Compressed Video Conferencing Technology in the Context of International Virtual Design Studios

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INSTRUCTIONAL CONCEPT

Almost every school of architecture offers a sequence of Design Studios in which students learn to design by actually performing design processes (Angulo, 1995). Practice-based learning methodologies are common in the design instructional domain and therefore our instructional environments tend to be largely analogue to the environments in which we end up practising the profession (Vásquez de Velasco & Angulo, 1994).

Our schools have a natural tendency to follow on the foot steps of our professional offices. Our traditional Design Studios used to look like our professional offices with halls full of drawing tables, but since the introduction of computing technology we have seen considerable change. Quite often, schools of architecture have calculated the trajectory of technological applications and anticipated ways in which students can bring innovation into the market place.

This may have been the case of Computer Aided Drafting (Port, 1989) in the early 80's. A case in which computer literate students coming out of our schools took well-established design firms by the hand and into the use of 2-dimensional drafting programs like AutoCad and/or MicroStation.

Following a similar approach, today is common to find Electronic Design Studios in most schools of architecture where the teaching of 3-dimensional digital modeling is producing designers that use computers in their design processes and not only for the production of project documentation. At the cutting edge of Electronic Design Studios we can find the use of object-oriented modeling software (Mitchell & McCullough, 1991) that looks forward to prepare our students for the use of a new generation of CAD tools before they effectively hit the market.

Finally, and as we see the potential of using computer networks for expanding design teams beyond a restricted time and space framework, some schools of architecture are implementing "Virtual Design Studios" (Bradford et al., 1994) that make use of telematics for simulating what we believe will be our working environment of the future. Over the last three years a number of Virtual Design Studios has been making use of Ethernet and ISDN networks for communicating design information (Cabellos, et al., 1994).

In addition to the conventional instructional targets of a Design Studio and even an Electronic Design Studio, a Virtual Design Studio offers an outstanding environment for acquiring knowledge about different cultural and professional contexts at the same time that targets the acquisition of skills on the use of telematics.

One of the most important components of a cultural context is its language. A Virtual Design Studio can offer magnificent opportunities for practising a second language and to do so in a domain-specific context (Vásquez de Velasco, 1996). Also of considerable importance is the understanding of how a different cultural context can have an impact on our design decisions. Such understanding is of fundamental value not only for transnational operations but also for our domestic practice in the sense that it stimulates introspection and critical questioning of our own cultural particularities.

With the introduction of the North American Free Trade Agreement (NAFTA) we have witnessed a growing tendency towards the establishment of international design and construction consortia.

This tendency is in particular dynamic between Texan and Mexican design and construction firms that see the potential for establishing a common market across the US/Mexican border. As the movement of building products between both countries is increased, the need of supporting building know-how with international consulting activities will also contribute to the intensification of additional and perhaps yet unforeseen international services.

On the balance, and considering our specific concern on a Tex-Mex cultural framework, a Virtual Design Studio offers potential for understanding the cultural structure of a border nation that shares of Texan and Mexican; a culture that is frequently misunderstood as alien to its transnational parenthood.

Beyond a general cultural framework, a Virtual Design Studio can target a better understanding of foreign profes-

sional environments. In particular, knowledge addressing building technology can play an extremely important role on the sustainability of transnational design partnerships. Building in the US is very different from building in Mexico. Due to our free trade agreements, the US/Mexican market of building materials may be moving towards a larger degree of integration, but the organisation of the building enterprise and the cost of labour in each country will remain to be quite different for a long time.

In this case, as in the case of our general cultural framework, we must be aware that the applicability of this knowledge is not restricted to transnational operations but can be a valuable asset in our domestic practice.

For the acquisition of skills on the application of telematics, a Virtual Design Studio makes extensive use of networks for maintaining on-demand communication between design parties. This means that students are offered learning opportunities on the use of network resources such as e-mail, the World Wide Web, file transfer dynamics, digital document conferencing, and digital video conferencing. The training acquired in such a learning environment is not only relevant to their design related activities but can have considerable impact on their ability to access information for other purposes.

INSTRUMENTAL NATURE

A Virtual Design Studio is an instrumental environment that supports collective design events through the application of telematics. In such context, digital document conferencing and digital video conferencing constitute two important avenues of technological application.

In the field of digital document conferencing we can find two main kinds of network resources: resources that operate on an asynchronous fashion and resources that operate on a real-time interactive fashion.

Good examples of asynchronous document conferencing resources are our e-mail and World Wide Web servers and browsers (Tennant, et al., 1993). In a design context, web pages offer a simple and fast way of establishing pin-up cyber-boards for our design information. Projects, at any level of development, can be displayed in the World Wide Web for our design counterparts to see, evaluate, and comment. In addition to the rendering of comments through web forms, we can also open e-mail communication for further textual interaction.

Whiteboarding is one of the real-time interactive dynamics offered by document conferencing programs. Given their present level of development, whiteboard modules largely resemble paint programs with particular strength on graphic import/export functions and a selection of mark-up tools. All what we see in a whiteboard screen is actually a bit-map that can be manipulated only as such. We can mark-up on top of a bit-map showing text but we can not manipulate that text as in a word processor and the same will apply to other data formats such as vector-based graphics or 3-dimensional models.

A key factor, which the industry and architectural user groups are paying particular attention to, is how fast can whiteboard modules update a large graphic in display (i.e. a high resolution floor plan). In the architectural domain, whiteboard modules are seen as potential components in multimedia teleconferencing set-ups, but the different speeds at which different media components are delivered require careful handling and calls for further development. This problem can be currently perceived in applications that combine whiteboarding with desktop video-conferencing

Our current use of digital video conferencing technology in the context of Virtual Design Studios remains to be experimental. Comparing our current use of room-based Vs desktop-based video conferencing technology, most of our effective experience is centered on the second one.

The main problem we face on the use of desktop based video conferencing is to be found on the cost of bandwidth or the hardware for handling high compression ratios. The cost of a dedicated T1 hook-up can hardly be justified for the interaction of two designers, and that means that desktop based video conferencing needs to deal with the yet considerable cost and not very convincing performance of an ISDN connection or the unstable video quality, due to fluctuations on frame rates, of an Ethernet connection. On-going work in the field of graceful degradation, for video images of variable frame rates (Yang, 1996), may come to upgrade present performance on packet switched networks but at the same time growing network traffic sets a challenge difficult to meet.

An advantage offered by room based video conferencing technology is to be found on its low cost per capita, even making use of a dedicated T1 connection, and the fact that only one person per site needs to be aware of interface protocols (Nunnink, 1994). This means that during a design review a large number of designers can interact without feeling the intrusiveness of the mediating technology. For added convenience room based video conferencing can make use of conventional delivery systems for the display of graphic documentation (i.e. pin-up material, overheads, video projection, etc.) that in the case of desktop-based video conferencing requires the support of parallel document-conferencing technology.

Considering our present level of technological development in the field of telematics it may be advisable to avoid the usage of a single package of media for supporting all our communication needs. It may be more advisable to use a number of independently efficient resources combined into an effective communication complex.

Ideally we need to support textual, graphical, and dynamic information. For textual information the Internet and e-mail resources have proven outstanding efficiency. In similar way, for graphical information the World Wide Web can efficiently support the display of graphic information for asynchronous interaction (Dern, 1994). Finally, for dynamic information, digitally compressed video transmitted through broad bandwidth networks has shown a level of

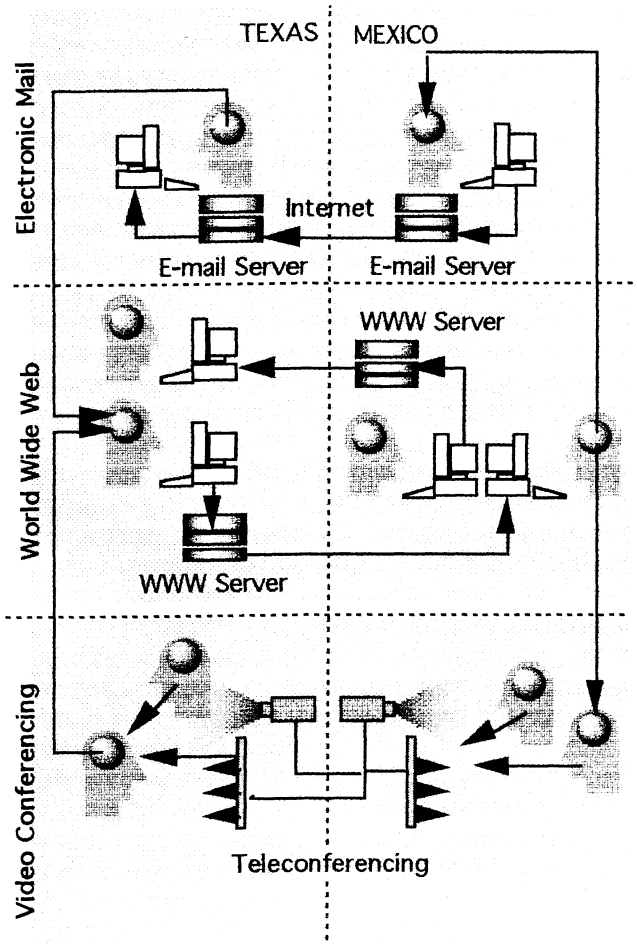

Fig. 1. Communication Instrumental Complex

affordable efficiency unknown until recently.

On balance (see Figure 1) it may be possible to combine the use of e-mail, the WWW, and compressed video conferencing for accomplishing communication effectiveness during design engagements. Designers could pin-up design information in web pages that may be viewed by design partners. Such partners could down-load graphic files for further manipulation of the information or could render design comments through E-mail. Beyond potential feedback and updating of design information in the project's web page, designers could also meet through compressed video conferences to discuss collective design decisions that require the benefits for real-time interaction.

AN ACTUAL IMPLEMENTATION

Having in mind the potential offered by current technology for establishing a Transnational Virtual Design Studio, and taking into account new telematics infrastructure linking the main campus of Texas A&M University in College Station with the Texas A&M Center in Mexico City, during the Fall semester 1996 we established an experimental Virtual Design Studio in conjunction with similar efforts from the School of Architecture and Graphic Design of "Universidad La Salle" of Mexico City. The experimental design studio has been called "The Tex-Mex Virtual Design Studio" and has initially counted with the participation of 15 American students, and 12 Mexican students.

Considering the cognitive demands to be imposed on the students of The Tex-Mex Virtual Design Studio it was initially decided to divide instructional targets among both groups. Taking advantage of some knowledge of the English language among Mexican students it was agreed that the Studio would be conducted in English and that the design subject was to be located somewhere in Mexico. In such way Mexican students were confronted with the task of learning to present design ideas in a second language at the same time that the Texan students had to learn about a design context that was in many ways different from their own.

From the many instructional scenarios we can find in a design studio, we selected seven scenarios to be implemented in a virtual context, namely: Formal Lectures, Seminar Meetings, Design Briefings, Desk Crits, Peer Crits, Pin-Up Reviews, and Presentation Reviews.

For addressing a joint lecture and briefing of the project we implemented a single 4 hours compressed video conference between Texas and Mexico in which we addressed the characteristics and instructional targets of the Virtual Design Studio. The design briefing was largely presented by the Mexican students making use of pictures of the building site and examples of Mexican architecture. The students of both groups had a chance to introduce themselves to the other group and initiate some kind of personal contact that was soon followed by a collective exchange of e-mail addresses.

During this first meeting the participants made use of speech, body language, and a limited number of 11"x8.5" or A4 format documents. In a retrospective assessment of this meeting we must acknowledge that the instructors were considerably distracted from their teaching by having to control the instrumental aspects of the tele-conference. Considerable amount of time was lost moving cameras to specific targets and controlling audio pick-up devices. Contrary to initial expectations, the student's performance was quite relaxed. On balance, the instructional objectives of the session were accomplished but it was clear that communication protocols had to be simplified in order to free the instructors from a largely instrumental role.

For addressing a seminar scenario, a second compressed video conference was coordinated. During this second meeting the students presented their conceptual designs and based on such short presentations a fluid exchange of opinions, questions, and answers was maintained. Having more experience with the handling of the video conferencing equipment, the instructors were able to take active control of the seminar. It was noted that the students acted with little or no attention to the interface standing between both groups. From the spirit of the discussion it was clear that the students were more interested on their conflicting opinions that on the points they could agree on. Their fascination upon the differences was notorious and together with such a fascina-

tion a tendency towards a competitive attitude was noticed.

Following our two first video conferences, both groups of students were asked to establish personal web pages in which they could pin-up personal data together with information on the development of their projects. All web pages were accessible through the Tex-Mex Virtual Design Studio Web Site. As the project evolved, instructors used the WWW for reviewing student projects, at any time and any of both groups, and render the equivalent to a desk crit through e-mail. Students were encouraged to do the same in emulation to peer reviews but evidence suggests that this dynamic was very limited and in any case it was restricted to few students that developed friendships across the Internet.

The American group operated from an Electronic Design Studio equipped with UNIX Work Stations. The two main pieces of CAD software in use were "AutoCad 13" for 2-dimensional drafting and "Reflex" for object-oriented 3-dimensional modeling and rendering. In addition to CAD software, the American students also had access to the use of bit-map editing programmes, word processors, and network software. About half of the American students had previous experience on the use of Computer-Aided Drafting software and networking resources.

The Mexican group operated from a conventional Design Studio and model-making workshop. Most of the Mexican students had no previous experience on the use of CAD or networking resources. Their access to networking resources was supplied by university-wide facilities housed in the same campus but different building.

In order to boost interaction, at mid-semester we conducted a first video review in which 3.5 hours were dedicated to the presentation, crit, and defense of eight projects at random. Each group made use of different media for presenting their projects and rendering a relevant feedback. The technical set-up in each site was somehow different.

In Mexico City the technical set-up was based in the use of one stationary camera, one moving camera, one document camera, two television monitors, and a table-top control panel (see figure 2).

The stationary camera was mainly used for maintaining a wide-angle view of the entire tele-conferencing room. The moving camera was used for zooming closer to certain groups of people and for approaching a pin-up board on which large format drawings could be displayed. The document camera was used on its standard position for showing small format images and by moving it to the side it could also be used for showing mid-size physical models of the projects. That camera could be used for showing the television monitor in which the remote location was on display.

In Texas the technical set-up was based in the use of one stationary camera, one moving camera, one document camera, two television monitors, one large format video projector, one large format data projector attached to a computer with Internet access, one overhead projector, and a table-top control panel (see figure 3).

The stationary camera was used for showing a large

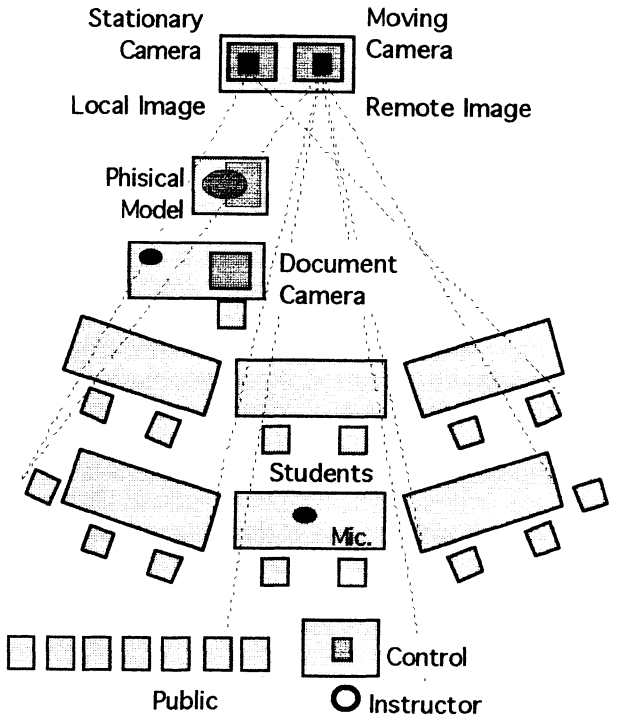

Fig. 2. Instrumental set-up in Mexico

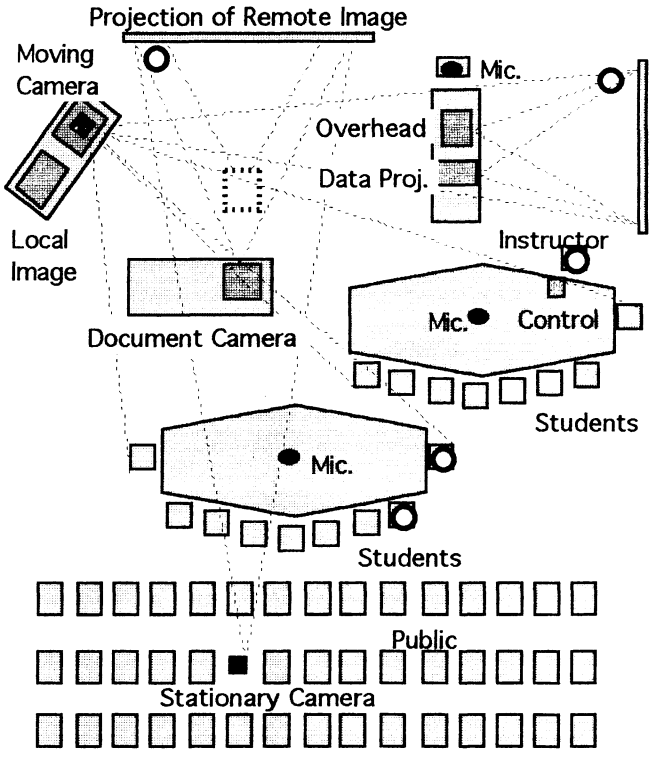

Fig. 3. Instrumental set-up in Texas

format projection of the remote location. The moving camera was used on 6 different pre-settings that zoomed on specific groups of people and could show a projection screen on which the overhead projector and data projector could display transparencies and web pages from either group. The

document camera was used only for small format images.

In general terms it would be fair to say that both groups managed to get their message across the interface but it was obvious that both set-ups required massive improvement. In particular we can outline such areas of improvement as follows:

- Conventional moving cameras do not render the quality required for the display of large format pin-up drawings. Better results may be obtained by using a hi-resolution camera similar to the one used for small format documents.
- The display of physical models is constantly disturbed by the movement of the model and the consequent effort of the camera to re-establish proper focus. Better results may be achieved by devising a turn-table system on which the physical model could be turned around in a slower and smoother fashion.
- The use of cameras that may feedback on images of the remote location is of fundamental importance during the rendering of a crit. We need to explore ways to improve the quality of the remote image on the feedback and add the possibility of real-time graphic interaction through the use of a whiteboard as video projection screen.
- Instructors tend to be anchored to the control panel. The use of a remote control, a wireless clip microphone, and perhaps a movement tracking camera may come to free the instructors from a specific location in the teleconferencing room.

Our intermediate video-review had a strong impact on the design performance of both groups. A healthy competitive attitude was reinforced but shortly after students started to divert considerable attention from the design process into a documentation process. Students felt the pressure of having to show their projects in a more effective way. In a number of instances, design instructors had to discourage students from pursuing fancy documentation at a cost in design quality.

The commitment of the students to maintain up-dated web pages was higher in the second half of the semester. In part this may be attributed to better skills on the handling of network resources and larger availability of design documentation for maintaining a pin-up review. In general terms the tendency of most students was to show their projects rather than to offer a crit to their peer.

The last video-review of the project was mainly a presentation review in which all the participants of the Tex-Mex Virtual Design Studio had a chance to show their projects. The amount of crit that was exchanged was very limited due to time constraints. Following the last video-review of the project, both groups conducted final pin-up reviews in their own schools and documented their projects for final display in the WWW.

For further information, the web site of "The Tex-Mex Virtual Design Studio" is situated at: http://archone.tamu.edu/~ARCH405/TXMXhome.html

CONCLUSIONS

In first place, it is important to underline that all the conventional instructional targets of a Design Studio were achieved and that non-conventional targets, particular to the Tex-Mex Virtual Design Studio, were largely accomplished. In future implementations we may choose to team-up Texan and Mexican students in order to increase interaction through the Internet. In addition, the possibility of having Mexican and Texan exchange students participating within local studios may contribute to establish closer personal relations. Students taking part in the Tex-Mex Virtual Design Studio appear to be strongly motivated to participate in international teach abroad programs or reciprocal student exchange programs. This kind of virtual experience, far from replacing actual international programmes, may be an important component in student recruiting and selection procedures.

In second place, we have been able to identify exceptional levels of dedication among both groups. Dedication largely motivated by a spirit of healthy competition. We believe that an initial team-up of students will not reduce a competitive tendency but on the contrary it may extend it to the inside of each national group. It is of considerable importance to continue addressing control on a natural tendency of the students to commit considerable effort to the documentation of their projects if it comes at a cost in design quality.

In third place, the unusual setting in which learning opportunities are offered tends to reinforce short term memory and the potential for retroactive introspection. This finding is of substantial importance because it comes to address our constant need to be reflective (Schön, 1987) upon the act of design as a prime learning opportunity.

The main drawback we have been able to identify is referred to the level of distraction that instructors can experience at the time of addressing a design crit and the teleconferencing protocol simultaneously. The control of cameras, audio level, and projection devices can come across the actual rendering of a focused design crit. We need to find way of simplifying communication protocols or move towards the possibility of using a "facilitator" that takes care of the technical aspects of the review.

Beyond human training in the use of the technology involved and its further simplification, the subject of effective use of media requires more attention. A pin-up review of large hand-made drawings is very different from a video-conference using small computer rendered images. The use of digital models as opposed to physical models transmitted as moving video take-offs requires careful consideration due to our limitations for remote physical interaction. The use of virtual reality models in our web pages is under study.

Last but not least, and as in the case of Computer Aided Drafting or Computer-Aided Design in recent years, the application of new technology can raise a defensive attitude from some sectors of the profession. As in previous cases, we will need to address the question of instrumental change in

a context where polarisation should be avoided. We believe that real face to face contact between design partners can not be replaced by virtual encounters, but we also believe that if we are to intensify transnational activities and open such market to mid-size and small size design firms, there is a definite place for the use of telematics in our profession.

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