

Integrating videoconferencing in Intelligent Tutoring Systems

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INTRODUCTION

In the paper here presented, we describe an instruction system through videoconferencing and video on demand (VoD), what it trays overwhelm some restrictions and limits of the current (academical and industrial) instruction, but even to incorporate, in this environment, some of the elements that the Distributed Multimedia Intelligent Tutoring Systems own. And we pose also in practice some ideas of the Engelbart's knowledge augmentation system (one of multimedia parents). A cause of the problems aroused, we can be sure that connect with concerns of Wiener, since they send to the difussion of the information.

This work presents some aspects of our project what tray to apply our investigations about the integration of ITS (Intelligent Tutoring Systems) and CAI Computer Aided Instruction) and TITS (Training Intelligent Tutoring Systems) in Multimedia environments, following the paths of RESMUL, MITS and DMITS (Brugos, 1993, 1995, 1997, 1998), and, here, in concret, in a videoconferencing and Video on Demand (VoD) environment, searching an applied link to instruction colleges and training workers of enterprises.

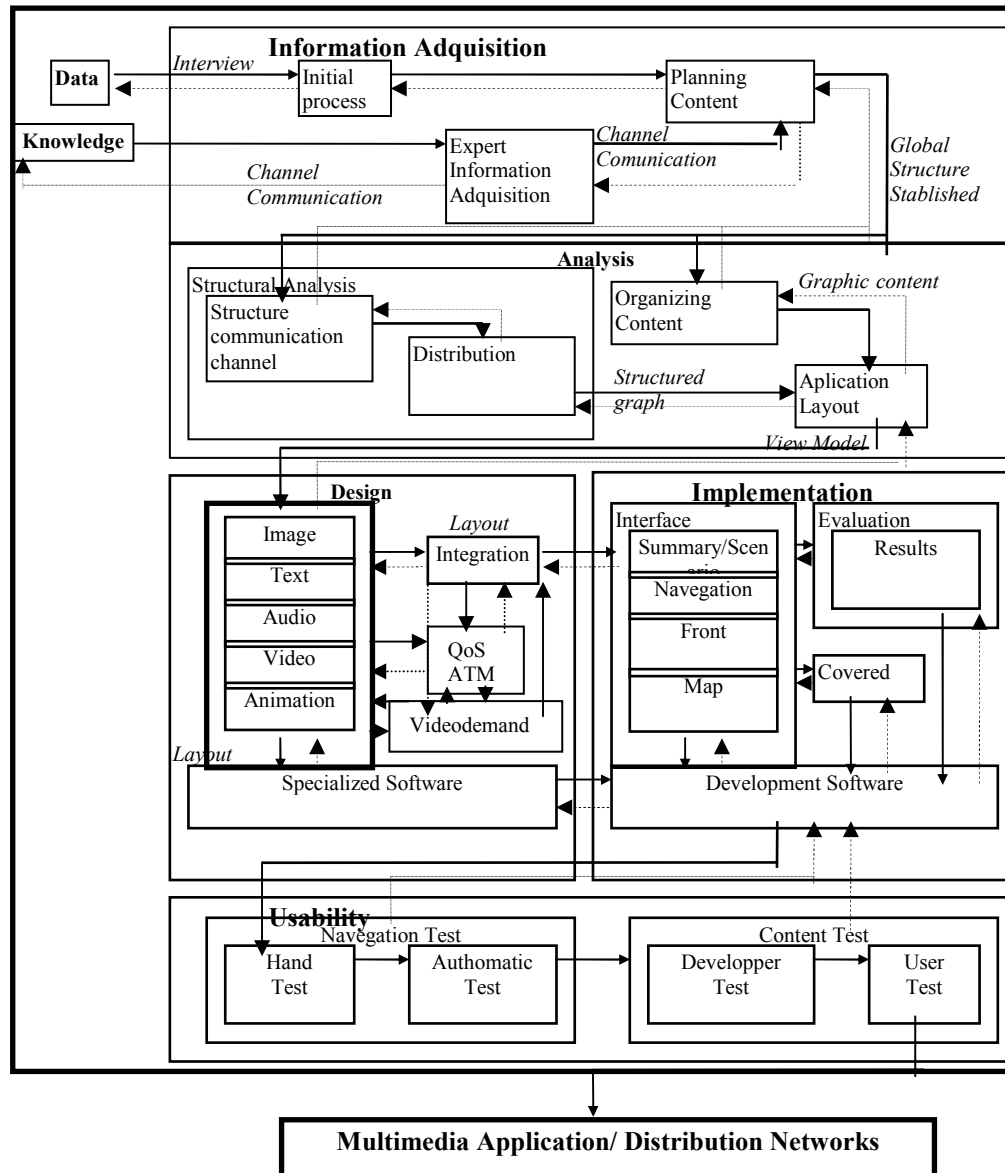
The main approach consists in CAI/ITS reinterpretation in multimedia environments (named MITS by us), understanding Multimedia in a large extension, what includes Distributed Multimedia, i.e., in networks and, therefore, using also the videoconferencing devices. Thus, so as moduls and models (i.e., student, professor/metaprofessor, tutor, interface, evaluation, etc.) than as the multimedia objects (to what knowledge is translated), builds considering its distribution through the communication available media.

Video on-Demand (VoD) allows users to decide what to view and when to view it. The ATM (Asynchronous Transfer Mode) Forum defines AMS (Audiovisual Multimedia Service) VoD as an asymmetrical service that uses several connections to transfer encoded video from video server to client, typically STT (a set-op terminal) or PC. The decoder in the STT reassembles, decompresses and decodes the streams. It then converts the video signals to analog signals for presentation on a screen. User-Network Interface (UNI) signaling is employed to stablish the video connection between the client and server, which is a point-to-multipoint connection. [Wu, 98]. Through a server of VoD (WEB) can be provide static information to future users about a course, that should be dynamically achieved during videoconferencing sessions. Thus the users can prepare their questions, and the tutor the answers. The courses can be restrict to specific users when this were required.

On the other hand, Distributed Multimedia (networks) requires a Quality Of Services (QOS) of five major elements: a QOS specifation mechanism, control to admitte application without affecting QOS of the other applications, QOS negotiation between application and system, resource allocation and schedulind, and traffic policing, i.e. traffic throughput, transmission delay, delay jitter, transmission reliability and synchronization. That is the temporal relationship which is peculiar to multimedia information, and (inter/intra media) *synchronization* is the problem for generation and replay, rather that in orchestrated (time-independent or discrete) but in live (time-dependent or continuous) applications. Multimedia over a network is *distributed*, at best on Asynchronous Transfer Mode (ATM) and BISDN (Broadband Integrated Service Digital Network) networks (SONET) rely on new integrated circuit switches, since fixed-sized cells are easier to handle than variable-sized cells. MPEG-4, scheduled for November 1998, experiments with wavelet compression, and MPEG-7, for November 2000, that will support interactive multimedia distribution in a multivendor client/server environment prepared by the Multimedia and Hypermedia information coding Expert Group (MHEG) [Lu,96;Raghavan,98;Wu,98]

This system incorpores to this context videoconferencing, begining with the analysis of the actors and basic elements what participate in the act of instruction transmitted by means of videoconferencing, i.e., the organitazion of cours, the cours, the questions of participants, consulting, the professor/metaprofessor (expert), the controlator, etc., which are the principal participatings in the action of teaching/learning, but overwhelming the disadvantages that distance and time produce today. Looking for a practical side, we propose the main activities and requirements to realice VoD, designing a system, entirely reliable, and implementing the aspects more eminentes to our purpose and following our propose of applied and theoretical searching. Here we not pose other goals, as multimedia object construction to be aplyed and distributed, neither the devices giving to the entire system the possible intelligence to an interactive communication with users and, availables for the controlator of sessions, and for the metaprofessor, person very important in our approach.

Methodology



Multimedia objects translation and integration.

A) Main fonctions of multimedia objects (aims).

The knowledge represented in the semantic network is translated to multimedia objects which have the following functions:

- Text
- Still (fixed) images
- Syncronic images (with movement): animations and video sequences
- Voice and sound
- Filmed videoconferences (Video on Demand: VoD)

The general principle consists in representing each concept graphically. So each concept must be described with images or graphs giving "prototypes" of its most representative examples, creating an unchangeable description, its script, such as in the making of icons. The essential features which show examples according to the point of view and aims of the expert must be selected. In order to do this examples are collected, classified and classed according to the essential significance of their content. The image, therefore, forms the mainstay and must contain the essential knowledge in all its features and parts.

Still images i.e. scripts, represent nodes on the semantic network, or rather a bunch of nodes.

The text should be explicit and reinforce some of the features and properties of the images so that they have a rather expressive and rhetorical nature. In the case of networks and also in that of videoconferences, those taking part may carry out many of the tasks involved. "Horizontal" communication is established among the participants and the facilitator is given important information which allows more relevant interventions to come to the fore following the criteria of the metateacher.

The animations represent relationships and processes within the concepts, or, in other words, their functional character. Therefore they must show the essential time sequence a process follows and as such, are of great importance in the representation of concepts.

The video sequences have a functional character subsidiary to the animation of processes and relationships, in actual fact they are the realistic version of the animation. They also manage to situate the user in the real context. Taken as filmed videoconference sequences they complement the explanations of the concepts and their relationships, just as the expert or teacher does when he/she explains a concept: he/she uses material meant to show and express a concept, but the important thing is the inner representation i.e. the model which the expert has in mind. The same occurs in live videoconferences where the whole teaching system is put at the service of the expert or teacher, at least this is how it is seen by those taking part. The idea of the teacher or metateacher in our videoconference system is that the whole teaching system be at their service and not the opposite.

Sound is used not only in a rhetorical way but also significantly, as it provides a means of interactive communication between the system and the user mainly by drawing attention to certain actions of both the user and the system, confirming them and helping to create an interface scenario.

The voice is used fundamentally as an aid, in situ, to guide the user and to reinforce interaction. However, in the case of videoconferences it has an even more fundamental function, as it explains and reasons upon the content of the concepts put forward and also constitutes the means of communication between the exponent and the participants. However, as we have already said, we must not lose sight of the general principle that the centre is still graphic representation which plays the role of virtual reality.

The videoconference which is filmed and distributed through video on demand substitutes the live videoconference, putting the filmed sessions of a previous course at the disposal of those who require them. But in our case these filmed sessions will also be used as longer or shorter video sequences, but in short only sequences. Following this approach they will be used with a similar function within the education system. Therefore frames and sequences must be selected and edited for their incorporation in the field of education corresponding to the command of knowledge, or a multimedia presentation.

B) Multimedia objects integration.

Integration is carried out following the norms of the supremacy of graphic representation over all others, exactly the same as when we talk of real world situations in a virtual way. So all the objects cooperate to make a more intelligible image, even sound. We must overcome the idea that verbal communication belongs exclusively to the telephone, although the idea of the videoconference certainly arose as a means to accompany the telephone, making communication more real, but always situated in a fixed space. We must not forget that with multimedia, we are trying to move about and live in a virtual space simulating the reality that exists in our minds. The centre is the communication of ideas through "harmonious" objects, where said objects acquire a symbolic representation, as in iconic communication. The participant, or user, not only speaks and writes to communicate but he also handles objects; he physically interacts.

So it can be said that the multimedia objects fit around the images, each one carrying out its appointed task. These objects have to be prepared in such a way that they contain the necessary information about their roles and about which other objects they are associated with, either wholly or partially. Therefore, each image must contain in its format all the features necessary to carry out its function of expressing a concept and of relating to other concepts expressed through other images. In synchronous objects the duration and order of the frames are included in these features, together with the main parts. For example, in the action of parking a vehicle each frame must refer to the action of "parking", to the place within the sequence of the action of parking, to the moment in time, to the object contained therein, to the relationship with the other essential objects contained in the rest of the frames etc. The object "voice" must also include these features, such as the duration of the frames they correspond to, including some of the main objects contained in the frames as well as the concepts to which they refer. In this way multimedia objects are constructed containing the necessary objects about their relationship with other objects and the concepts they exemplify not only to be mutually integrated but also to facilitate the package which is needed for distribution on networks and for communication systems in general. In other words, codifying/decodifying, compressio/decompression and packaging in ATM cells (with a size of 53 bytes) all become easier. So the order in which they are sent will not substantially affect

the deployment and use of the objects made by the user. The aim is to facilitate the modular nature of the multimedia objects as well as the so-called Quality of Service (QoS).

In conclusion, the design, the putting into effect and the integration of the multimedia objects will be carried out adhering to a format which fulfills the demands of MPEJ, MHEJ, and ATM convenient for distribution on networks, including its use in a videoconference system and vice-versa as far as the videoconference is concerned. This can be either live or on demand because, within the education system, this is regarded as an object more. In the case of Multicast Backbone (MBone), within the Bay Area Gigabit Network (BAGNet), where IP over ATM metropolitan-area network is tested as the channels of image and sound are separate, the procedure is even more obvious. In this way, MBone tool set is used for multicast audio and high quality video, which employs 30 frames and a resolution of 320x240 pixels (for example, LLNL, Stanford University, Apple, UCB and Xerox-Parc).

Distributed multimedia.

This follows the prototype constraints and interface properties, especially the usability attributes observing task users in action [Hackos, 98]. Norman's seven-stage cycle establishes these seven steps: forming the goal and the intention, specifying and executing an action, perceiving and interpreting the state of the world, and evaluating the outcome.

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Basic videoconferencing and VoD System

The videoconferencing is incorporated into the system beginning with the analysis of actors and basic elements that take part in the act of teaching with this method: i.e. the organisation of courses, the classes, the intervention of participants, consultations with the teacher/metateacher (experts in the subject) or with the arbitrator, etc. There are the main characters in the activity of teaching/learning who overcome the drawbacks which distance and time produce. Looking for a practical side, we propose the main activities and requisites to carry out Video on Demand (VoD) designing a totally feasible system with the available means and introducing the most relevant aspects for our intentions and in accordance with our proposal for applied and theoretical/conceptual research.

Other aims will not be taken into account here: aims such as the production of multimedia products to be applied and distributed or the mechanisms which provide the whole system with the possible intelligence to communicate interactively with users and are at the service of the arbitrator of sessions and the metateacher, a very relevant figure in our hypothesis.

Now, then, it is important that the videoconferencing system is designed following our approaches (DMITS), that this works, and that considers its functioning as VoD, because this is the more practical form to approach the system and its use.

The initial proposes are modest but implementables with the current ressources:

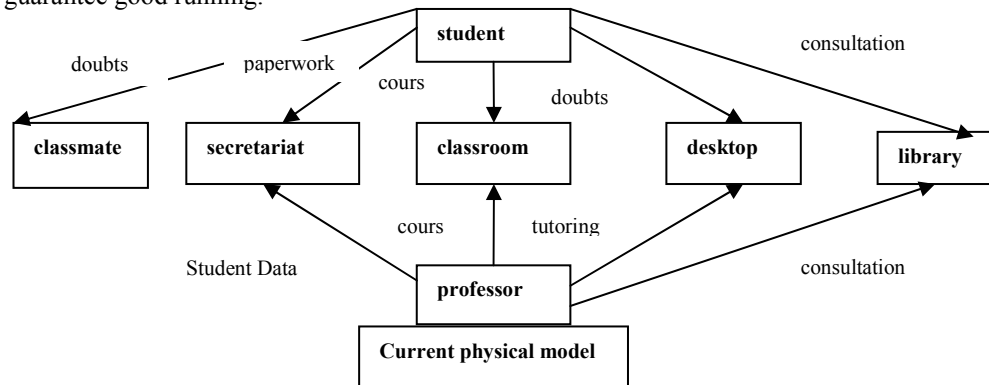
- To provide for all person interesting the access to the courses organized.

- To allow, at any moment and anywhere, the student-professor communication, so during the development of the course as when the course is finished.
- To provide to the participants the documentations about contents what will give.
- To inform about the bibliography and references interesting for current course.
- To make feasible the entire or partial recovery of a session.
- To avoid the displacements of everybody.
- To make feasible the realization of consultations without necessity of displacements.
- To make feasible the dialogues between the participants without to bother neither to interrupt the normal development of the sessions.
- To allow the possibility of the realization of another activities while a session occurs.
- To have available, at any moment, the updated and centralized information for use and consult of the system users.

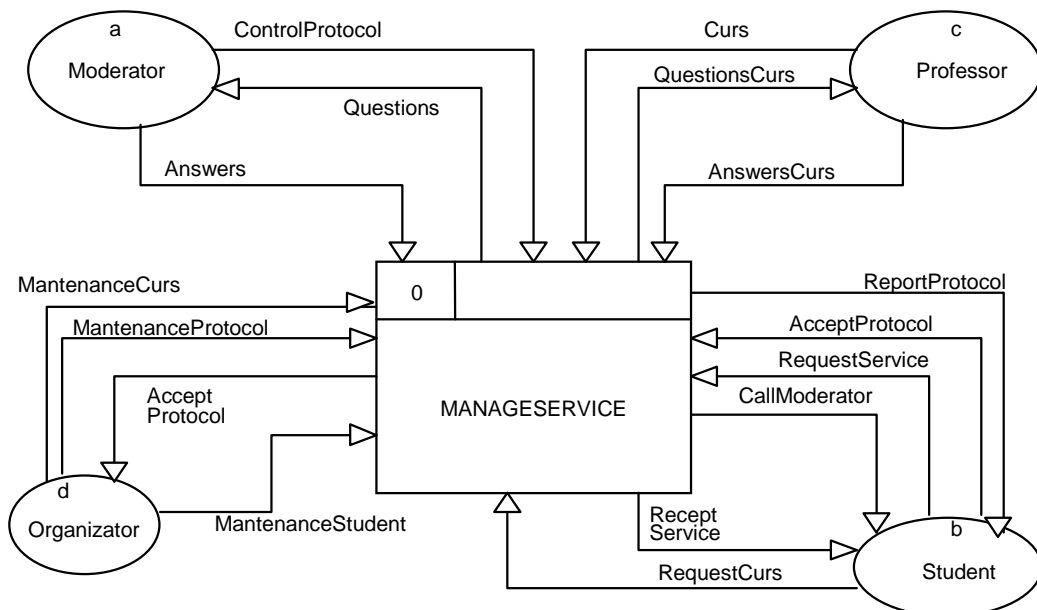
The tow figures of *customer and server* will constitute the tow big groups of the system. Customers will be all the users which have access to the system to ask for some type of services. The server will be which provides the services.

Users of the system are:

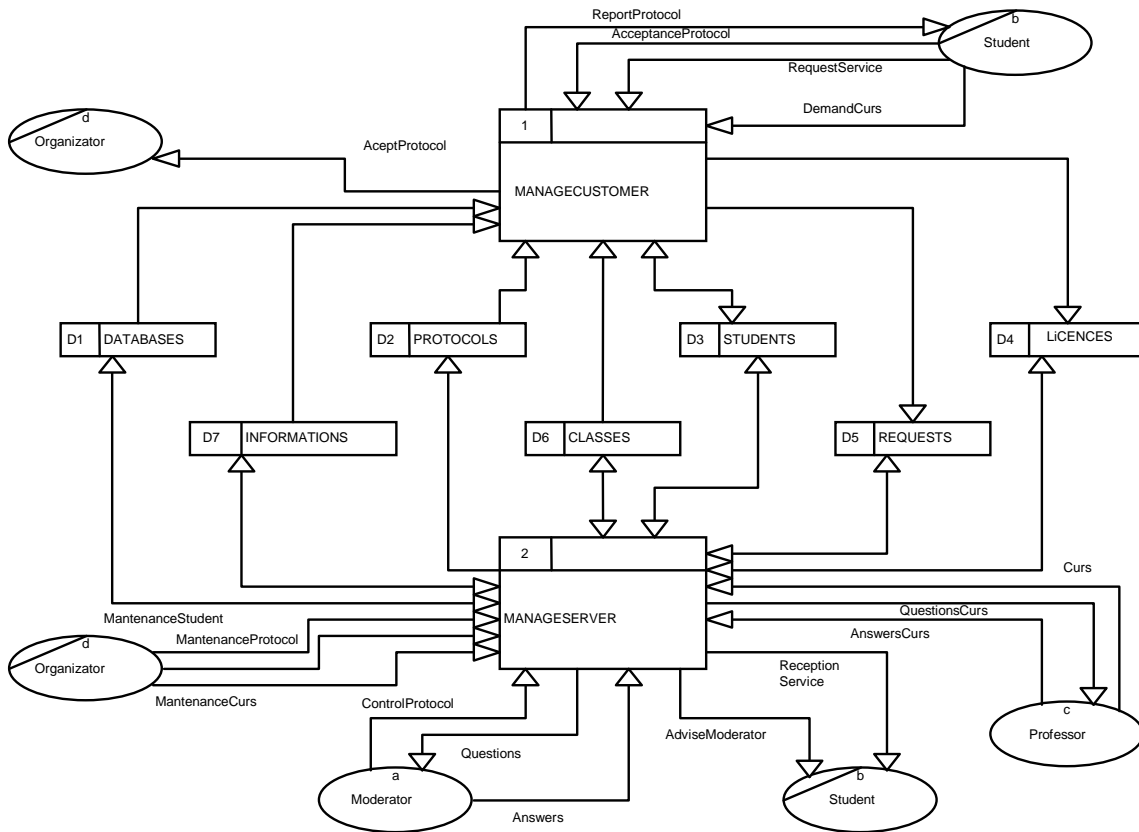
- The students, i.e., persons which go to receive and to participate in the courses what system will distribute. They are the customers of the system and which take advantage of the distributed information.
- The professors are the persons charged teaching and contents of courses supplied. They are tow kinds of professors: the professor which teaches and the metaprofessor which drives teaching. Such instruction will be taught through videoconferencing sessions.
- The organizer are the person charged prepar the contents and its organization. He is the responsible of all which happes around the courses
- The driver will be present through all the sessions to control its development and to guarantee good running.



Context Diagram



Subsystem Diagram



Conclusions

This paper continues to expound on the essential subject of our researches into the integration of ITS (Intelligent Tutoring Systems) and TITS (Training Intelligent Tutoring Systems) and CAI (Computer Aided Instruction) within Multimedia surroundings, following the line set out years ago by RESMUL, MITS and DMITS in a videoconference environment. Oviedo University has been a pioneer in Spain in incorporating CAI, ITS and MITS in university teaching trying to achieve not only the training of computer scientists in these techniques and research, but also trying to find a connection applied to teaching centres and the training of workers of firms whose network is surely the most complete.

The main approach lies in reinterpreting CAI and ITS in multimedia environments (MITS); understanding multimedia in the widest sense of the word. This includes Distributed Multimedia, in other words on networks, and therefore also using the resources of videoconferences. So both modules and models (e.g. of the student, of the teacher, of the tutor, of the interface, of assessment) as well as the multimedia objects (receivers of knowledge), are produced bearing in mind their distribution through the available media.

The present paper incorporates the videoconference into this context, beginning with the analysis of the actors and basic elements that take part in the act of teaching with videoconferences, i.e. the organisation of the courses, the classes, the interventions of the participants, the consultations with the teacher (expert in the field) the arbitrator etc, who are the main characters in the activity of teaching and learning, but overcoming the drawbacks which distance and time produce nowadays. Looking for a practical side, we propose the main activities and requisites to carry out Video on Demand (VoD), designing a totally feasible system with means within everyone's reach and introducing the most relevant aspects for our intentions and in accordance with our proposal for applied and theoretical or conceptual research.

Other aims will not be considered in detail here; aims such as the production of multimedia objects to constitute applications and be distributed nor the mechanisms which provide the whole system with the necessary intelligence to communicate interactively with the users and are at the service of the arbitrator of the sessions and of the "metateacher", a very relevant figure in our thesis. We will concentrate mainly on the outline of the integral method.

As far as the system of videoconferences is concerned, what interests us here is that it be designed according to our theory and that it work and that its functioning be considered in the form of Video on Demand as this is the most practical way to consider the system and its use.

A instruction system must be able to incorporate **disabled** people. To make this possible suitable economic interfaces must be available by means of sons and ultrasonic sons, radio waves, to brain paralytics, tactile wrist to deafs and blinds, allowing access to PC's and Internet, implementing tools to develop characteristic languages of this population (SPC, BLISS, etc.), creating author languages (Intelligent Tutoring Systems and Training Systems) in order to professors can incorporate instruction, by example "global instruction", entertaining plays, training management, job, etc.

We believe we have managed to formulate a reasonable, feasible proposal which fills us with optimism and hope and we are sure we will be able to continue developing the system progressively until we obtain full integration of MITS methods, i.e. our research and experience in Intelligent Tutors in Distributed multimedia environments.

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