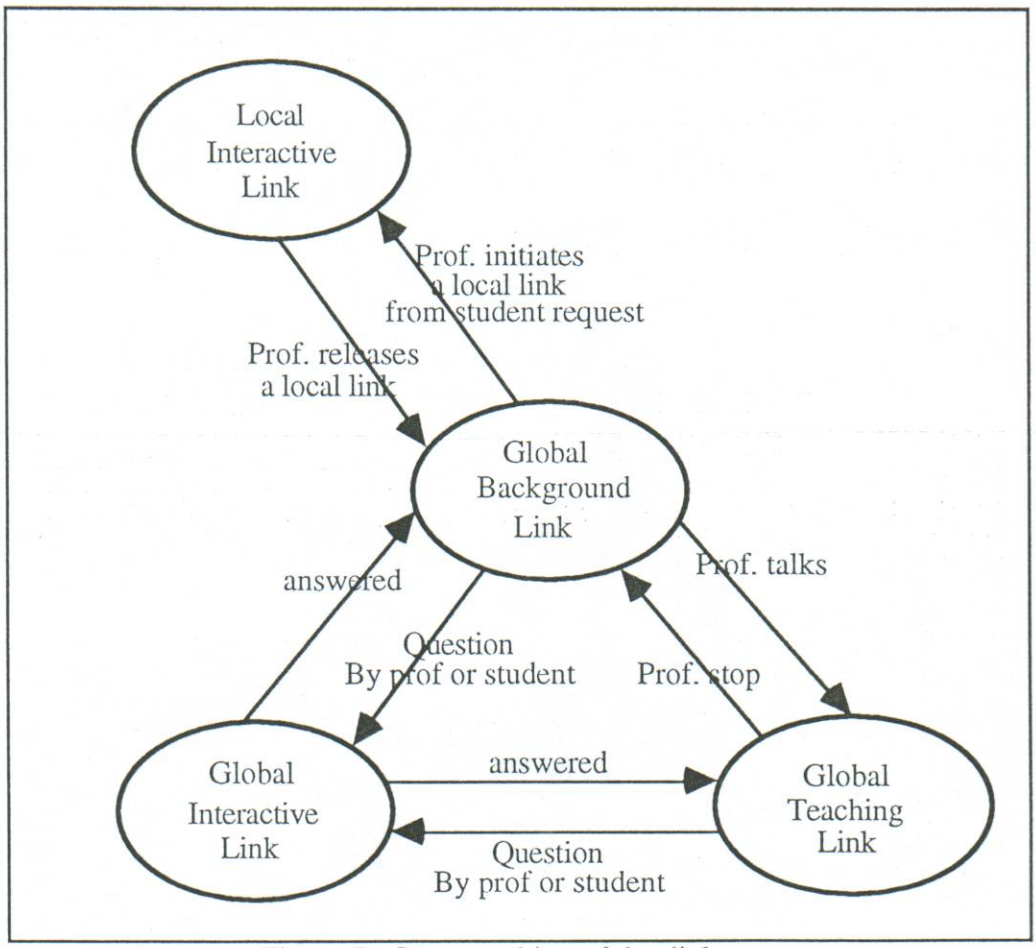

Figure 7 : State machine of the dialogue

4.3.1 - UI SPECIFICATION -

The main functions of the UI will be to serve the transition between the Global and the Local states and vice versa. Our design is based on the premise that the student is the one who requests the link and the professor is the one who initiate and control it. However, the professor can request a connection as well.

The professor will be able to switch between the global and the local states very smoothly. The interface should avoid latency due to the identification of the target student.

In addition to the State Transition functionalities the UI will also provide the functionalities of altering the connections of the current state. Examples are:

-Mute student audio,
- Insure privacy when in local communication ,
- Affirmation of earphone use.

The following are suggested functions for the Teleteaching UI.

End of local communication link by the professor

An earcon which will signal to the students the end of the local communication link with the professor. The students should have the choice to react to the signal.

" I did not finish my question"

Feedback for the technology

A feedback mechanism should be provided for the students in order to check the operation of the technology at the beginning of each session.

A mirror function should be provided for the professor in order to determine his position in relation to the camera.

Request for a local communication link by a student.

Student Screen

When a student requests a local communication link and the professor is engaged in a conversation with another student , a message will appear on the student screen which will indicate:

Professor Smith is busy, your request will be answered ***ASAP***

When several students request a local link during the same period of time the message will also indicate that:

There are 5 requests a head of you, please wait

When a request is answered it will be indicated on the computer screen

*There are **4** requests a head of you, please wait*

When a student puts down his earphones while a professor is trying to reach him an earcon will indicate it . The earcon will be followed be a message on the student screen.

*Prof. Smith is trying to reach you ,**put on** your earphones*

While the professor is browsing around, an earcon will indicate (worn) to the student that the professor is connecting with him.

Professor screen

When a student requests a local communication link an earcon will indicate it to the professor and a message will follow

***Johny** is requesting a link.*

The Professor might have on his screen:

A map of the students sitting positions which will indicate where Johnny is sitting:
or
A map which includes the students pictures and their names.

This functionality will help the professor to identify who is Johnny.

When a student requests a link while the professor is engaged in another local communication link, an earcon will indicate this request which will be followed by a message which will remain in a dialogue box:

***Tony** is requesting a link*

If more than one student requests a link at the same period of time their names will appear in a sequential order in the box

***Tony** requests a link*
***Mark** request a link*

When the request are answered the name will be removed

***Mark** requests a link*

When several students are requesting a link at the same period of time, a message on the professor screen will continuously indicate how many students are waiting.

***5** students are requesting a link*
***6** students are requesting a link*

When the Professor is switching from global to local link and vise versa a message on his screen will indicate:

*You are in a **local** communication link*
or ,
*you are in a **Global** communication link*

5 - Validation -

Physical setup (audio/video)

Installation and test : The physical setup should be tested when all devices are available, the PiP, the 28" monitor, unidirectional microphones and cameras should be purchased. A final test should include site illumination and use of CSCW tools.

Analog connections (audio/video)

Installation and test : Analog connections should be tested when all the devices are available.

UI

Tools definition : the audio/video UIs will be designed on top of X-lib or of a GUI (motif or open look), a communication layer should be available in order to allow the professor UI to send commands to IIIF as well as both the professor UI and the student UI to communicate with each other.

Unitary tests : Detailed specifications will be produced and two program will be delivered (the professor UI and the student UI). Some unitary tests will be conduct in the local site. Some remote tests should be conducted as well in order to validate the design step by the step.

Integration tests : The relationship between the audio/video UI and the sharing software UI should be investigate.

Digital connection (audio/video)

Quality of the image : the digitization and the compression of the PAL analog images produces artifacts. We have to validate that the decreased quality does not impact on the application (e.g. on the global view of the classroom, or on communication via the whiteboard).

Quality of the audio : the digitization and the coding of the audio by the Sun reduces the quality of the audio, we have to validate that the decrease of quality does not impact on the application (e.g. the mixed audio of the whole classroom is still understandable or earphones are still usable).

Delay added by the network : the delay added by the network as well as the other part of the digital system should be test in order to verify that the system is still usable (e.g. if there is a delay on the audio, an echo effect could lead to severe communication problems).

Digital connection (switch control)

Delay added by the network : The professor located in EPFL will control the switch located in Eurécom. The commands sent by this UI to the IIIF will be delayed by the network (compared to our local setup). These delays should be taken into account.

Sharing software

We are waiting for information from EPFL on the sharing software.