ON-LINE DISTANCE LEARNING PLATFORM

Sergio Ramírez
Computer Architecture Department, University of Malaga, Spain

Hugo Rosales
National University of Piura-Perú, Peru

Oswaldo Trelles
Computer Architecture Department, University of Malaga, Spain

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Abstract: In this work we report a software platform for synchronous distance learning, which makes the presence of teachers in the student's house possible, deploying the same class, in the same time, with the same mates, through the internet. Thus the working scenery is a normal student room, in which some students are present and some others are virtual students with interactive presence that allows to participate, be interrogated by the professor, and maintaining a fluid communication with partners. Several important technical aspects has been solved using public domain components: web-browsers, blackboards, on-line messaging –chats, forums-, and real time sound delivery. All these components have been integrated in a user friendly environment with record of use, and interface customisation for different age-levels. The participation of learners, psychologist, computer-science technicians and teachers has allowed a very simple but powerful way to integrate our children in the educational circuit.

1 INTRODUCTION

Current trends in the technology information domain go towards the multimedia and networking technologies. Immersed in this information revolution era, education is one area with the greatest impact, with richer and more expressive models to represent the contents (images, sounds, video), with the elimination of distances between the teachers and the students and with the possibility to receive updated knowledge in fast and inexpensive ways. On the other hand, there are several social groups whose members have limitations to regularly attend the school (i.e. children with haemophilia, diabetes, etc.), with severe influence in the learning rhythm and in social integration with friends.

A software platform for synchronous distance learning, to make the presence of a teacher possible in the student's house –or wherever they are- giving the same lesson, in the same hour, with the same friend , through the internet would be of special help in the social integration of these students. The child workspace can be drawn as a normal classroom, in which some students are present and some others are remote connected with interactive presence and active participation with both teachers and students.

There have been many previous efforts in the design and development of methodologies in this application domain (*i.e.* GroupLog (Bath University, 2003), Moodle (Dougiamas, 2003) or Academic Talk (JISC UK, 1998) for asynchronous distance learning as virtual campus). Unfortunately, these tools are expensive and/or not focused specifically on educational environments (i.e. on video conference: Netmeting (Steves, 2001), MSN Messenger (Microsoft, 2006), Mbone (G. Fortino, 2002) and Marratech (Marratech AB, 2006). There are also public-domain tools provided by academic centres and other institutions, mainly related to specific research issues such as a particular technique or algorithm implementation.

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In this project we present a software tool that covers the following combined features: (a) centralized control of connections to reproduce teacher functionality; (b) efficient and interactive user friendly interface; (c) historical record of connexions and data transmission (d) free availability.

2 SYSTEM & METHODS

2.1 Major Guidelines

One of the key aspects in the design of our AVI platform (Aulas Virtuales Interactivas / Interactive Virtual Classroom) has been to ensure a centralized control of activities as the best way to reproduce teacher control in the classroom. The following basic principles have guided the design of the AVI platform:

- Component-based (*e.g.* modular design) as integration paradigm to facilitate the incorporation of new high quality multimedia modules.
- Uniform but customisable interfacing for tools including help system, training information, etc.
- Platform scalability is provided by means of intelligent resource management to allow increment on the number of user making use of AVI at the same time.
- Robustness of the platform is ensured by server replication at different sites.
- Enabling standard storage, secure access and exploitation of proprietary data allow expanding the scope of user applicability.
- Efficient use of computational resources is achieved by intelligent computational load distribution among the different modules of the platform (server, client, teacher side…).

The language used for the modelling of the system was UML. Next pictures represent some use cases diagrams for the server, teacher and student, the three main actors in this system.

During the development of the system we have considered the following points of interest:

- Client/Server multithreads architecture based on Java and TCP/IP.
- Mechanism to handle sessions and users authentication.
- Protocol for send text data between users
- A module for send multimedia data (Video & Audio) between the teacher and his/her students, and from them to him/her.
- A tool to interchange of files.
- A tool for show web pages and presentations.

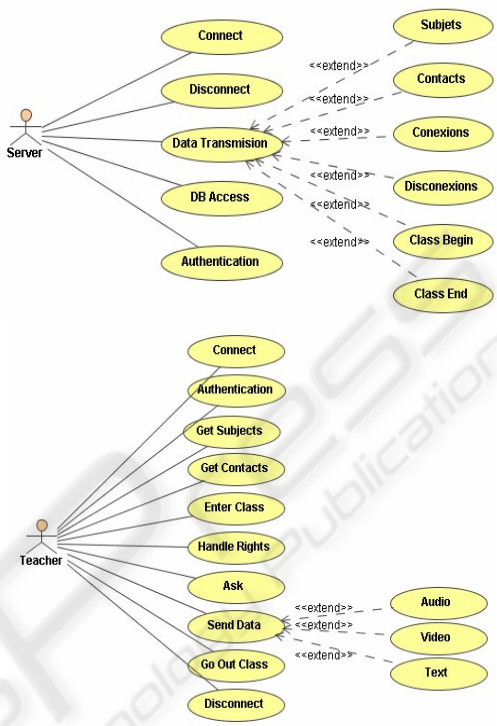

Figure 1: Use cases diagrams for the server module (on top) and for the teacher module of the application (at the bottom).

With this idea we implement an application that allows participating in the school work for those students who cannot attend in the classroom, by making use of the facilities that Internet offer to us.

To allow this functionality the application fulfils the following requirements:

- Establish a fluid video and audio communication in real time, between the main actors of the educational process, the professor and each one of the students.
- Provide support for the traditional educational activities and to the new ones, such as electronic blackboards, video-conference, file transfer, chat and browser of Web pages.
- Provide remote access to those students that are unable to attend in the classroom, without disturbing the "local" students.
- Implement software procedures to reproduce teacher-student interaction (i.e. ask for authorization to participate. In a particular issue.

- Offer a simple interface to allow fast access to most of functions in order to be easier to use, and offer the functionality to customise the interfaces in agreement with the ages of the users.
- Allow the students to present/display their homework during the period in which they can participate in the class.
- Minimise the effects of the distance between the students and the teacher, which is fundamental for the acceptance of the method by students and professors.

2.2 Design

The traditional video-conference tools are designed to communicate every client with the rest of the group, which makes it difficult for the teacher to control the class and it wastes system resources, by sending data between students that should not be sent.

To avoid this problem the system has not been designed with a pure client-server architecture, because some clients (teachers) can work like servers. This architecture leaves the central server some minimal coordination tasks, while the clients work in a distributed way.

To minimize more the data sent, the clients are grouped by classes, so they only need to interchange information between them, relieving the main server of these tasks (Figure 2) and thereby improve the efficient.

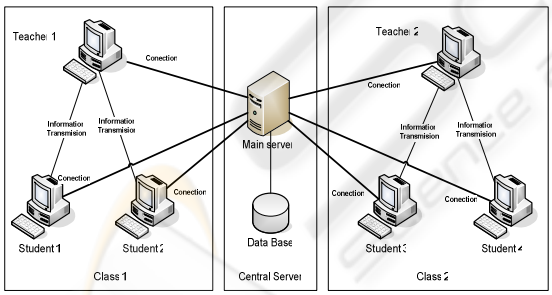

Figure 2: Schema of the system architecture.

The main server is delegated to do some functions of general coordination; it is in charge of authenticate the users and give them general information like the list of classes where they can access and their contacts information (students in the case of teachers and only the teacher for the students)

For each class there is a sub-server, role played by the teacher, which is in charge of handling and coordinating the messages sent by the students in the class. In this way, every student can see the teacher and hear his/her explanations. The students send a video stream to the teacher, when the class begin so he/she can see what the student is doing, but they can not send audio and participate actively in the class until the teacher allows it, although the students can ask for permission to speak, similar to if they put the hand up in a real class.

No other data is sent from the students to the teacher and never between students. In fact the ip address of the students is unknown for all the clients except for the teacher.

With this architecture's schema each class is independent of the others, decreasing the problem of interferences between them, and the amount of data sent by the clients.

The application uses three communications protocols, two for the video and the audio transmission, and other more for the transmission of text messages and synchronization commands.

For the multimedia transfers we chose the standard audio and video protocols provided by the Java Media Framework (JMF) library (sun, 2006). These protocols work over UDP so they provide real time transmission but don't guarantee the reception of data.

For the coordination tasks, we created a text commands based protocol. It has commands to start and finish the class; handle the permission of the students, get user info, etc. So, we need that these messages arrive to the target, for that we developed it over TCP. Other feature that this protocol offers, is the possibility of sending text messages like in a chat, this is the only global communication between all the participants of a class, but always under the supervision of the corresponding teacher, of course, the teacher also can communicate personally with any student using this method in a private way.

The modular design of the application, also allows the inclusion of new features, as plug-ins, which can extend and improve the functionality of the program. For example, we have a tool to send files between users of the same class or a whiteboard where as much the professor as the students can write and draw (always under the supervision of the teacher) and also a practical slide show where the professor can make presentations. Theses two features can aid the teacher in the class when the quality of the video sent by him/her has not got enough quality.

3 RESULTS

A testing suite of the system here described is being used by the Haemophilia Association of Malaga-Spain (AMH) to help in the education of children that eventually cannot attend to the school.

3.1 Installation Procedure

In this implementation (Rosales, 2006), the main server application runs in the AMH-server and clients can be downloaded from their web page (www.hemofilia-malaga.org). The new clients can obtain a password to access to the server by requesting for it to the AMH (Figure 3). Once the AMH verifies the request, they include the new institution in the system and send them the user and password for their own centre's administrator.

With this password the administrator can access to the server (www.hemofilia-malaga.org/avi) and

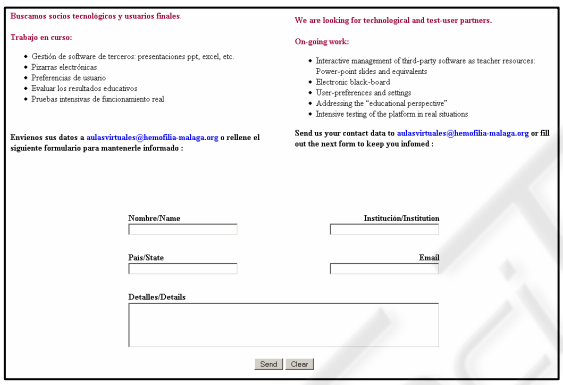

Figure 3: Registry formulary to request an user for a new educational centre.

administrate the centre by him/her self, defining classes, teachers, students, timetables, etc. A web-

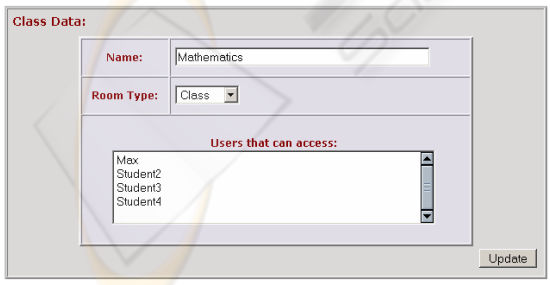

Figure 4: Formulary to add a new room in a centre.

based interface has been deployed to allow handling the internal database and facilitating the administration of the different centres, users and classes (Figures 4 and 5).

3.2 Use Example

The application starts by showing the authentication interface (see Figure 6), which includes the selection of the specific server to connect and logging on it. At present, the AMH has installed this server in testing phase, but once the systems become approved, it could be installed in each institution.

Just, this type of decision (a centralized server against several loosely coupled servers) is close related with robustness and trustworthiness of the entire application, giving alternative to the user to belong to several educational centers or virtual academies.

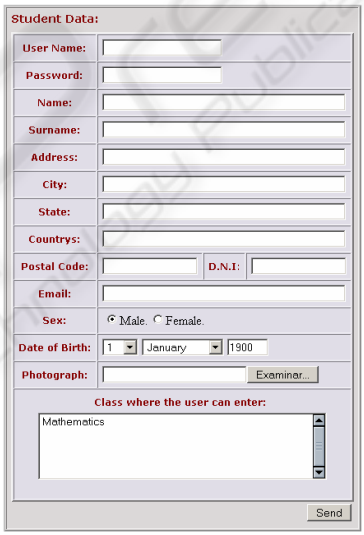

Figure 5: Formulary to add a new user to a centre.

Once the user is logged in the system, the interfaces for students and teachers become different. In Figure 6 we shown a list of classes related with the user, the ones that the student can attend and the ones that the teacher can teach.

Choosing one of those, the list at the bottom of the screen shows the contacts' state for the selected class. In the teacher side, the state of all the students registered in the class will be showed but in the student interface the list will only contain the state of the corresponding teacher.

From this screen the user can now enter the class. A teacher can enter and start the class when he/she decides so, but a student must wait until his/her teacher begins the class.

When the class begins, the interface showed to the user also varies depending if is a student or a

teacher. If the user is a teacher, he/she will find an interface similar to the one showed in the Figure 7. In this interface the teacher has got all the tools needed to control his/her class.

When the teacher needs to open a document or works with some of the features provided for a plug-in, then a new screen is unfolded, providing an independent and personal interface for every plug-in where handle documents, interact with the user and communicates with other clients.

The client interface for a student is similar to the teacher but hiding those features that should not be handled by the students, thereby simplifying the

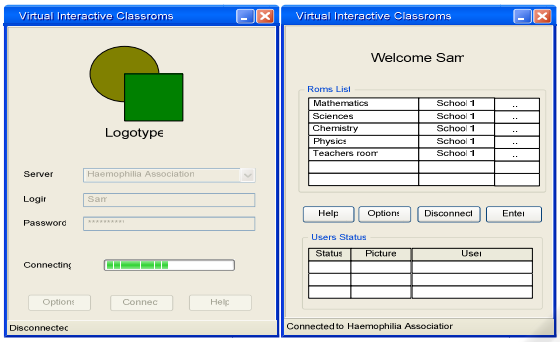

Figure 6: In the left, Login-Screen, providing option to choose the server and input the login and password. In the right, Welcome-Screen, where the user can take a look of the classes and contacts.

application and making it more accessible by young students (Figure 7)

The only action that can be done by the students but no by the teacher is ask for the teacher's attention, so that he/she can give him/her the possibility to make a question.

4 CONCLUSIONS

Internet and many other technological breakthroughs have enabled a revolution on the way educational contents can be deployed. In this work we report a software platform for synchronous distance learning created with the aim to help students to overcome limitations that would otherwise keep them from schools. We expect its use will have a positive impact with their learning and social integration with friends.

The system provides support to reproduce traditional teacher-functionality such as enable or denied access for participation; full control of connexions (i.e. voice); distribution, task coordination around the different students; etc.

Several important technical aspects has been solved using public domain components: web-browsers, blackboards, on-line messaging –chats, forums-, and real time sound delivery. All these components have been integrated in a user friendly environment which includes a database with a log of use.

Finally, the participation of learners, psychologist, computer-science technicians and teachers has allowed a very simple but powerful way to integrate our children in the educational system.

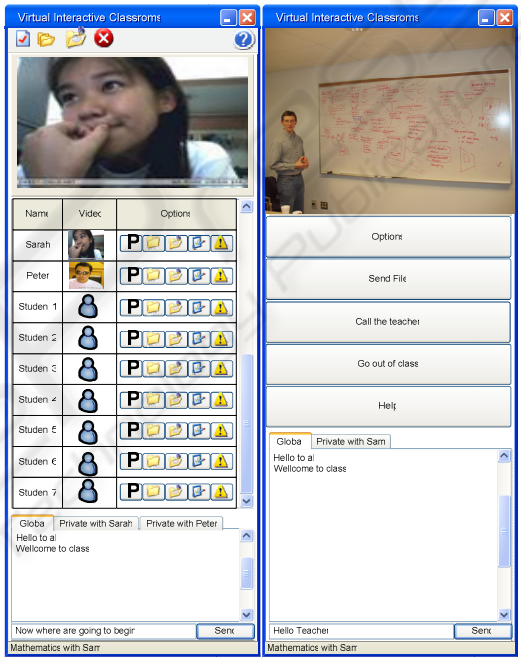

Figure 7: Interfaces showed to the teacher (left) and the student (right) when a class begin.

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APPENDIX

Additional information is available at: http://chirimoyo.ac.uma.es/bitlab in the link "products-> On-Line distance e-learning".