Telepresence User Interface Design Issues and Solutions

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Executive Summary

The user interface team has been given the role of developing the user interfaces for the Telepresence project. To do this they are working with the social science team and developing interfaces for each of the field trials. They are updating these interfaces based on data gathered in the field trials. The knowledge acquired from their design activities will be used to design a final general flexible interface for Telepresence and to generate recommendations to the corporate members of the Telepresence project on the types of technology that need to be developed underneath to make the interfaces work effectively.

A secondary focus of the user interface team is that of determining effective design and implementation strategies for encouraging the adoption of the telepresence technology. They are also investigating how to apply the information gathered in the social science field studies to the evaluation of the interface designs and the generation of new designs. Human communication is not an area covered by the traditional cognitive psychology approaches to interface design so that the exploration of sociological data as a predictor of design is being examined.

This report details the current user interface designs and user studies that have been conducted and lays out the proposed requirements for future designs and user studies that are being planned. It closes with a set of deliverables and a time line for when these deliverables can be expected from the work of this team.

The Role of the User Interface Team in Telepresence

The user interface team's main purpose is to develop user interfaces for users of the Telepresence system. By user interfaces, we mean the mechanisms by which a person using a Telepresence system requests the system to perform communication activities and all the visible states and responses that the Telepresence system provides for that person. Screen displays which show possible selections that a user might make and the system's displayed response when the selections are made is a part of the user interface, but so is the layout of the equipment on a user's desk, the switches and dials on the equipment as well as the office environment in which the equipment is placed. The user interface is therefore everything the user sees and interacts with associated with the Telepresence system.

We have two primary types of user interfaces we are concerned with. client-centred and research-centred. The first and most immediate interface that we are
developing is the client-centred one that will be used in our field trials. We are developing each of these interfaces to work specifically for the needs of the client. The research-centred interface will be a flexible general interface that will be based on information we acquire in our field studies and laboratory studies and via our exploration of the design space for these types of systems.

More specifically, the user interface team's main focus will be on gathering information from identified user populations and using that information to specify the functionality of the Telepresence system and the design of a set of user actions that will invoke the functionality. The team will also iteratively test designs on Telepresence users and make necessary modifications indicated by the tests. A secondary focus will be on designing for adoption. The functionality, interactivity, and introduction plan will be designed to reduce user's apprehension with the technology and to provide useful functions, ease-of-use and user-perceived control that balance the learning costs and invasiveness of the technology. Data will be gathered on the effectiveness of the designs and techniques used to foster adoption.

### Design Philosophy

The design of the user interface serves as the driving thrust for the development focus of the other Telepresence teams. The basic design philosophy of the Telepresence project is user-centred., i.e., the functions provided by the system need to be those functions that will fulfill the communication needs of the user - both those the user can articulate now and those that we can anticipate the user will need in the future. In essence the project is based on the premise that the user is right. The user interface team, in addition to designing the user interface, is therefore engaged in actively studying potential users and iteratively incorporating the results of their studies into new versions of the interface design. The team is engaged in five basic activities that follow this user-centred philosophy. They are listed in Table 1 and described below.

Because users of computer supported audio and video systems have had no prior experience with the technology, it will be difficult for them to articulate how they want to use the system. Thus, the project has to rely on gathering data on existing communication activities and iterative design to create an effective technology. Since the project stems from the previous NSERC funded CAVECAT project, much of what has been learned about user response to and usage of the CAVECAT system will be applied to the initial designs of the user interface.

### User-Centred Design Approach

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1. Use of data captured from potential users by means of interviews, surveys, and observation techniques to guide design

2. Use of results from prior empirical studies and field studies conducted in the CAVECAT project to guide design

3. Use of laboratory studies to evaluate and iteratively change design

4. Iterative design of user interface

5. Identification and communication of current limitations in technology that constrain optimal user design

Table 1. Five basic activities undertaken by the user interface group based on Telepresence’s user centred approach to design.

Although the design of the user interface will serve as the driving thrust for the underlying software and engineering development of the project, it is understood that many of the constraints that currently exist in the off-the-shelf hardware purchased for the Telepresence system, in the cost of rebuilding existing server software and in the basic costs of setting up viable systems with current technology will limit the optimality of parts of the design. Thus, although a driving force for what can be done with software and hardware, the user interface design will also work within practical constraints of what is technically feasible and at building interfaces that make these constraints as transparent as possible to the user.

One of the outcomes of the user interface work will therefore be the identification of the hardware and software constraints and the suggestions to Canadian industry for technology that will circumvent these constraints with the advent of ISDN lines and digital video.

The Tight Integration of the User Interface Team with the Rest of Telepresence

Given the user interface design philosophy for the Telepresence project, the user interface team needs to work closely with all other groups in the project. The group is therefore made up of representatives from each of the projects in addition to its user interface designers. All representatives contribute equally to the interface design and also carry back issues from the design to their respective teams.
The Toronto Software Development Team

The Toronto software team is rewriting the IIIF server to include call management and automatic update facilities into the software which manages the switching of the audio and video lines for Telepresence. The low end capabilities for call management limit the functionality the user interface can provide to its users. For example, if the interface makes contacting individuals in a distributed office as simple as selecting the name of the contactee from a menu, the IIIF server needs to provide automatic dialing and call answering for codecs that connect the distributed sites.

The Toronto software team is building the Telepresence Communication Server (TCS). This software serves as an intermediary between the IIIF server and the user interfaces built for the Telepresence system. The TCS takes a functional request from the user interface and issues calls to the IIIF server that will carry out the requested functions. The functionality built into the user interface determines the different sets of calls the TCS will need to issue and manage for the IIIF server.

Finally, the Toronto software team is also building the interfaces being designed by the interface team. As each interface gets finalized, it is built in a prototyping system such as Hypercard or Supercard on the Macintosh or SUIT on the Sun workstations. These prototype interfaces allow us to quickly modify details about the interface design and to mockup new interfaces thereby rapidly responding to user needs on our field trial projects. Figure 1 illustrates the integration of the Telepresence software with the user interface.

An individual from the software team who has user interface experience also is a member of the user interface team. This is Tracy Narine. His role is to contribute to the design of the interface, to inform the team of possible design constraints or

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**Figure 1.** Direction of calls to and from the user interface.
limits of the IIIF server software and to convey design change request back to the IIIF server team. From time to time, the user interface team also meets with Tom Milligan, the head of the Toronto software team.

The Ottawa Engineering Team
The user interface team interacts with the Ottawa engineering team in two major fashions. First, many of functions specified for the field trials cannot work without code written to manage the low level functions of the technology being used in the field trials. An example of this is automatic dialing of the codecs. Second, the general interfaces specified by the user interface team require re-engineering of off-the-shelf technology and drivers for this technology. An example of this is the code and interfaces that will control the vcrs that will be used in video mail.

An individual from the Ottawa engineering team sits on the interface design team. He is Maciek Kozlowski. His role is to help in the user interface design, to review the design team's specifications and let them know about constraints that may limit the interface design and to communicate functional requests back to the Ottawa engineering team.

The Social Science Team
Perhaps the tightest overlap is the linkage between the social science team and the user interface team. It is the social science team that makes the contacts and sets up the field studies for which the user interface team designs their interfaces and extrapolates from the data collected in the field studies and studies on these designs to the more general interface they are developing.

The pre-implementation surveys that are part of the field studies collect data relevant to the user interface design. The adoption strategies of the user interface team parallel the adoption concerns of the social science team. The user group that the social science team sets up for each field site will feed redesign information to the user interface team and information on the effectiveness of the adoption measures taken. A portion of the data collected by the social science team for examining communication networks and work practices feeds directly into developing requirements for the user interface design.

Three individuals sit on the user interface team that also sit on the social science team. They are Garry Beirne, Marilyn Mantei and Beverly Harrison. Their roles are to work directly with the social science team specifying their needs on the design of the questionnaires and interviews that will be administered as part of the field trial. They also need to apply the data gathered by the social science team to the interface
design. Schedules and Duties need to be tightly integrated between the two teams so that each team does not overwhelm the field trial sites nor fail to meet a deadline necessary for the work of the other team.

**Toronto Field Experiment Coordination**

For each field trial, equipment needs to be purchased and coordinated. The type and amount of equipment to be installed is constrained, in a large part, by the budget of the organisation agreeing to the field trial. The liaison person for setting up these field trials, Garry Beirne, also resides on the user interface team. His role, in addition to aiding in the specification of the interface, is to indicate the cost and physical constraints of the system being installed on the proposed designs.

Overall, the user interface team has the requirement to disseminate both its designs and their rationale as quickly as possible to the rest of the Telepresence teams because of the defining role they play on the project.

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### The Indigo Project

The user interface team is directing its efforts towards developing user interfaces for the field trials. The experience gained in the field trial designs is expected to drive the final flexible interface prototype the team will generate for telepresence systems. The first of these field trials is Project Indigo which is with an organisation that is at arms length from the Telepresence project. (Indigo is not the true name of the organisation. The code name Indigo is used to protect the privacy of the studied company.) The organisation is friendly to the Telepresence project and receptive to the idea of being studied by the social science group.

The Indigo organisation is distributed across two sites in Ontario. Its work requires it to be located at two sites to interface with its primary clients. There is significant communication between the home office at site A and the remote office at site B. The director of site B travels to site A approximately two times per week and a large amount of telephone and email traffic goes on continuously between both sites. There is also considerable communication between the organisation's clients on a regular basis.

The Telepresence project has agreed to set up a computer-based video communication system between the two sites. Eight people work at both sites, three at site B and five at site A. A camera, monitor, microphone, workstation and speaker will be installed on the desk of each employee. The two sites will be
connected by codecs. In addition to the desktop units, a videoconferencing setup will be installed in the meeting rooms at both sites. The user interface group is to design the user interface that will reside on the desktops and in the two conference rooms for Indigo.

Because of tight time schedules and potential interference with the work of the social science group plus the considerable knowledge gained from the CAVECAT use interface designs, the Indigo interface design did not follow recommended interface design practice which insists on gathering information from the user population prior to design and building and testing prototypes of the design prior to installation. Instead, a preliminary design was constructed based on the previous experience of the designers with the CAVECAT project and on cognitive walkthroughs of the design by members of the design team. Unresolved design issues and the design rationale followed for different aspects of the design were investigated in an interview with users considered similar to those in the field trial organisation. The interface design was modified based on the interviews and the walkthroughs. Its specification was released to the software team and it is now being developed for a March 15th installation.

We call the preliminary design Version 1. Version 1 is a very simple interface with limited functionality. It was intentionally designed this way so that added features planned for later versions would give users a feeling that we were responding to their requests and needs. A limited set of capabilities will also to make learning of the system easier. We were also concerned that employees at Indigo feared that adopting the system would make them vulnerable to privacy invasion by individuals more technically skilled. We therefore created a simple low tech appearing interface to assuage these concerns and promote adoption. A final reason for our simple interface was simply time. Since we did not have time to test out prototypes of the interface, we were concerned that something more complex would contain more missed user problems which could lead to the non use of the system.

Although we are unable to apply user information to Version 1 which has already been released to development, we are already designing version 2 of the interface software. It is this version that user data collection and user studies will be applied to. Preliminary design of Version 2 and even Version 3 was necessary for Version 1 to insure that techniques learned by the user with Version 1 would not be violated in subsequent versions.

In the next sessions, we describe in more detail the user interface design specifications for Indigo Version 1, the interviews that were conducted, the design walkthroughs, the planned pre-implementation questionnaire administration and the proposed user testing of the design prior to the design and installation of
Version 2. We also list the requirements we have currently established for Version 2 and a partial plan for Version 3 although the plan is expected to change as we apply information gathered from the Indigo users.

**Design Specifications - Version 1**

The first version of the user interface that the UI team has specified for the Indigo project is currently under construction. We describe this interface and the design rationale underlying features in the interface briefly in this section. The document listing the functional specifications of the interface that has been given to the Toronto software team is included as Appendix A of this report.

We are currently constructing all proposed interfaces in prototyping systems so that we can readily change the appearance of the interface and add new features for the user. This follows the interface construction policy of iterative design and also meets our plan to design for adoption and multiple platforms. A prototyping system allows us to respond quickly to user requests. Because there exist useful prototyping systems for all common personal workstation platforms, we can quickly develop multiple similar interfaces for each platform. All will talk to the Telepresence Communication Server residing on a unix-based machine. We are currently planning to use Supercard on the Macintosh and SUIT on the Sun and PC systems for our prototype interfaces. Each of the prototyping systems has inherent limitations that constrain the design and each of the platforms requires us to use different designs based on the integration of the design with the user's knowledge and work practices on a particular platform.

As previously indicated, the user interface is not only the software application, but the entire physical layout, aesthetical appearance and interactivity of the system being installed. With this in mind, we first specify the physical characteristics of the system that will be installed for version 1 followed by a description of the software environment.

**Physical Characteristics - Version 1**

The physical characteristics of the system planned for Indigo's version 1 installation are constrained by both cost and available technology. The system to be installed will consist of:
• a 13 inch TV monitor that will sit on the person's desktop next to their Macintosh workstation.

• a small PZM microphone that will be mounted on a wall near their desk. Desk units in Indigo that are in open areas come with front reception panels that can serve as mounting walls.

• a small speaker unit that will sit on the person's desktop next to the TV monitor. The speaker unit will have a volume control knob attached to it.

• a small three-inch long and two-inch wide colour camera unit that will be velcroed to the top of the TV monitor.

• an optional swivel stand that will support the TV monitor.

• cabling that will be hidden in cable trays in the ceiling or under the floors in the office space.

• A powerbar hidden underneath the flooring or inside the desk to which all the above equipment will be plugged in. This powerbar will not be visible to the user but will have a connection to it that will allow the user to turn off all power to their equipment if they so desire.

• An existing Macintosh workstation that resides on each person's desk.

• Timbuktu software for sharing screens between workstations.

Other parts of the system such as the Sun IPC station for the servers and the video and audio switching gear will be in a storage closet and not form part of the active physical environment of the users although the underlying cabling and equipment that runs the system will be available to any user who wishes to examine it.

The physical interface poses some serious problems to the interface design. The Indigo organisation is very heavily paper-based and stacks of paper cover much of an employee's desk. The introduction of four pieces of technology that take up space on a user's desk will limit the space for typical office artifacts and the large volume of paper that is processed by the organisation. We have therefore chosen technology that will take up as little space as possible but still be cost effective. An alternative approach would have been to put onscreen video in everyone's workstation, but screen space limitations and the need to install more expensive workstations at some of the desks made this decision infeasible. Another parameter in our choice was the belief that Indigo employees did not use their workstations on a continual basis throughout the day. This belief still needs to be verified in our user studies.

Each of the Macintosh workstations has been upgraded to System 7.1. Memory will also be added to all the workstations to bring their capacity up to 8 Megabytes of memory. The user interface software is intended to reside in memory at each
workstation at all times. The extra memory will ensure that this constraint does not slow down other user activities with the workstation. It also gives the user the appearance that our system has suddenly speeded up all their system activities.

**Software Application - Version 1**

The software application being designed for the Indigo organisation is currently called Telepresence. This name may change in the future if the Indigo users decide to generate their own name for the application. Figure 2 illustrates what this interface will look like. It is a screen capture of the prototype application that is currently being built in Supercard.

![Figure 2. Example user interface design for version 1 of the Indigo installation.](image)

The application will load and the interface shown in Figure 2 will be displayed when the user turns on their Macintosh workstation. Users will automatically be connected up to the audio and video switching system whenever they turn on their computer. Similar to standard Macintosh practice, moving the cursor to the upper left hand box on the window displayed and depressing the mouse button will cause the window display to go away. It will reduce to an icon representing the connection window. Moving the cursor to the icon and doubleclicking the mouse button will restore the window. The only way the user can quit the application is by going to the menu bar under "file" and selecting "quit" from the pulldown menu.