Defining Negotiation Process Methodologies for Distributed Meeting Environments

by
Kareem A. Benjamin

Submitted to the Department of Electrical Engineering and Computer Science
in partial fulfillment of the requirements for the degree of
Master of Engineering in Electrical Engineering and Computer Science
at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

May 1998
[June 1998]

Author . . . . . .
Department of Electrical Engineering and Computer Science
May 22, 1998

Certified by . . . . . .
Feniosky Peña-Mora
Assistant Professor
Thesis Supervisor

Accepted by . . . . . .
Arthur C. Smith
Chairman, Department Committee on Graduate Theses

Defining Negotiation Process Methodologies for Distributed Meeting Environments

by
Kareem A. Benjamin

Submitted to the Department of Electrical Engineering and Computer Science
on May 22, 1998 in partial fulfillment of the
requirements for the degree of
Master of Engineering in Electrical Engineering and Computer Science

Abstract

In an effort to facilitate the changes that occur during the life cycle of large scale engineering projects, the Da Vinci initiative was put forth. An integral part of the Da Vinci initiative is the CAIRO (Collaborative Agent Interaction control and synchROnization), a system designed to conduct distributed meetings using the Internet, saving time and monetary expenses incurred due to organizing and travelling to in-person meetings. In order to make these distributed meetings as productive as possible, this research sought to define meeting processes that are common to physical face-to-face meeting environments. Meeting processes were defined through literature reviews, and through observations of a distributed class conducted at the Massachusetts Institute of Technology. The research yielded the five meeting process definitions: brainstorms, colloquia, debates, discussions, and presentations. Once these processes were defined, the concepts of an agenda, a means for creating and editing an agenda, and wizards to translate process definitions into agendas were all encoded into the CAIRO system. With the newly added features of agendas and process definitions, the CAIRO system now has a more directed focus towards organized meetings and is better able to support productive distributed meetings.

Thesis Supervisor: Feniosky Peña-Mora
Title: Assistant Professor

Contents

List of Figures

List of Tables

Chapter 1

1.0 Introduction

An integral aspect of project management is collaboration and the sharing of information and ideas. Traditionally, such communication has been handled through person-to-person meetings. In an effort to facilitate the changes that occur during the life cycle of large-scale projects on a global scale, the Da Vinci initiative was put forth. The Da Vinci initiative aims to explore the support mechanisms for enhancing distributed engineering design change negotiations. the system envisioned would include computer-supported design tools, distributed communication tools, design knowledge access tools, design artifact object models, as well as a methodology and inference engine for design change management [Peña-Mora, 1996].

As part of the larger Da Vinci project, the CAIRO (Collaborative Agent Interaction control and synchROnization) effort develops a methodology for computer-supported coordination of distributed negotiation meetings. Conferencing is often one of the more difficult aspects of large scale projects, especially those involving participants from many different parts of a country or the world. The CAIRO conferencing system is designed to provide a means for productive conferencing using the Internet. Internet access costs are relatively inexpensive compared to other communication costs such as telephone bills and travel expenses.

1.1 Why Is This Research Important?

Significant research efforts have been devoted to the area of sharing information through computers and the Internet. Some of these efforts have resulted in new concepts such as data warehousing. On top of these massive databases sit many products that handle, process and

share information. Resulting products include work in computer aided design (CAD), product and artifact modeling (e.g. STEP), work flow processing (e.g. Lotus Notes) and scheduling. However, limited attention has been devoted to the basic communication mechanisms and encoding these mechanisms [Peña-Mora et al., 1997]. The CAIRO system aims to aid in the project management process. More specifically, CAIRO tries to address three areas of the project management process - communication, collaboration, and methodology rational.

A result of the undeniable influence of the Internet is the increased ease of communication. The CAIRO system tries to exploit the Internet as a relatively reliable and cost effective way of communicating around the world. As mentioned before, communicating via the Internet saves money and time costs due to travelling. This research plays an important role in utilizing today's technologies to find a new and better way of communicating.

Perhaps the most fundamental aspect of any group work from a two person discussion to a large civil engineering project is the need for effective collaboration. The collaboration process in the real world environment is often hard to quantify. The CAIRO system not only tries to determine what qualities of the collaboration process provide for effective meeting outcomes, but in addition tries to transfer these qualities to the environment on the Internet. This research is important in the on going effort to find effective ways of collaborating in a decentralized manner of the Internet.

Finally, as a result of the collaboration research, the CAIRO system seeks to identify the process methodologies that accompany effective meetings. Certain meeting methodologies lend themselves to the collaboration process in such as way as to allow for productive meetings. This research is important in identifying and encoding process methodologies for the Internet environment, the result of which can be applied to real world, person-to-person meetings.

1.2 Research Objectives

The objectives for the CAIRO system are three fold. First, the system aims to remove the same-place constraints that are characteristic of face-to-face meetings. Elimination of same-place requirements allows for true global collaboration without collocation, saving the time costs of collaboration as well as reducing project expenses.

Second, in addition to the removal of the physical limitations of in-person meetings, the CAIRO system also seeks to remove the temporal or same-time constraints. Without same-time constraints, participants could contribute to the collaboration process asynchronously, adding convenience to the entire negotiation process.

Finally, CAIRO seeks to model meeting control structures. In general, whenever three or more people work together face to face, it is called a meeting [Doyle, 1982]. Therefore, the CAIRO system implements many forms of meeting control structures, in order to facilitate the flow of information.

Given these basic objectives of the CAIRO system, this research combines the encoded concepts to create a new abstraction for a collaboration process. Here a process would be defined as the necessary steps that need to be taken to accomplish a successful negotiation. A well defined process that is applied to a particular part of an engineering project might be reflected in a forum with a certain agenda in which distributed clients might participate with their respective agents working to meet a common goal.

1.3 Thesis Statement

This research focuses on the use of intelligent systems and agent technology concepts in conjunction with an understanding of group meetings and negotiation processes to facilitate computer-supported conferencing among distributed team members. More specifically, definitions for meeting processes were sought, in an effort to accurately model the meetings in the collaborative environment.

The proposed hypothesis of the research is that meeting processes can be well characterized and encoded into the CAIRO system. Much like any other process, such as a manufacturing process, the meeting process can be described. However, there are significant differences between a meeting process and a manufacturing process. A meeting process can be a far more dynamic event, with many different execution paths. As a result, a meeting process can have several outcomes, some of which might be deemed as successful outcomes, while others are deemed as failed meetings. By making the process definition as dynamic as possible, they will conform to the real world meeting practices. Furthermore, embedding such processes into a conferencing

tool such as CAIRO will increase meeting productivity, compared to in-person meetings. The increased productivity is a result of the added abilities provided by computers, the Internet, and the ability to share massive amounts of information at any time with ease.

1.4 Research Benefits

The most obvious benefit that this research provides is the usability of the CAIRO system as a whole. Establishing a set of processes that can be used as a general structure for distributed meetings, improves the quality and productivity of meetings, and adds to the value of the CAIRO system. Ultimately, encoding the process definitions make CAIRO a more useful tool as part of the entire Da Vinci initiative.

The second benefit results from seeking process definitions. Not only did this research attempt to incorporate existing processes into the distributed environment, but also aimed to establish new process definitions. These new processes might not only apply to the CAIRO system, but also to real world negotiations and collaborations, adding to the knowledge base for keys to effective, productive meetings - distributed or otherwise.

Chapter 2

2.0 Background

The current implementation for the CAIRO system allows for meetings to be conducted over the Internet. Due to the global commitment of the entire Da Vinci Initiative, cross platform usage for the CAIRO system is imperative. Therefore, Sun Microsystems' platform independent Java language was used in the actual coding of the project. CAIRO establishes a system in which its users or client, each with access to the internet and to the CAIRO software, can meet in a virtual meeting environment. The entire system operates under the object model described in Fig. 1 [Hussein, 1998].

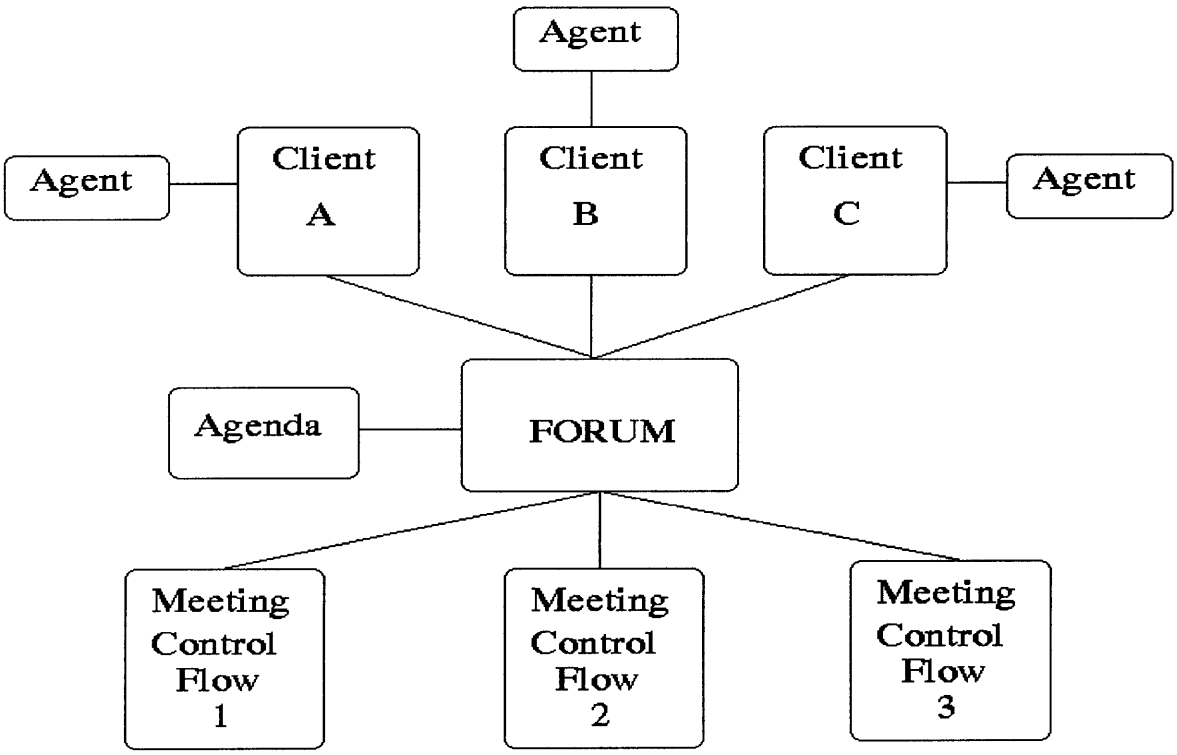

FIGURE 1. Object model diagram for current CAIRO system.

2.1 Client/Forum

When a user wishes to use the system, he or she must start up the CAIRO client and register with the nameserver, which itself if a Java message sending program running on some machine on the internet. Once a client has registered with the nameserver, the nameserver provides the client with a list of all the meetings that are currently running on the CAIRO system. A meeting, or forum as it is named in the CAIRO system, is another Java message sending program. Once a client decides to enter a forum, messages are then passed directly from the client to the particular forum.

A forum is a virtual presentation of a meeting room where clients can collocate over the internet. The basic concept is much like a chat room, where users can join a chat and talk to each other. The difference is that CAIRO provides communication tools to the clients that are more conducive to the engineering collaboration process. A more crucial distinction between a chat room and the CAIRO system is that CAIRO embodies the notion of a meeting control strategy, including chaired meetings, roundtable meetings, and lecture meetings.

2.2 Meeting Control Strategies

In a chat room anyone can make a comment or talk at any point in time. However, actual engineering negotiation meetings cannot follow this format for it would lead to chaos. The CAIRO system allows forums to take on characteristics similar to those of actual meetings, which are called meeting control strategies. A strategy is a way of deciding which member of a meeting is allowed to contribute to the meeting. An example of a control flow strategy is one that models a chaired meeting. In the chaired meeting strategy, one client is designated as the chairperson of the meeting. If another client wishes to collaborate with other clients in the meeting, he or she must first request permission from the chairperson. Another example is a roundtable control strategy. As may be inferred, any client can collaborate at any point in time for there is no chairperson, and permission need not be requested. There are several other control processes under development in the CAIRO system. Detailed descriptions of all current meeting control strategies can be found in the following sections.

2.2.1 Chairman Meeting

The chairman meeting control strategy is analogous to a real world board meeting. In such a meeting, a designated chairman is in control of all aspects of the meeting. Most importantly, the chairman controls who gets to communicate with other members of the meeting and when. If the chairman wants to address everyone in the meeting he simply takes the floor and communicates as he pleases. He does not require anyone's permission to communicate. However, if another member of the meeting wishes to address others in a meeting, he or she will most likely have to raise his/her hand and get permission of the chairman to talk. If the chairman thinks that the meeting member should talk, then the request is granted or otherwise denied. In the chairman meeting control strategy for CAIRO, similar control has been implemented. Because you really can't raise your hand over the internet, CAIRO has implemented pop-up menus so that users can request a variety of things including talking to everyone, talking to particular individuals, and the means for accepting and denying requests.

2.2.2 Free Style Meeting

The free style meeting control strategy is analogous to a very informal meeting. In such meetings, no particular person is in charge. Here, meeting members can take the floor and communicate with other members as they please, allowing all users to contribute to the collaboration process equally. Ideas can be expressed freely without censorship. Essentially, there are no accept and deny request protocols.

2.2.3 Lecture Meeting

The lecture meeting control strategy is analogous to a real world lecture or classroom setting. Similar to the chairman control, the lecturer control all communication in the meeting. Requests are done in the same manner with menus, and all necessary requests go to the lecturer.

Fig. 2 shows the user interfaces for all three meeting control strategies. The CAIRO system employs the real world metaphor for its user interface. Here, the conferencing user interface presents the user with a 3-Dimensional environment. This is done to make the user feel more comfortable with the CAIRO system and ultimately aid in the productivity of the collaboration process through the CAIRO system [Benjamin, 1997].

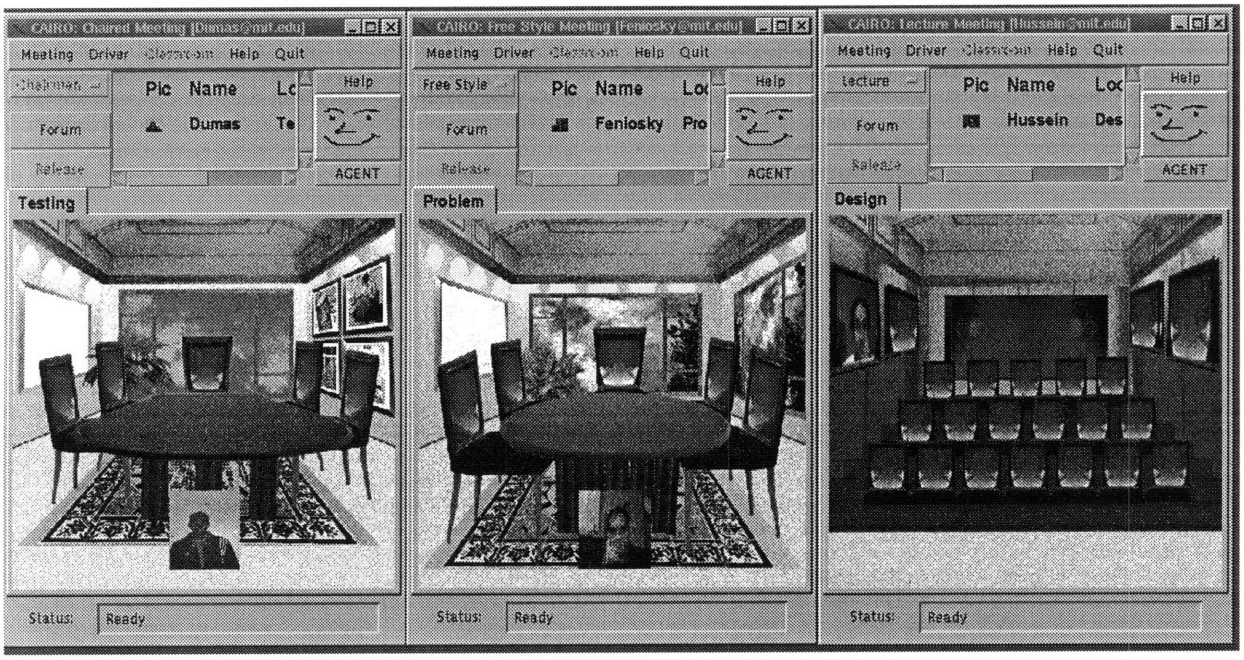

FIGURE 2. Control Interfaces. From left to right, Chairman, Roundtable, and Lecture.

These meeting control strategies are perhaps the single most important contribution of the CAIRO system to the distributed collaboration process [Hussein, 1998]. There are other internet conferencing systems currently available that allow for communication. However, none of them offer the methodology for having structured discussions with appropriate control mechanisms for keeping the communication focused. By implementing ways of controlling which users communicate when and who is able to grant permission to communicate, the CAIRO system introduces a new level of control and structure to Internet conferencing which better facilitates the distributed collaboration process.

2.2.4 Side Conversations

A final component of the control mechanism embodied in the CAIRO system is the concept of side conversations. Members of in-person meetings often feel it necessary to lean over to the next person, and whisper something, or comment on what is currently being discussed. Since they may not want to share this information with everyone, the ability to have side chats seems important.

One of the pop-up menu options in the CAIRO system includes a Side-Chat option. Here, a member of the meeting can request a side conversation with another member of the meeting. The request is made known only to the members involved, regardless of the current meeting control strategy and/or the presence of a chairperson. If the other member chooses to accept the side conversation, both members are moved to a similar side conversation virtual room. This virtual room's user interface is just like the original meeting room, except that, all the other members having been removed, only the members in the side conversation room are the two members that initially wanted to have the side conversation. CAIRO implements the Microsoft Windows-like tab metaphor to manage side conversations. Each new side conversation creates a new tab on the user interface. Figs. 3A and 3B provide an example of a side conversation in progress.

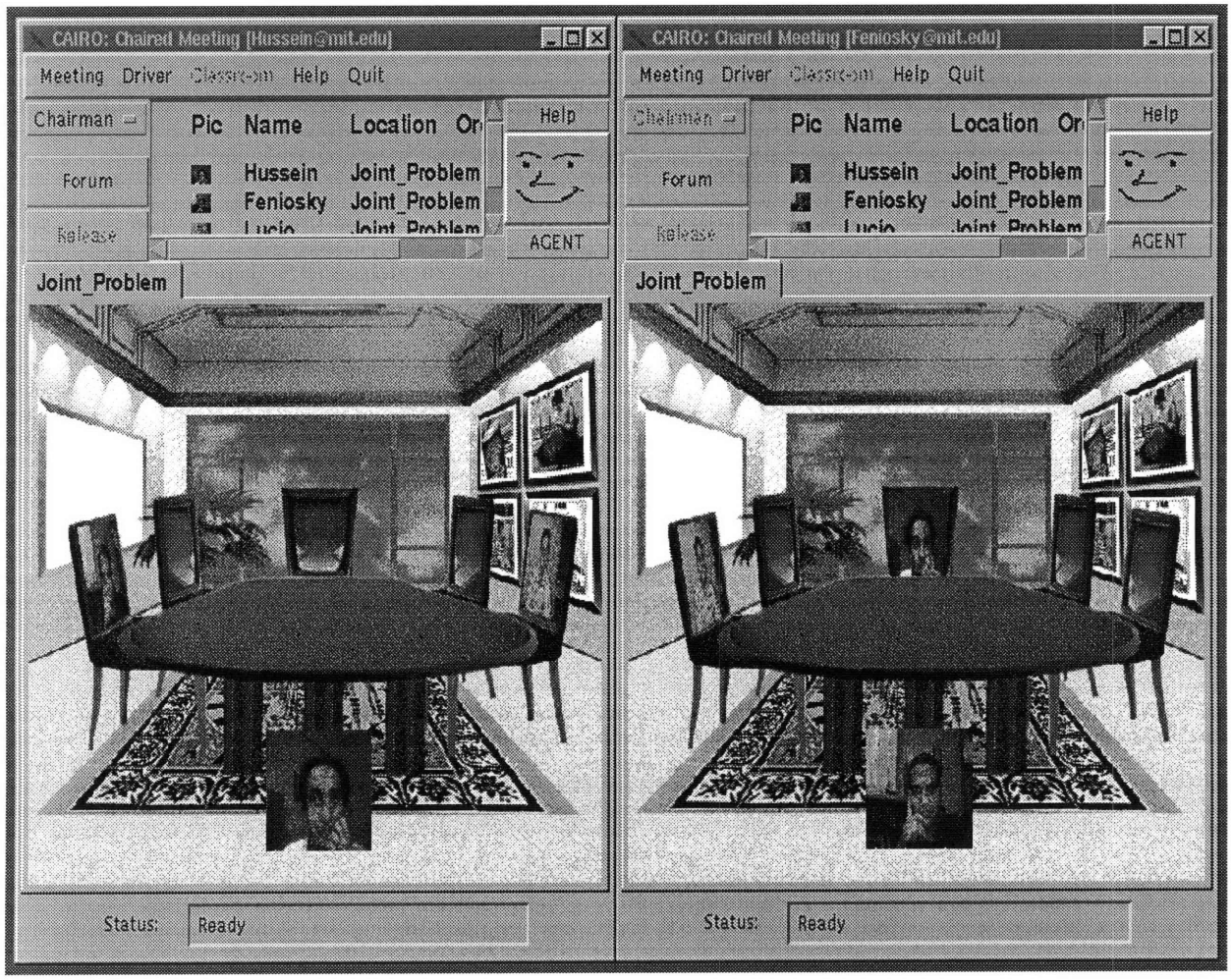

FIGURE 3. (A). Meeting without any side conversations.

Members of a side conversation can communicate with each other freely. For this reason, the new tabs are also created on all collaboration tools so that side conversation users are not limited in how they communicate. There are two important aspects of the side conversation. The first is that those members that are not involved in a side conversation know that a side conversation exists but not which members are involved. The other important aspect is that the members not involved in a side conversation are not privy to the information being exchanged in the side conversation. Fig. 3B illustrates this point clearly. The user interface on the left shows a room with three members present at a meeting. The tab indicates that the user is in the main meeting room. The interface on the right shows a user in a side conversation. There are only two members located in the virtual room, which is indicated by the tab. The privacy issues encoded into the CAIRO system follow along the whispering metaphor of side conversations.

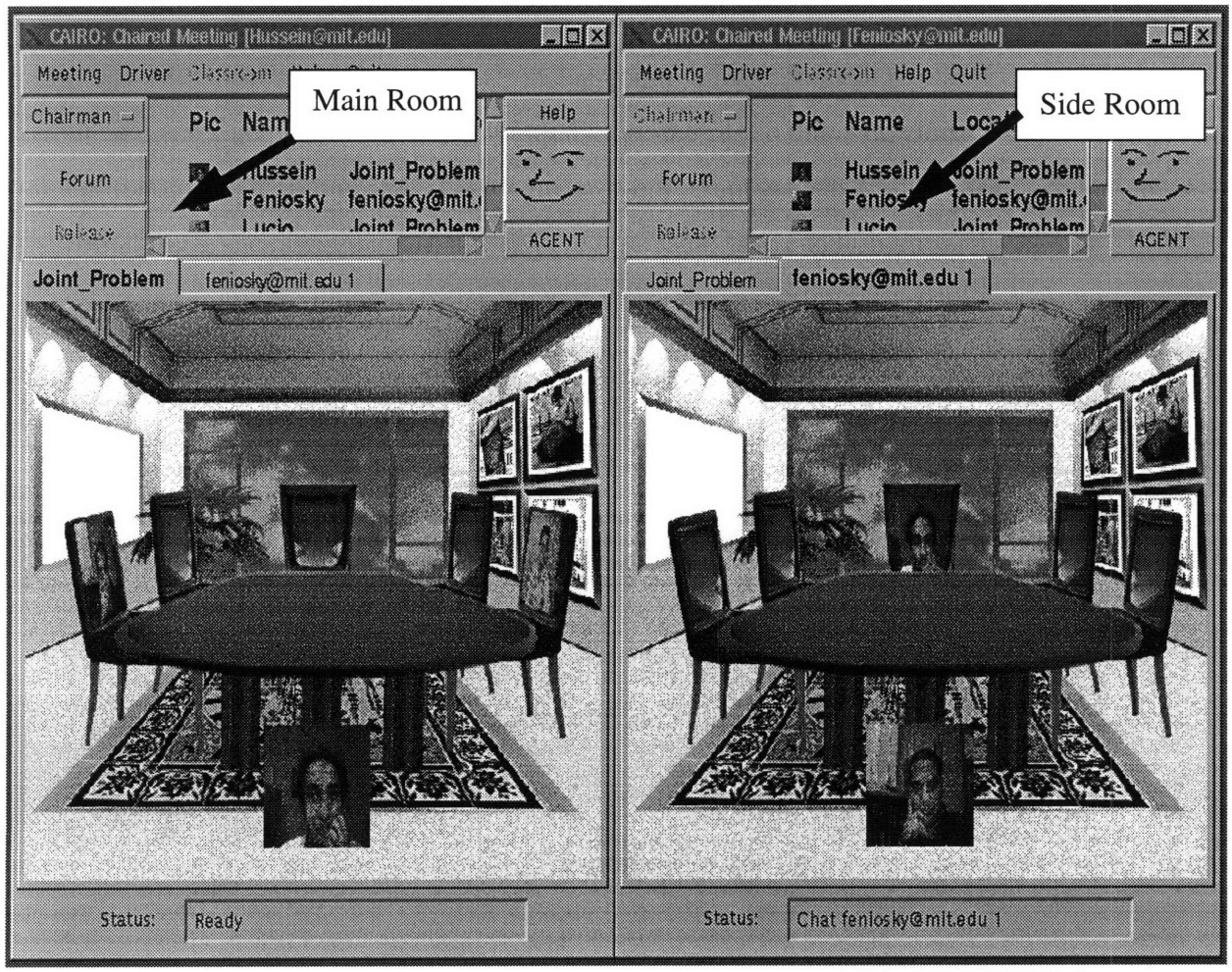

FIGURE 3.(B). Meeting with side conversations

2.3 Agendas

Associated with the CAIRO concepts of clients and forums is the notion of a meeting agenda. An agenda is defined in Webster's Dictionary as "a list, outline, or plan of things to be done". An agenda presents a list of things to be done during the course of a meeting, and it should specify a notion of how long each activity should take. In the CAIRO system, an agenda works in conjunction with a forum to conduct a meeting, much like a real world, face-to-face meeting. Within the definition of an agenda, each item has an associated time and an associated control flow strategy. In CAIRO, once a forum object has been started with a certain agenda, a collaborative meeting can be initiated. As each agenda item is tackled, a certain control flow strategy is employed which is hopefully conducive to the productivity and on-time completion of the particular agenda item.

2.4 Agents

The major component of the CAIRO system is the agent. An agent can be generalized as a software component or program that works in conjunction with people or represents people and acts in their best interests. In the CAIRO system the agent is a Java class that monitors the actions of the client. The goal of the agent is to learn to work along with the client to make the meetings as effective as possible. In relation to the agenda, the agent follows the agenda for the client. During a CAIRO meeting, if the time associated with an agenda item should expire according to the set agenda, then the agent will make a suggestion to the client to move on to the next agenda item with the item's specified control flow strategy.

The client may choose to follow the agent's suggestion. If so, the agent will make note of the current meeting situation and observe the user's tendencies. However, a client may also reject the agents suggestion. In this situation, the agent would modify its assumptions of the user's tendencies, and these new assumptions would be reflected in future suggestions [Hussein, 1998].

]

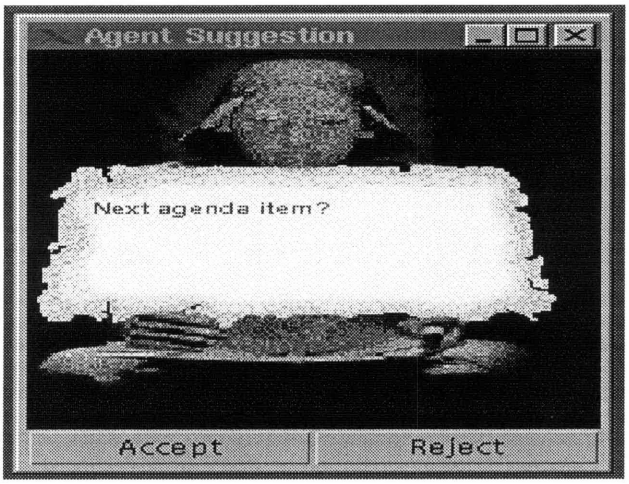

FIGURE 4. CAIRO agent at work.

Agents also monitor the collaboration activity during meetings. Agents monitor the content of text messaged being delivered among the members of the meeting, parsing the information, looking for key words. If the agent finds words such as "explain", then the agent would suggest that the members of the meeting change to a lecture meeting control strategy. Another example would be if the agent finds the word "discuss", then it would make the suggestion to move to a roundtable meeting control strategy. All this parsing information is kept in a dictionary file which can be edited by the CAIRO users.

In addition to monitoring the content of meeting communications, agents also monitor the communication requests. If, during a chairman meeting control strategy, the agent notices that there are a high number of requests to talk, then the agent may suggest to move to a roundtable meeting control strategy, which would better facilitate the need for many meeting members to communicate.

Implementation of agents that follow agendas, monitor collaboration processes, and parse communication content is a method for allowing all meeting participants to be involved in the negotiation process. It is almost impossible to run a fair meeting when you have a personal investment in the subject matter [Doyle, 1982]. The agent removes some level of direct involvement in running a meeting. Therefore, abstracting and encoding the running of an agenda for meetings through an agent helps accomplish the ultimate goal of productive meetings.

2.5 Sample Session

A good way of explaining the functionality of the CAIRO system is to walk through a sample meeting using CAIRO. Because product demonstrations are crucial in presenting research results, part of this research effort resulted in the development of a demonstration script. The script provides a way for anyone interested in understanding the features of the CAIRO system to do so. By going through an automated, pre-scripted meeting, users can develop a better comprehension of the capabilities of the CAIRO system, as well as gain an idea of the possible applications for the system. The following is a description of the events of the script to demonstrate the implementation and usability of the CAIRO system.

The scenario played out in the script demonstration involves a distributed group of civil engineers. The team is comprised of four team members - Hussein, Lucio, Feniosky and Jim - and is headed by Hussein. The group needs to convene to discuss a problem with a joint connection on a recently constructed building. Due to time and cost constraints, the members feel that the problem, although quite important, does not warrant an in-person meeting. For these reasons, they decide to use the CAIRO system to discuss and hopefully arrive at a solution for the building joint problem.

2.5.1 Setup

The administrator for the meeting, Hussein, informs the other group members via e-mail that the group will be meeting on the CAIRO system to discuss the joint problem with the recently constructed building. Before a collaboration can be conducted via CAIRO, a few simple setup things need to be done. First, the nameserver network object needs to be running on a machine somewhere on the Internet. As described before, the nameserver is much like a web server. However, instead of providing web pages, it provides a list of available forums to possible users. If the nameserver is not already running, Hussein would need to start the network object. In addition to including in his e-mail announcing the time for the meeting, Hussein would include the Internet location of the nameserver. This is analogous to the real world process of deciding what building to hold a board meeting. The second setup requirement is to provide a forum network object. Again, the forum allows users that have entered to communicate and collaborate as

need be. Hussein creates a forum called Joint_Problem and registers it with the nameserver. The title of the forum would also be included in the e-mail. This is analogous to telling all the members in what room number the meeting will be held. While creating the forum, Hussein would also have to establish an agenda for the meeting. Once all the start up tasks have been completed, everything is ready for productive, cost effective collaboration through CAIRO.

2.5.2 Entering a Forum

As the time arrives for the meeting, the users start to log into the CAIRO system. As can be seen in Fig. 5, the CAIRO user interface presents the user with the feeling of a hallway. Available forums on the nameserver are represented as doors in the hallway.

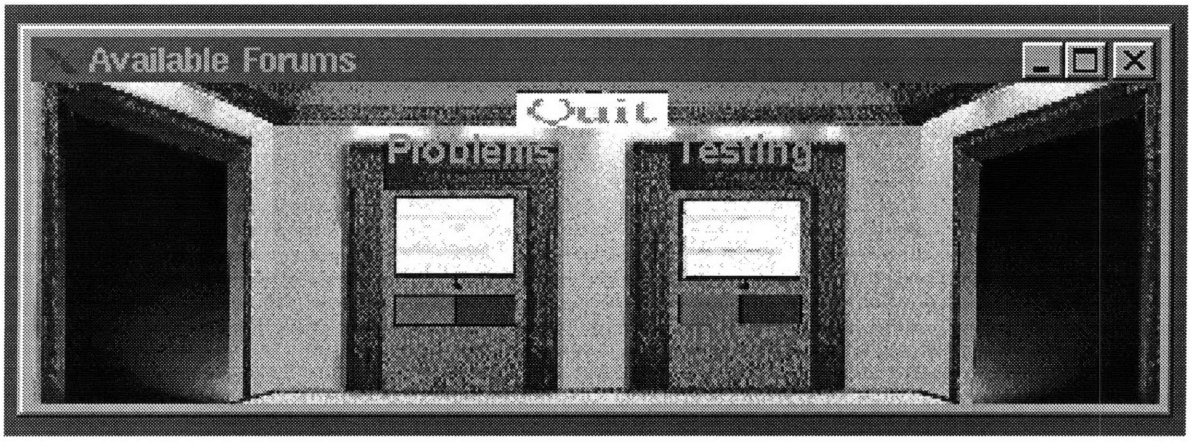

FIGURE 5. CAIRO hallway interface for entering forums.

Users can move up and down the hallway to view all the available rooms. Rooms are entered by selecting one of the doors. CAIRO provides an animation of a door opening to give the real world implication of actually entering a room. Continuing with the script demonstration, Hussein, Lucio, and Feniosky enter the meeting on time and are ready to begin the meeting.

2.5.3 Starting the Agenda

Despite Jim's apparent absence from the meeting, Hussein decides to begin the meeting. Because the agenda has already been preset in the CAIRO system, all Hussein has to do is

display the agenda and start the agenda. CAIRO will then take the members to the forum synchronously through the meeting. Fig. 6 shows the agenda for the Joint_Problem meeting.

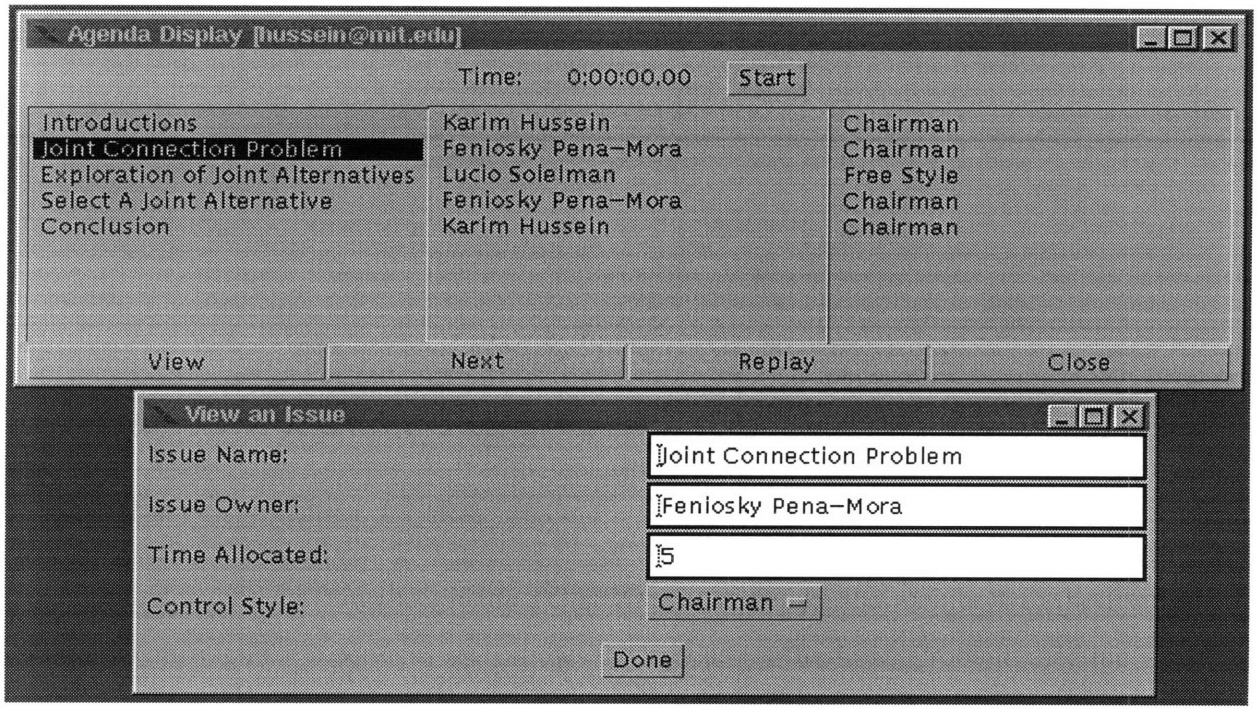

FIGURE 6. Agenda Interface.

The first item on the agenda is the Introductions. As can be seen in Fig. 6, the agenda also contains more information about each agenda item. By selecting an agenda item and choosing the View button, users can see who is in charge of a particular agenda item, how long the agenda item should last, and what type of meeting control strategy is being employed for that particular agenda item. In the example provided in Fig. 6, the agenda item Joint Connection Problem uses the chairman meeting control strategy. In this strategy, the chairman of the meeting, in this case Hussein, can communicate with other meeting members as he so desires. However, if other members wish to communicate, they must first receive permission from the chairman.

CAIRO provides pop-up menus as a means for talk requests. Users wishing to communicate with everyone in the meeting can click on the table. A menu will appear with several options including a Talk-Everyone choice. However, users wanting to communicate with a particular member can click on the image of the person. Another menu will appear with more options including a Talk option. As mentioned before, depending on the current meeting control strategy,

communication requests may be immediately granted, or they may be sent to the chairman to make the decision of granting the requests.

2.5.4 Feedback

To illustrate the pop-up menu functionality, Figs. 7A-7D have been included. Fig. 7A shows a user, Feniosky on the right, requesting to talk to everyone in a chairman meeting control strategy. Due to the rules of the chairman control strategy, the request goes to the chairman of the meeting, Hussein on the left. Fig. 7B shows that the meeting member Feniosky is highlighted in red (although this cannot be seen due to lack of color), meaning that Feniosky is requesting to talk. The highlighting is used to grab the attention of the chairman, making the request easily known.

As the chairman, Hussein now has the option of accepting or denying Feniosky's request. To do so, Hussein is now presented with another pop-up menu listing his current options, including Accept and Deny. The pop-up menu implementation gives the chairman the opportunity to respond to the request as he or she pleases. Much like a board meeting, when members show interest in talking, the request is not always immediately acknowledged.

Finally, Hussein decides to grant the request to Feniosky. Fig. 7D displays the resulting interface after the request has been granted. Two things should be noted from the figure. First, on Hussein's interface on the left, Feniosky is highlighted in green, letting Hussein know that Feniosky is talking to him. Second, on Feniosky's interface on the right, a black dot has appeared next to Hussein's name as well as all the other names in the meeting. This lets Feniosky know to whom he is talking.

CAIRO also provides the same sort of requesting with color indications for talk and side conversation requests. All of this information is a a crucial element of feedback that is necessary in the collaboration process [Hussein, 1998].

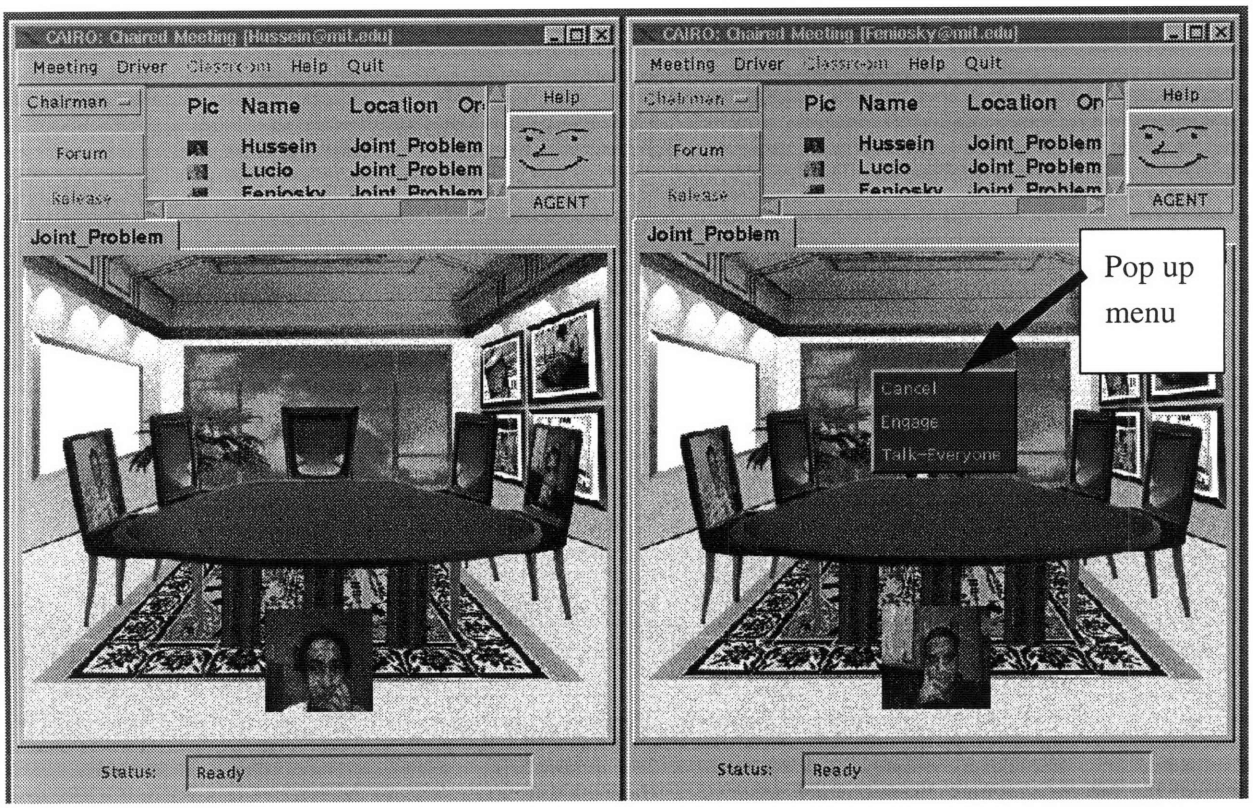

FIGURE 7. (A). Talk to everyone request from Feniosky.

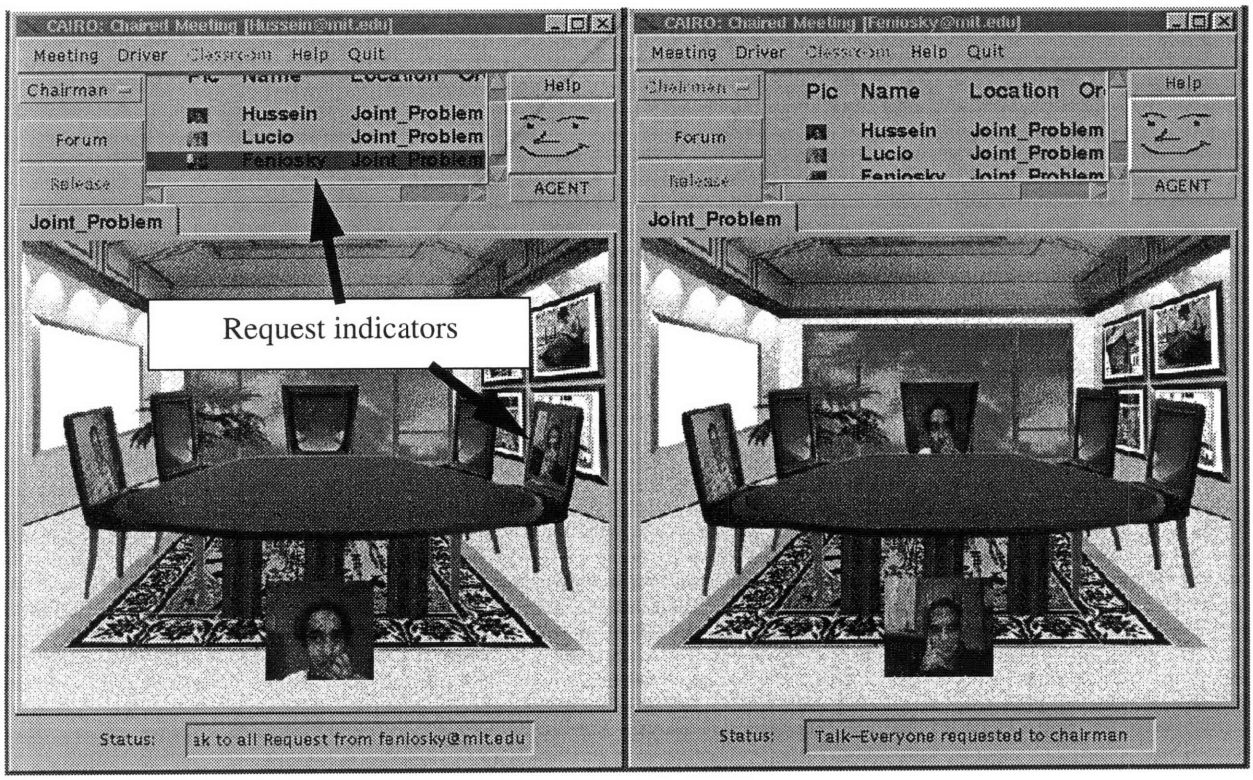

FIGURE 7.(B). Request received by the chairman.

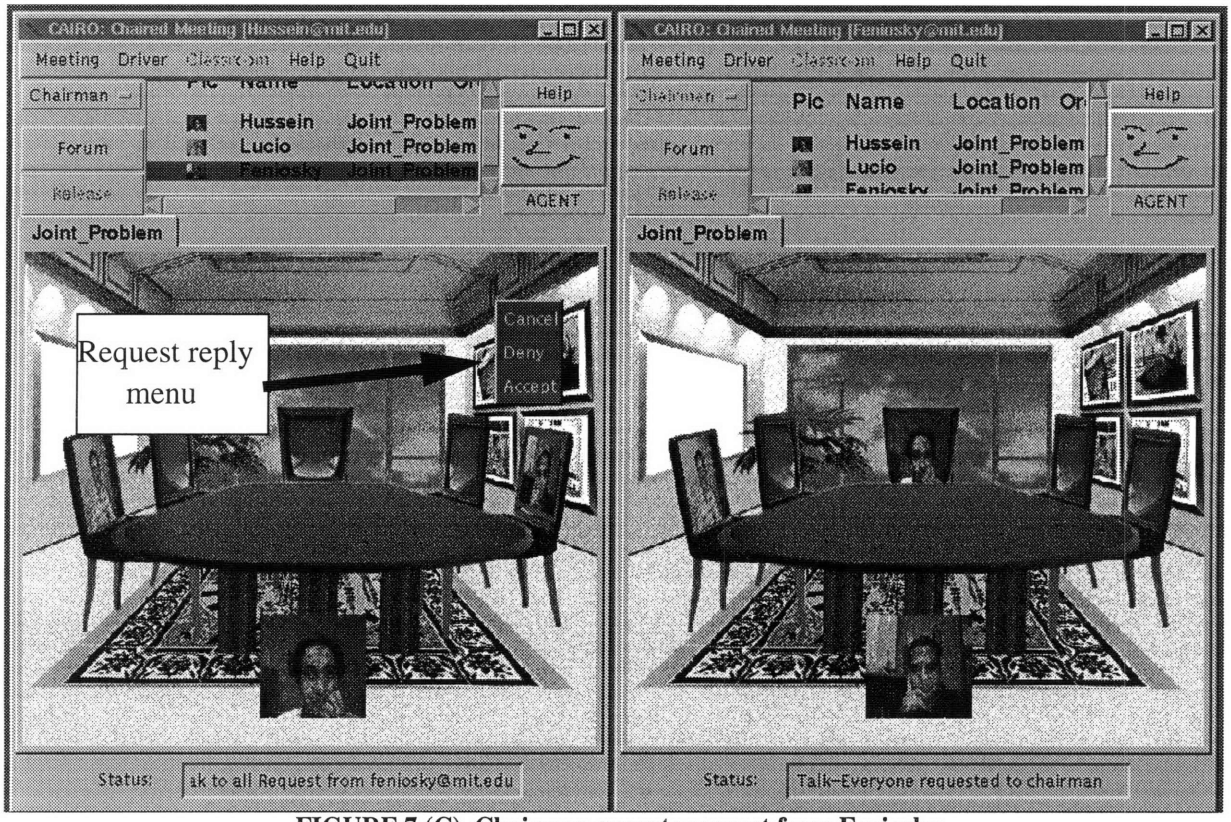

FIGURE 7.(C). Chairman accepts request from Feniosky.

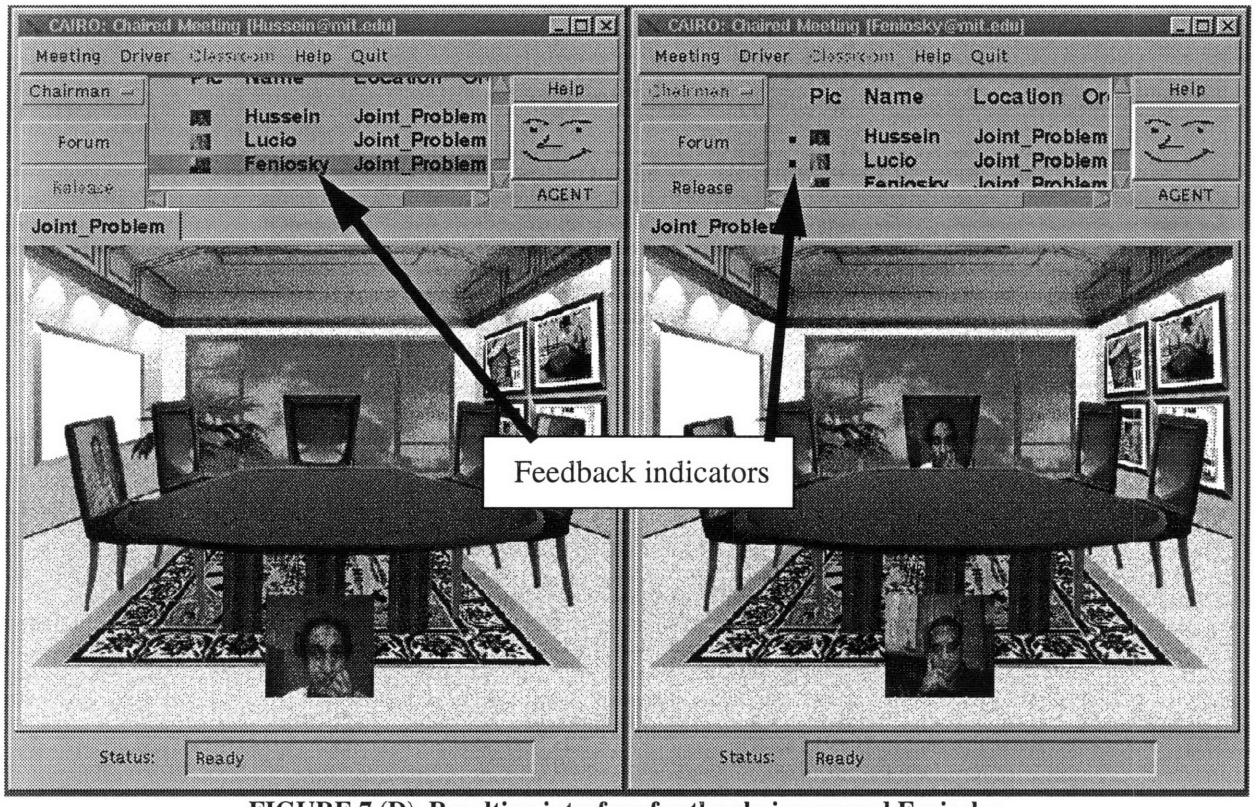

FIGURE 7.(D). Resulting interface for the chairman and Feniosky.

2.5.5 Means for Collaboration

No matter how much structure has been built into the CAIRO system to control and manage the distributed collaboration process, the process as a whole would be futile without tools for communication. In real world meetings, tools such as black boards, overhead projectors, and note pads are used to share information. CAIRO includes tools for communication and collaboration.

Currently the CAIRO system supports a couple of collaboration tools. The first is a message board that is designed for passing text messages across the Internet to other meeting members. Much like drawing tools such as Microsoft's Paint, Xpaint, and Macdraw, the CAIRO whiteboard has a simpler functionality. An added feature is that, when appropriate, meeting members can see what is being drawn on other members' whiteboards.

In addition, the overall design for the implementation for the CAIRO tools was that of a plug and play nature. A perfect example of the plug and play nature is the scheduling tool. This tool allows users to edit scheduling information on a server and receive graphical updates of the information. This tool, which is not crucial for the functionality of the CAIRO system, was easily incorporated into the system. Other collaboration tools, like ACAD for engineering, could easily be connected to the CAIRO system to extend and customize the usability of the system. The initial focus of the research for the CAIRO system was not to develop means for distributed collaboration, but rather to provide a way of facilitating and structuring the collaboration process [Hussein, 1998].

2.5.6 Collaboration through CAIRO

As the meeting continues from the first agenda item the second, different members of the meeting request to talk. At the start of the second agenda item, Feniosky proceeds to describe the problem with the joint on the wall in the building. By presenting diagrams on the whiteboard, along with written descriptions through the message board, he is easily able to explain the situation to the other members of the team. Fig. 8 shows Feniosky's interface at this point in the demonstration.

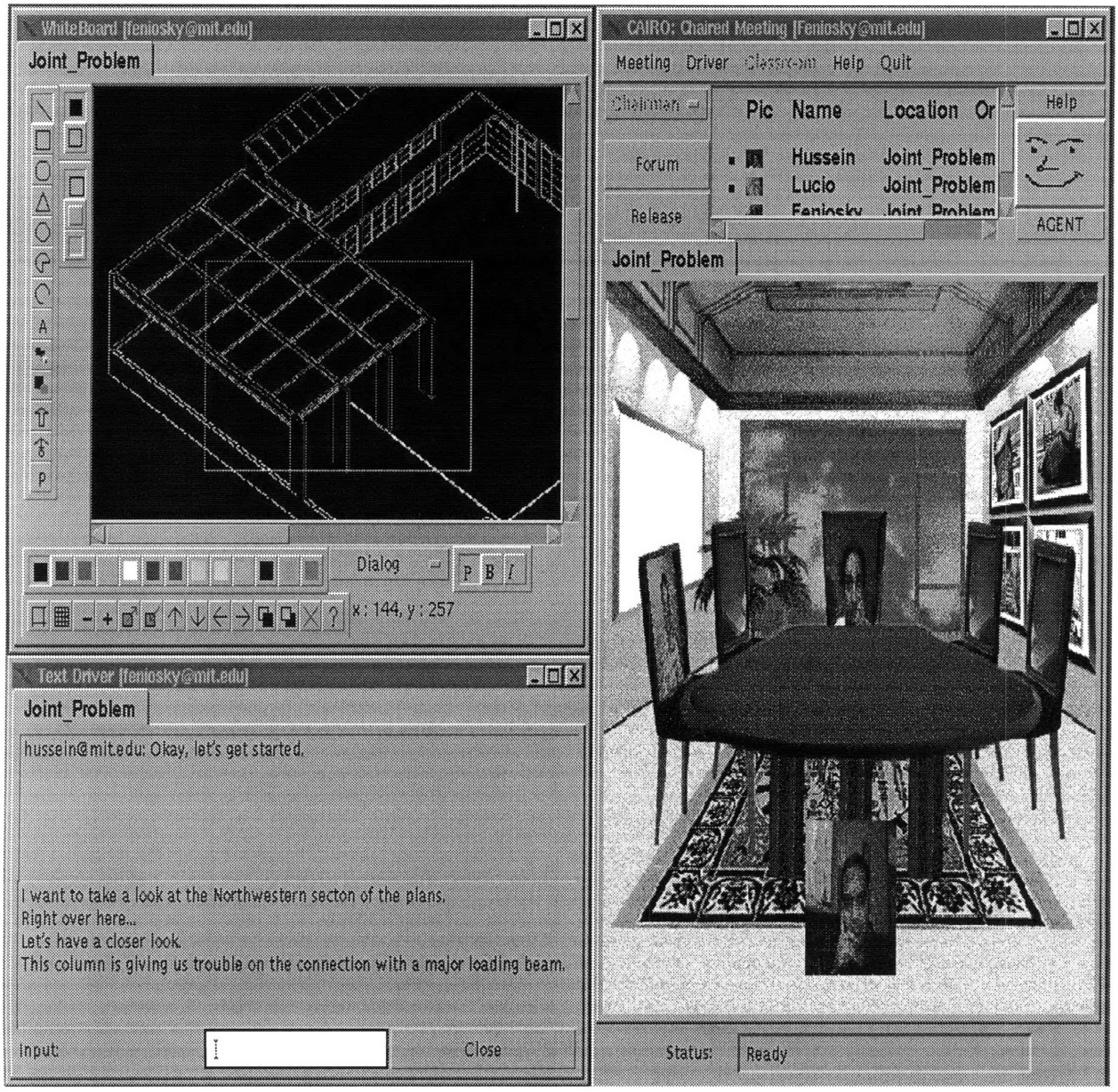

FIGURE 8. Feniosky's user interface

Following the problem definition by Feniosky, the allocated time for that particular agenda item has run out. The CAIRO system, through the agenda agent, pops up and suggests that the meeting proceed to the next agenda item. The interface for the agenda can be seen in Fig. 4. Since Feniosky has finished, Hussein accepts the suggestion and moves on to the next agenda item.

The subsequent agenda item calls for a discussion and an exploration for alternatives to the current joint setup. This particular agenda item employs the free style format for its meet-

ing control strategy. Here, members can speak up and contribute freely to the discussion at hand in order to come up with a solution to the problem. During the discussion, Lucio requests a side conversation with Feniosky. Feniosky accepts, and Lucio begins explaining what he thinks is a viable solution for the joint problem. Before Lucio can start to explain, Feniosky suggests that they really should share this information with everyone else in the meeting, namely Hussein. By using the tab features on the CAIRO interface, Lucio and Feniosky return to the main meeting room where Lucio proceeds to propose a solution of adding a kicker to support the joint connections. Fig. 9 provides an illustration of Feniosky in the side chat with Lucio.

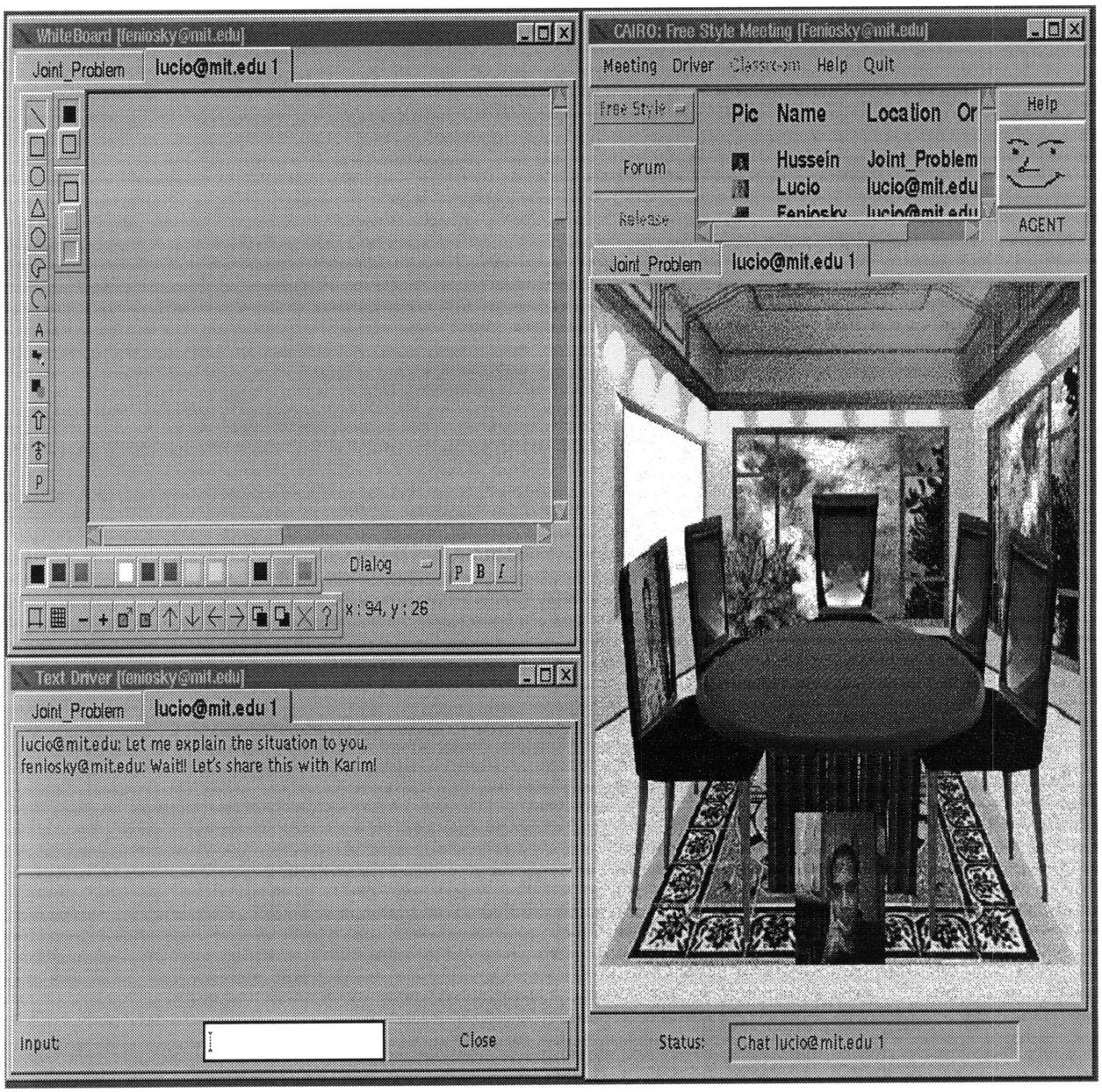

FIGURE 9. Feniosky in the side chat with Lucio

2.5.7 Agent Interaction

As Lucio prepares to describe his solution for the kicker, he sends a message via the text board indicating that he would like to explain something to everyone. The agent then interrupts the meeting and suggests that the members switch to a lecture meeting control strategy because Lucio would like to explain or present information to all the users. Fig. 10 shows the agent interacting with Hussein. Hussein, as administrator and head of the meeting, likes the idea and accepts the agent's suggestion. The meeting now proceeds in a lecture mode with Lucio presenting his kicker solution to the joint problem.

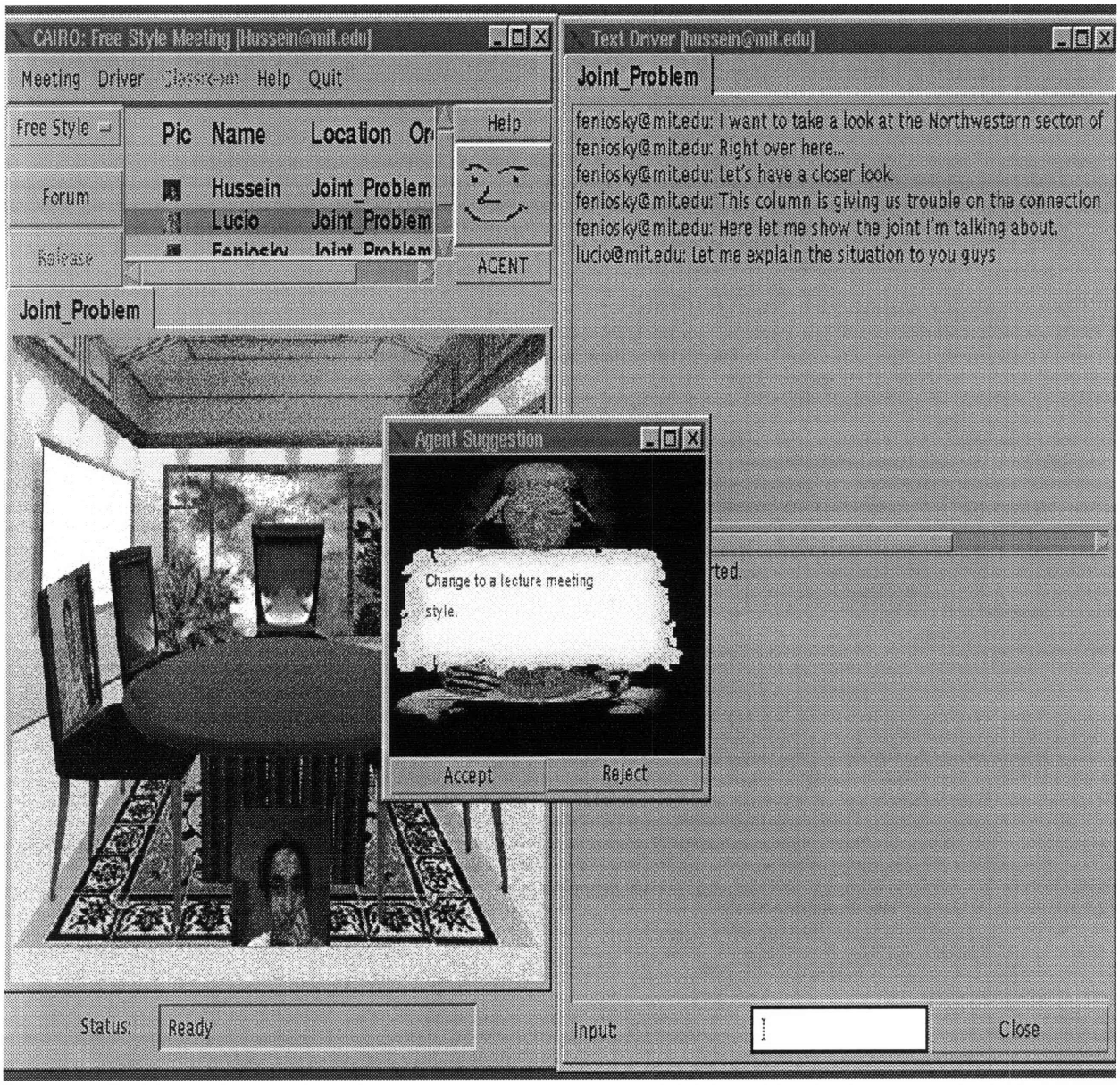

FIGURE 10. Agent interacting with Hussein

Fig. 11 indicates that the meeting has switched to a lecture control strategy, and Lucio continues with his solution. During Lucio's presentation, which apparently is taking longer than the allotted time on the agenda, the agent pops up again, suggesting that the members of the meeting move on to the next agenda item. This time, Hussein feels that the agent's suggestion is inappropriate and rejects the suggestion. Lucio finishes his presentation. Hussein now decides to move on to the next agenda item where are all the members will decide upon a solution for the joint problem.

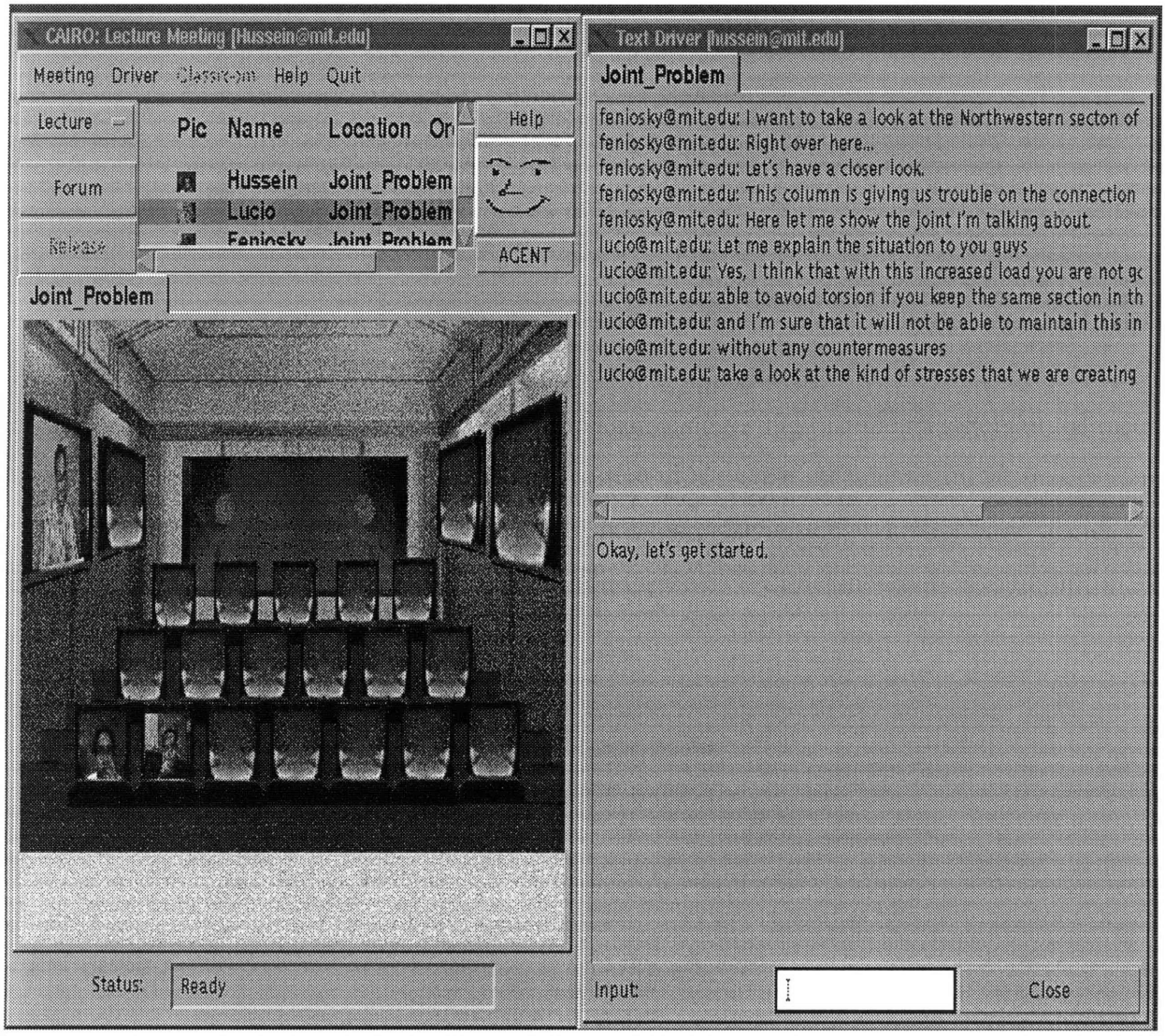

FIGURE 11. Meeting has switched to a lecture control strategy

After some discussion, it is agreed upon that Lucio's kicker suggestion is a good one. The members quickly check their schedules using the schedule tool that was developed independently of the CAIRO system but was easily added due to the plug and ploy nature of the system. Fortu-

nately, adding the kicker will have no serious effect on the schedule. Fig. 12 displays the CAIRO system at work towards the end of the meeting.

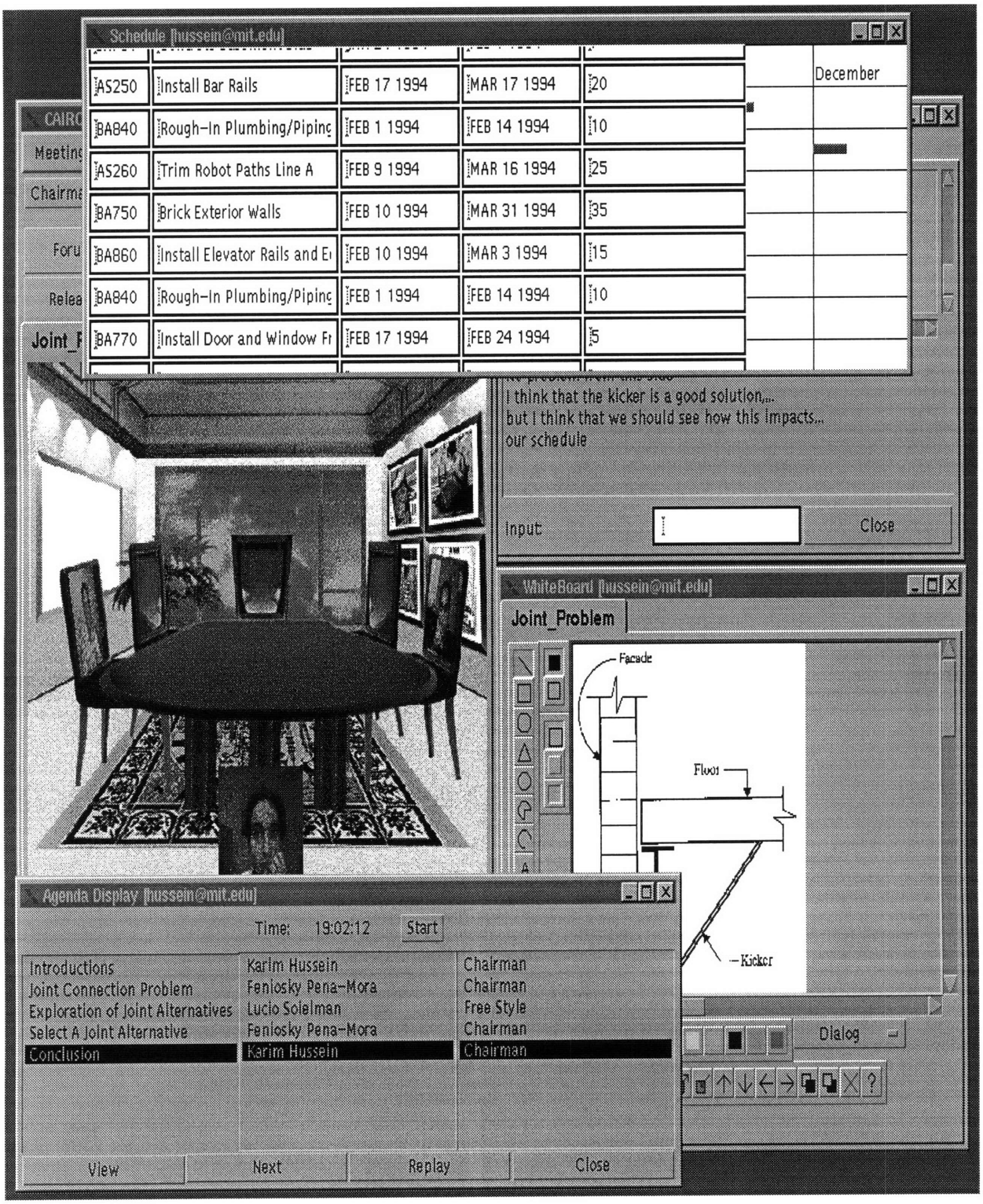

FIGURE 12. CAIRO at work

2.5.8 Replay

As the members of the meeting are about to adjourn, the fourth and final team member, Jim, enters the forum. Jim apologizes for being late. Hussein, a little irate but always a consummate professional, excuses Jim. Jim is a little concerned that he has missed the entire meeting. Fortunately, the CAIRO system also aims to enable collaboration asynchronously. All events in a forum are logged to file. If the forum receives a replay request, the log file is "played", showing all events and actions to the clients. Hussein informs jim that he can select whatever agenda item he is interested in viewing, and by choosing the replay feature on the agenda, he can witness all communication and all tools used during that particular agenda item.

As Jim reviews the meeting, the other three meeting members leave and return to their other work. Jim is then able to catch up on all the problems, discussions, and decisions that occurred during the meeting. If need be, anyone interested in learning more about the joint problem can log on to the CAIRO system, enter the forum and replay the entire meeting.

The CAIRO system could then be used in other aspects of the project including redesign, cost flow analysis, or any other part of a project that requires meetings and collaboration. In general, the CAIRO system is designed to be used in the manner illustrated by this example - to provide its users with an alternative to in-person meetings in a effort to save time and monetary costs.

The goal of this demonstration is to provide information about all aspects of the CAIRO system. It should have shown the capabilities of the system, displaying more of the CAIRO features, as well as explaining how the system can be used. Ultimately, the demonstration shows that the CAIRO system not only amply facilitates distributed collaboration, but also improves the quality of the collaboration.

Chapter 3

3.0 Methodology

The concept of negotiation is an extremely broad topic. Negotiations occur everywhere on some level. Negotiation is a basic means of getting what you want from others [Fisher et al., 1991]. Whether it be deciding where to eat or a company investing millions of dollars into a particular project, the art of negotiation is a fundamental concept in society. Negotiation is defined as "back-and-forth communication designed to reach an agreement when you and the other side have some interests that are shared and others that are opposed" [Fisher et al, 1991].

It is obvious to see that the negotiation process plays a critical role in the life cycle of an engineering project, especially in the phases of design and redesign. In an effort to accomplish the CAIRO system goal of facilitating productive distributed meetings, the many pertinent negotiation processes must be identified. Negotiation process research has been conducted in three major steps: process identification, definition of the process, and encoding the process.

3.1 Process Identification

The first step is to seek and identify current engineering negotiation processes. An attempt to identify all possible negotiation processes would most likely prove to be a futile venture. Therefore, the CAIRO system is designed to focus on the engineering world, where negotiations usually take on a well structured form. In addition, the basis for such negotiation is also well founded, e.g. some technical dispute or cost issue, and not based on the whims of an individual, such as choosing chocolate over vanilla. There may be many important design decisions that are

made on an impulse; however, this research does not tackle such issues. Identification of a negotiation process can be done through two basic channels: literature and direct observation.

3.1.1 Identification through Literature

The first is the more traditional research of literature. Defining a process is a concept that has been well documented. Some of these processes have been named and even copywritten [Levasseur, 1994]. An in-depth literature search provided and identified many of the possible meeting processes that could be applied to an engineering project.

3.1.2 Identification through Observation

The other method for seeking meeting processes was through observation. During the academic year of 1997-98, 1.120 - Information Technology M. Eng. Project, a software engineering class was conducted with the Center of Scientific Research and Higher Education (CICESE) in Baja California, Mexico. The purpose of the class was to engineer a software product that would aid communication via the Internet.

Due to the distributed nature of the students, the 1.120 class was an ideal sample for this research. Observation of the class during the life cycle of the computer engineering project, as well as the participation in the project, provided direct insight into the negotiation process. Information was gathered concerning which negotiation processes are productive during the major phases of a design project. These include requirements analysis, design, and testing phases of an engineering project.

3.2 Definition of a Process

Once the processes are identified, formal definitions can be created for each process. A well defined process can give information as to what an agenda that serves that particular process should look like.

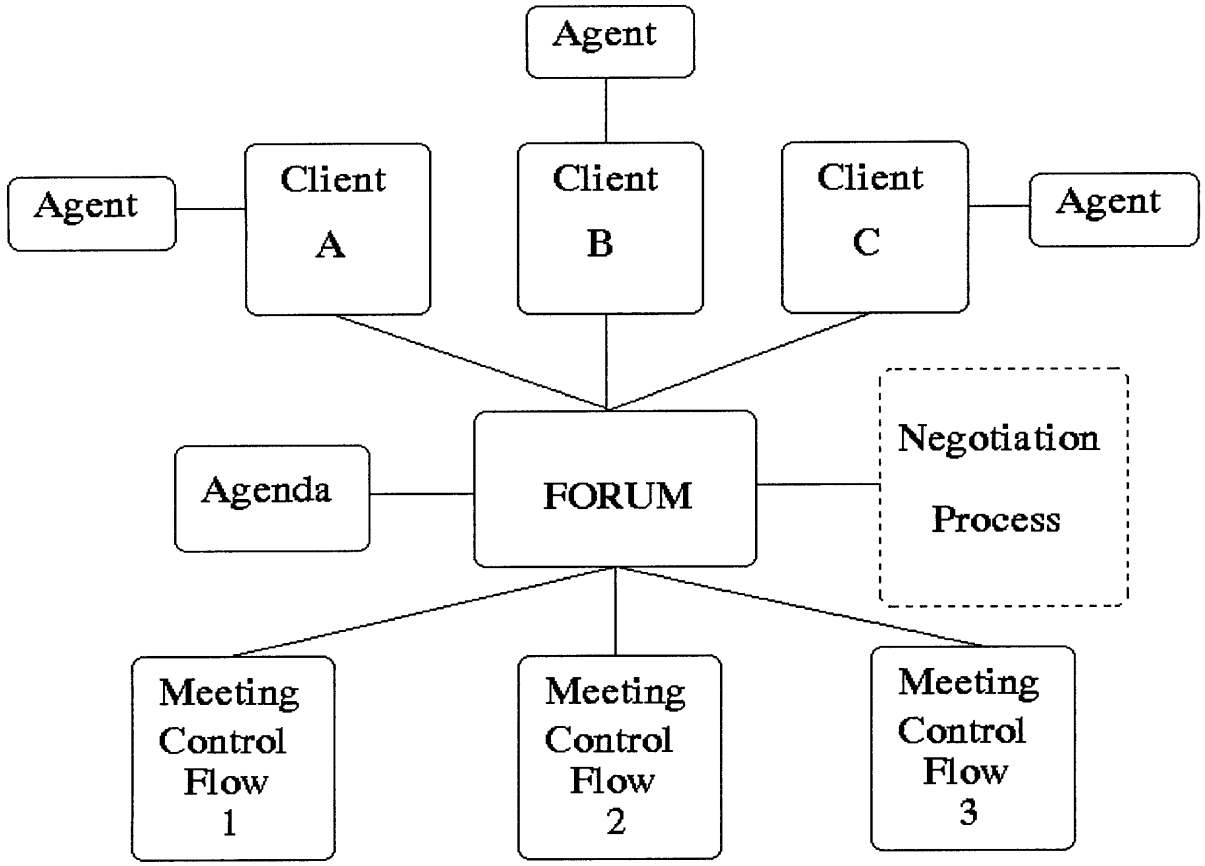

FIGURE 13. Extended object diagram for the new CAIRO system

For example, one particular process might require a ten minute session of a roundtable, free-for-all style of meeting control flow, followed by a five minute chairman meeting control flow, and then concluded with a fifteen minute lecture style meeting control flow. As can be seen, this definition for a meeting process is composed of sessions of pre-defined meeting control flow structures, and the process can be translated in a meeting agenda.

3.3 Encoding the Process

Finally, a well defined process can be translated into an object class definition. As the previous example demonstrates, a negotiation process implements different meeting control structures at different times. Fig. 13, above, displays the new object class and how a negotiation process object class fits into the general CAIRO object class model.

After the negotiation processes have been defined and encoded as object classes in the CAIRO system, the new object class needs to be incorporated with the behaviors of the agenda and the agent. As stated before, the agenda now becomes an implementation of a defined negotiation process. This relation could even be extended to stipulate that many agendas might exemplify a negotiation process.

Chapter 4

4.0 Results

All told, this research yielded an abundance of useful meeting processes that are not only applicable to in-person, real world situations, but can also be transferred into the computer environment and the CAIRO system in particular. Many of the processes defined in previous research were quite similar. For this reason, many of the meeting processes that were ultimately applied in the CAIRO system can be viewed as a superset of similar processes that vary only slightly.

What follows is a summary of the results for process definitions from both literature reviews and observations from the 1.120 class. The bulk of the processes that were defined for the CAIRO system resulted from the literature. In fact, in some way, all of the process definitions did come from prior documentation and research. The observation resulted served two purposes. First, the observations acted as a field test of the meeting processes defined in literature. During the class, direct applications of negotiation processes could be observed and evaluated. Second, because of the distributed nature of the class, the observations also presented the opportunity to assess the pertinence of the literature processes in an environment similar to the CAIRO environment. In all, both research methods were quite useful in defining meeting processes for the CAIRO system.

4.1 Literature Results

Because of the vast nature of this research and the many publications on meetings and meeting structures, the results have been separated into each of the defined processes. It is worthy

to note that much of the available literature on meetings was more focused on the organization of meetings. References discussed steps needed in running entire conferences, from budget allocation to the validity of having an after-dinner party. Fortunately, some attention was paid to preparing agendas and discussing the many types of meeting processes.

4.1.1 Colloquia

Often many members of a meeting need to present information or points of view to an audience. This sort of meeting is known as a colloquium. Colloquia consist of a panel of six to eight persons - half representing the audience, half serving as resource persons or experts. The panelists engage in discussion, usually under the guidance of a moderator [Nadler, 1987]. Colloquia can be organized many different ways depending on the desired degree of audience participation. For the purposed of the CAIRO system, the current interface limits the possible audience size. Therefore, the process definition for colloquia in the CAIRO system is one that is more related to a limited audience and, therefore, limited audience participation.

There are many factors that contribute to a successful colloquium. The most important aspect of a colloquium is the topic. A successful colloquium must have a challenging topic: the more controversial or confusing the issue, the better [Epple, 1997]. Unfortunately, the topic can not be controlled through the CAIRO system. However, some of the other attributes for the colloquium can be moderated.

The current interface design for the CAIRO system's lecture control strategy allows for four presenters. In keeping with the interface, the colloquium process definition is limited to four presenters or platforms. Marathon talkers are always a distraction to the meeting process [Epple, 1997]. In order to help control the problem of lengthy speakers, the colloquium process has suggested times for each part of the agenda. This is most important in limiting the length of the meting was a whole. Table 1 presents the resulting agenda for the colloquium process.

TABLE 1. Colloquium Process Definition

Agenda Step	Time Allocated (min.)	Control Strategy
Introductions	5	Chairman
Presentation I	10	Lecture
Discussion I	5	Free-Style
Presentation II	10	Lecture
Discussion II	5	Free-Style
Presentation III	10	Lecture
Discussion III	5	Free-Style
Presentation IV	10	Lecture
Discussion IV	5	Free-Style
Presentation V	10	Lecture
Discussion V	5	Free-Style
General Discussion	40	Free-Style
Conclusions	5	Chairman

The colloquium process definition provided titles for each step in the agenda, as well as the associated recommended time and the appropriate meeting control strategy. This agenda model can then be encoded into the CAIRO system in order to successfully conduct a colloquium meeting process in a distributed manner.

4.1.2 Debate

Negotiations often come down to choosing between one of two options. One of the key aspects of negotiations is trying to convince others not only of the validity of one's point of view, but also pointing out the problems with the opposing point of view. This sort of situation is ideal for a debate meeting process.

A debate is an exchange of thought and argument by persons on opposing sides of a proposition or question [Zelko, 1969]. the other participants of the debate are observers who are present to evaluate the presented view points and subsequently form their own opinions [Nadler, 1987]. Often a debate is thought of as a type of discussion which is untrue of a debate meeting process. The important distinction is that there is no attitude of inquiry and reflective thinking about the best solution. The presenters have already made up their minds, and are merely present-

ing their ideas to the audience in an attempt to win over the audience, not the opposition or other presenter [Zelko, 1969]. Despite the clear difference between discussions and debates, debates are often thought of as a discussion program in that they allow for the discussion of a particular topic, be it only between two people.

There are many forms to the debate process that can be productive. Table 2 presents on particular debate process that is broad, encompasses many sub-forms, and can be tailored to meet specific debate needs.

TABLE 2. Debate Process Definition

Agenda Step	Time Allocated (min.)	Control Strategy
Introductions	5	Chairman
First affirmative speaker	10	Lecture
First negative speaker	10	Lecture
Second affirmative speaker	10	Lecture
Second negative speaker	10	Lecture
First negative rebuttal	5	Lecture
First affirmative rebuttal	5	Lecture
Second negative rebuttal	5	Lecture
Second affirmative rebuttal	5	Lecture
Conclusions	5	Chairman

Again, the debate process definition provides titles for each step in the agenda, as well as the associated recommended time and the appropriate meeting control strategy, which can be applied to the CAIRO system.

4.1.3 Discussion

At the heart of the negotiation process is perhaps the discussion. A discussion requires the analysis of come sort of problem in order to arrive at first possible solutions, the perhaps the best solution and a recommended course of action [Zelko, 1969]. Examination of literature demonstrates great similarity between the discussion process and many other meeting processes including panel, symposium and general group discussions. It is hoped that the discussion process encompasses all of the afore mentioned discussion variants.

There are key differences between he discussion process and other processes defined by this research. First, unlike a colloquium, there is no group of privileged panelists or presenters. Each member of the meeting is expected to contribute to the discussion as well as the solution [Epple, 1997]. Second, as mentioned in the debate process definition, the point of a debate is not to arrive at a group consensus [Zelko, 1969]. Ultimately, a successful discussion should produce a solution or course of action.

TABLE 3. Discussion Process Definition

Agenda Step	Time Allocated (min.)	Control Strategy
Introductions	5	Chairman
Problem Definition	10	Lecture
How serious is the problem	5	Free-Style
What caused the problem	5	Lecture
Does everyone understand the problem?	5	Free-Style
Possible solutions	5	Lecture
Suggestions?	10	Free-Style
Value of proposed solutions	10	Free-Style
Best solution	5	Lecture
Is there a solution that meets current goals?	5	Free-Style
Is there an agreeable solution?	10	Free-Style
What action should be taken?	5	Free-Style
Make the decision	5	Chairman
Take immediate action or postpone action	5	Chairman
Conclusions	5	Chairman

As can clearly be seen from Table 3, the discussion process definition is one of the more complicated and involved definitions yielded by the literature review. There are a couple reasons for the complexity of the discussion definition both fueled by the same cause. First, the definition is broad in its scope. The discussion agenda hopes to capture many other meeting processes. Therefore, the many vague and non-descript steps allow the agenda to be used for other processes. the defined agenda captures the overall discussion process. Second, the agenda definition is lengthy. Again, in order to capture the concepts of all the similar meeting processes, the agenda needs all the crucial parts of each agenda process.

In all, the discussion process is perhaps the most useful and applicable agenda definition, especially in the negotiation process. This definition allows for easy implementation of the meeting process into the CAIRO system.

4.1.4 Brainstorm

Perhaps one of the more useful types of meeting processes, the brainstorming session is designed solely for the purpose of generating ideas. Brainstorming is a no-holds barred, non-judgemental explosion of ideas, concepts, policies, decisions, and strategies. All contributions are valid. The key is to get as many ideas as possible without evaluating them [Larsen et al., 1996].

For a complete brainstorming session, it may also be necessary to evaluate the ideas once they have been generated. Once the brainstorming has been done, the results of the brainstorming session can be analyzed and the best solutions can be explored either using further brainstorming or more conventional solutions [Manktelow et al., 1998]. The result is the brainstorming process definition provided in Table 4.

TABLE 4. Brainstorm Process Definition

Agenda Step	Time Allocated (min.)	Control Strategy
Introductions	5	Chairman
Cycle I Preparation	2	Chairman
Generate ideas I	20	Free-Style
Prune ideas I	5	Chairman
Cycle II Preparation	2	Chairman
Generate ideas II	15	Free-Style
Prune ideas II	10	Chairman
Final presentations	10	Chairman
Conclusions	5	Chairman

The intent behind the described agenda definition for the brainstorming is much like the inverted triangle approach. First, generate unencumbered and uncensored as many ideas as possible. This represents the top of the inverted triangle. Once ideas have been contributed, a short pruning process is needed, not necessarily to remove ideas, but rather to discuss the virtues of all ideas presented. This helps in the next session of generating ideas. Again, following the

generation of ideas, a pruning session is necessary to discuss and possibly remove ideas until the meeting arrives at a final base of ideas that can be agreed upon and presented.

As is the case with the other process definitions, the brainstorming process is easily translated and encoded into the CAIRO system.

4.2 Observation Results

The 1.120 class that was observed during the 1997-98 academic year proved to be quite an interesting experience not only for the students that participated in the class, but also for the professors and those observing the class. For the purposes of this research, the 1.120 class provided a wealth of cases of distributed interaction, creating a substantial base for process definitions. In order to understand the processes used during the class, it is important to know how the students collaborated in the distributed environment.

4.2.1 Communication Tools

There were quite a few tools that were used to aid in the communication between the two groups. During actual class times, the two groups, one at M.I.T. and the other at CICESE, used a variety of internet communication tools. Microsoft's NetMeeting was used primarily for the audio communication. A video conferencing tool on the Silicon Graphics platform was used to transmit the video. Web browsers were used mainly to share information, and an html presentation software called Web Presenter was used to coordinate html documents, so that both groups could share the same information at the same time.

Unfortunately, the major complaint with the class was the poor quality of the communication between the two groups. Often the audio quality was poor to the point where students could not hear or understand what others were saying. In fact, the poor quality caused the class to be rescheduled to a different time during the day, hoping that less internet traffic would result in better audio quality. At time, there were still problems with the audio, but it was a definite improvement.

The video communication was of rather low quality. Because the video information was being sent indirectly through the Internet, as opposed to having a designated direct T-1 line connection, the frames per minute ratio for the video was rather low. As a result, it seemed that the video communication was almost inconsequential. It server more as an occasional communication aid, used to see if certain members of the groups were present and other such menial jobs. However, the video communication presence was not unnecessary, for visual aide do help the communication process.

Based on observations made during the class using the described communication tools, the class seemed to have been conducted in two manners. There different manners led to defining two more meeting processes that were incorporated into the CAIRO system.

4.2.2 Presentation

The first of the two meeting process defined during the 1.120 class is the presentation process. A definition for a presentation process does seem appropriate for a classroom environment. Due to the distributed nature of the class, the lecturers, one from the M.I.T. group and one from the CICESE group, each took turns at presenting material to the class through lectures. The effectiveness of the distributed learning is a rather interesting topic of research that has already sparked vibrant debates throughout the research and academic communities. However, distributed learning effectiveness was not a focus of this research effort.

There are many similarities between a lecture and other meetings that present information to a group of people. Therefore the process definition was expanded to encompass all presentations. The process defined for the presentation meeting is quite straight forward and could be applied to any sort of presentation. Table 5 illustrates the steps used in the definition. The basic process flow is to introduce the topic, present all relevant information, close the presentation and finally have some sort of discussion about the presentation where the presenter could answer questions from the group.

The presentation process definition provides a simple framework for an agenda that allows someone to convey information to a group of people. The presentation process is also easily translated and encoded into the CAIRO system.

TABLE 5. Presentation Process Definition

Agenda Step	Time Allocated (min.)	Control Strategy
Introductions	5	Chairman
Presentation part I	5	Lecture
Presentation part II	10	Lecture
Presentation part III	10	Lecture
Presentation part IV	10	Lecture
Presentation part V	5	Lecture
Discussion	10	Free-Style
Conclusions	5	Chairman

4.2.3 Decision

The other meeting process that was defined as a result of observations made during the 1.120 class was a decision process. Due to the nature of the class, where the students were required to go though the entire software engineering process, many decisions had to be made by the group. Group decisions, which involved both M.I.T. and CICESE teams, were made on a range of issues varying from broad issues during the requirements and analysis phases of the project down to specific implementation details in the programming and testing phases of the project. No matter what the topic or focus of the decision was, a few standard characteristics existed for all decision making processes.

In order for a group to arrive at any decision, and for that group to make an informed decision, it is first necessary to present all the different ideas and options that affect the decision. The first common characteristic is to present all options to the group. Part of presenting the different options it to ensure that all members involved in the decision fully understand each option, and are ready to make a well informed choice. another common characteristic for the decision process is that there must be some period of open discussion. Here, members involved have the opportunity to hear other opinions about the subject matter. In addition, members also get the chance to possibly explore the finer nuances of each option and the decision as a whole.

The decision process described above much resembles the discussion meeting process previously defined through the literature review. The relation is that the discussion meeting process hopes to conclude with some sort of decision. As mentioned before, the observation of the decision process during the distributed class helps prove the validity of the discussion process. Because of the similarities between decision making and discussion, no new meeting process definition was required for these observations.

4.3 Architecture

Once the processes were researched and identified, the next step was to design a software architecture for incorporating the processes into the rest of the CAIRO software. Due to the object oriented nature of the Java programming environment, as well as the modular nature of the CAIRO implementation as a whole, it was necessary to design a process architecture that fit within these models for design.

4.3.1 Agenda Tree Structure

The first and most fundamental component of the architecture was creating a representation for an agenda. Due to the list like nature of an agenda, along with its hierarchical structure, the agenda objects in the CAIRO system were represented as a tree structure.

TABLE 6. Sample Agenda

Agenda Step	Time Allocated (min.)	Control Strategy
1. Roll Call	5	Chairman
2, Discuss previous homework	10	Free-Style
3. Present tonight's assignment	5	Chairman
3.1 Explain assignment	10	Lecture
3.2 Discuss new assignment	10	Free-Style
4. Final Questions	5	Chairman

Each item in the agenda is presented as an object. The agenda item object contains information about that particular agenda item. In addition, an agenda item also contains a list of all agenda items that fall under that particular item. In other words, and agenda item contains a list of all its sub-items, much like a node in a tree points to all its children. Table 6 presents a sam-

ple agenda. Fig. 14 shows the resulting tree structure from the agenda presented. This sort of architecture for the agenda possesses the pros and cons that all tree structures possess.

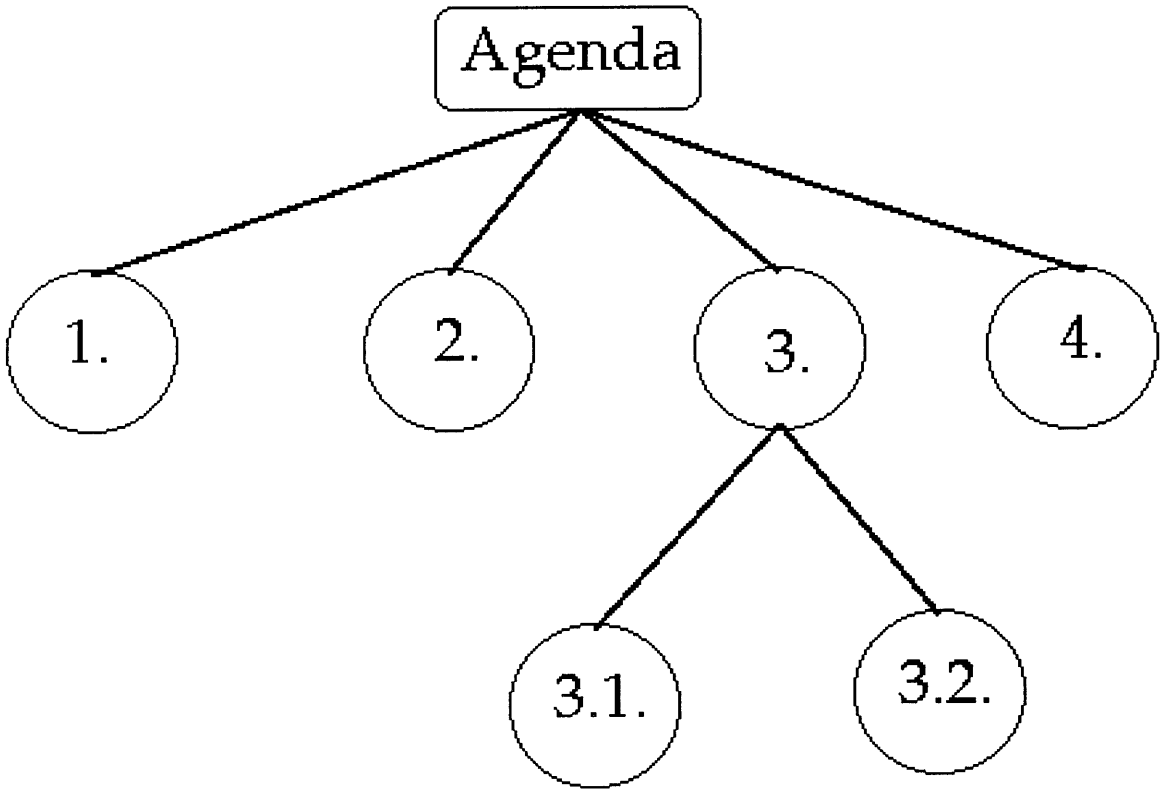

FIGURE 14. Resulting agenda tree structure

There is no direct access to each agenda item; only a pointer to the top of the agenda tree need be passed around. The major draw back is that in finding a particular agenda item, and agenda tree transversal is necessary. However, from the information gained from the agenda research, the depth and breadth of agendas result in negligible time for tree traversals. Fig. 15 shows the intended object design for the agenda architecture. As the figure demonstrates, the agenda is composed of or contains AgendaItems. The AgendaItems have various fields that define the item. One of the AgnedaItem's fields displayed in Fig. 15 is the SubItems. SubItems gives the AgendaItem the ability to contain other AgendaItems. Again, by enabling this design where AgendaItems comprise other AgendaItems, a recursive structure is created for ease of use. All the needs to ne known is the object at the top of the agenda tree structure. All other information about an agenda can be attained from the top object

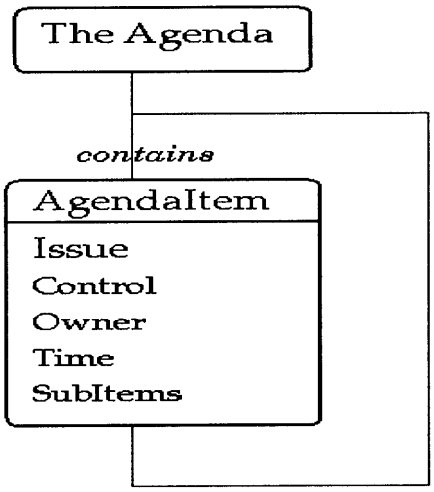

FIGURE 15. Basic object diagram for the agenda data structure

4.3.2 Editing an Agenda

Once the agenda architecture was established, it was important to design a protocol for creating and editing the agenda tree structure. During the design phase of the research, this was a very abstract concept. Architecturally and from the software point of view, an object needed to be created that could manipulate an agenda object. Table 7 lists the major criteria for the agenda editing object.

TABLE 7. Editing Criteria

Criteria	Description
Create	Create a new agenda
Add	Add a new agenda item anywhere in the agenda structure
Delete	Delete an agenda item from anywhere in the agenda structure
Delete All	Delete the entire agenda
View	View the attributes of a particular agenda item

4.3.3 Process Wizards

One of the major features included in the design of the CAIRO agenda system is the employment of wizards to prepare agendas for meetings. Thanks greatly to the slew of user intensive products available for personal computers, wizards have become a familiar component of

software products. Wizards aim to ease the use of software products for users. By taking a user step by step through a particular process, whether it be installing some software or preparing a presentation, wizards provide a smooth, linear, and practically fool-proof way for end users to operate and obtain useful results from a software product.

Because this research was able to yield several meeting processes, the design architecture required a way of capturing the basic functionality of a process wizards and then extending this functionality to include the specifications of each particular process definition. The design result was to first establish a base object that is able to run an agenda process wizard. This wizard object would also have to interface with the agenda editing object previously described. Fig. 16 presents a general design diagram for the entire agenda process module of the CAIRO system.

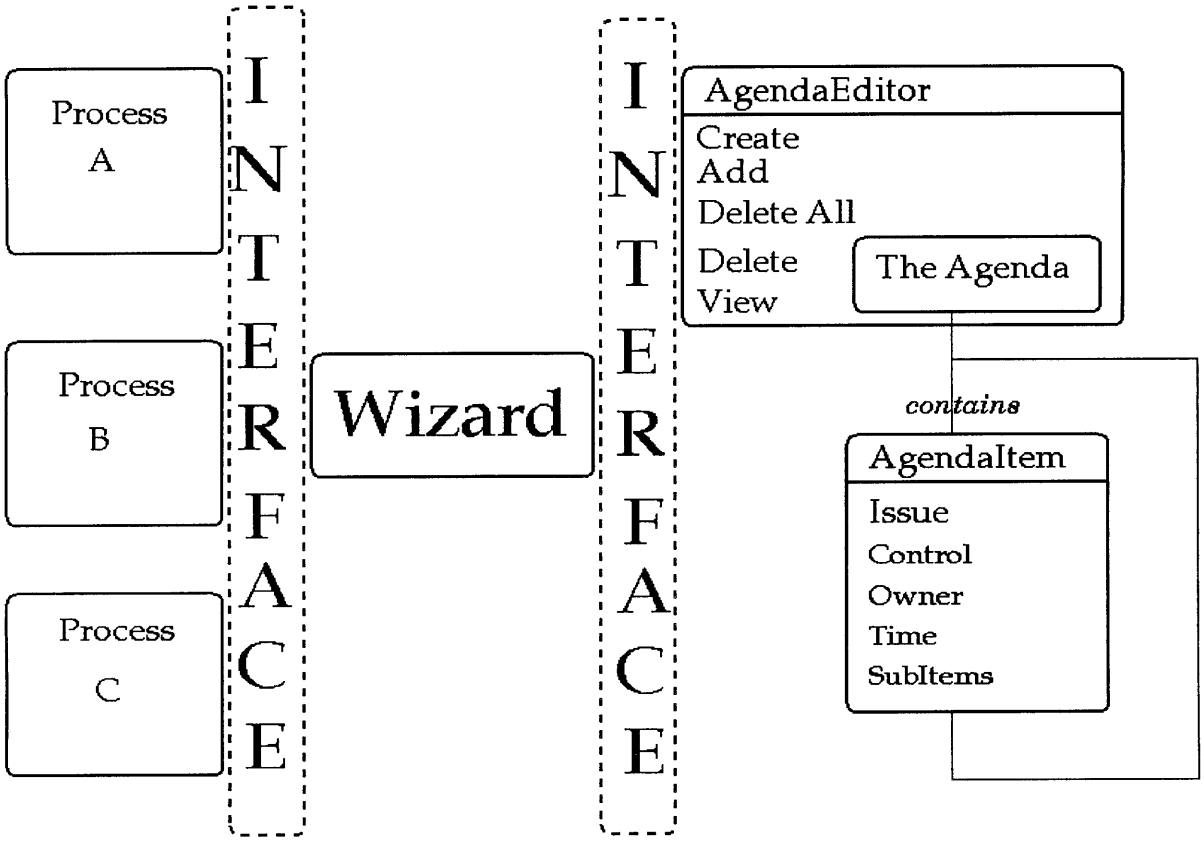

FIGURE 16. Basic object diagram for the agenda editing structure

The goal is that depending on what process a user wants to use to establish a particular agenda, the wizard object would take the user through the different steps of the process provided by the process definitions. As the user fills in the information for each pre-defined agenda item,

the wizard object would act as an interface to the agenda editing object and update the agenda as need be according to the process and the information provided by the user as the wizard is running. Again, Fig. 15 clearly illustrates this interfacing role of the wizard object. It functionality is to combine the selected process definition with the user's input and edit the agenda structure using the agenda editing object to produce an agenda for a meeting.

4.4 Implementation

Once the meeting processes are clearly defined and a system architecture developed, implementation is a straight forward process. The actual coding of the system followed easily from the design and led to an effective implementation.

4.4.1 Associated Work

Fortunately some concurrent work was done by fellow researchers on the CAIRO project to implement a system that produces meeting agendas. The result was a system that took a user through the many steps of preparing an agenda for a distributed meeting. In an effort to make the previous work more compatible with the object of the research, minor changes were made. The results of those changes and the current processes are described below.

The agenda creation module of the CAIRO system has three basic steps. The administrator of user designing the agenda must first indicate who the members of the meeting will be. During this step of the agenda definition process, users have the ability to create groups of users. The group concept is useful if users work on projects with the same individuals on a consistent basis. The agenda setup module therefore allows users to create and edit the groups.

Once the user has specified who will be attending the meeting, the next step of the agenda definition process is to provide specific information about the meeting. This information includes meeting fields such as the title for the meeting, when the meeting is scheduled to be held, who is the administrator for the meeting, who is responsible for the minutes of the meeting, and other pertinent administrative information. The second step of the agenda definition process is dynamically connected to the first step of indicating who will be attending the meeting. Therefore, only users that are slated to attend the meeting can be delegated for responsibilities during

the meeting. This is accomplished by providing the user with list boxes with user's names instead of text fields where the user is able to input any name.

Once the user has provided the general meeting information, the final step of the agenda definition process is to create the actual agenda. The third step of the agenda definition process is where the discussed architecture for the agenda and agenda processes was implemented.

4.4.2 AgendaItem

Following the proposed architecture for implementing a meeting agenda, the agenda is constructed using the discussed tree structure. Each agenda item object, or node in the agenda tree, contains two basic types of information. the first set of information is the agenda item fields. The fields for the agenda include the name of the issue, which meeting member is supposed to run that particular agenda item, for how long the agenda item is scheduled to last, and what type of meeting control structure is to be employed for that particular agenda item. The second major attribute is that the agenda contains a list of its direct subitems. The list of subitems contains agenda item objects as well, enabling a recursive definition for agendas. A full object model diagram of the AgendaItem class can be found in Appendix A.

4.4.3 AgendaEditor

An editing class for the agenda object was successfully created. The result was the AgendaEditor object. This object, as per the architecture, manipulates the agenda tree structure as well as provides the user with agenda viewing capabilities. The resulting interface for the AgendaEditor class can be seen in Fig. 17.

The figure shows that the AgendaEditor object allows users to add items and subitems to the agenda, in addition to the ability to view and edit the information for a particular agenda item. As an added convenience, the AgendaEditor also allows the user to remove all items or clear the agenda. However, the AgendaEditor class also provided the wizards to help automate the agenda definition process. A full object model diagram for the AgendaEditor class can be found in Appendix A.

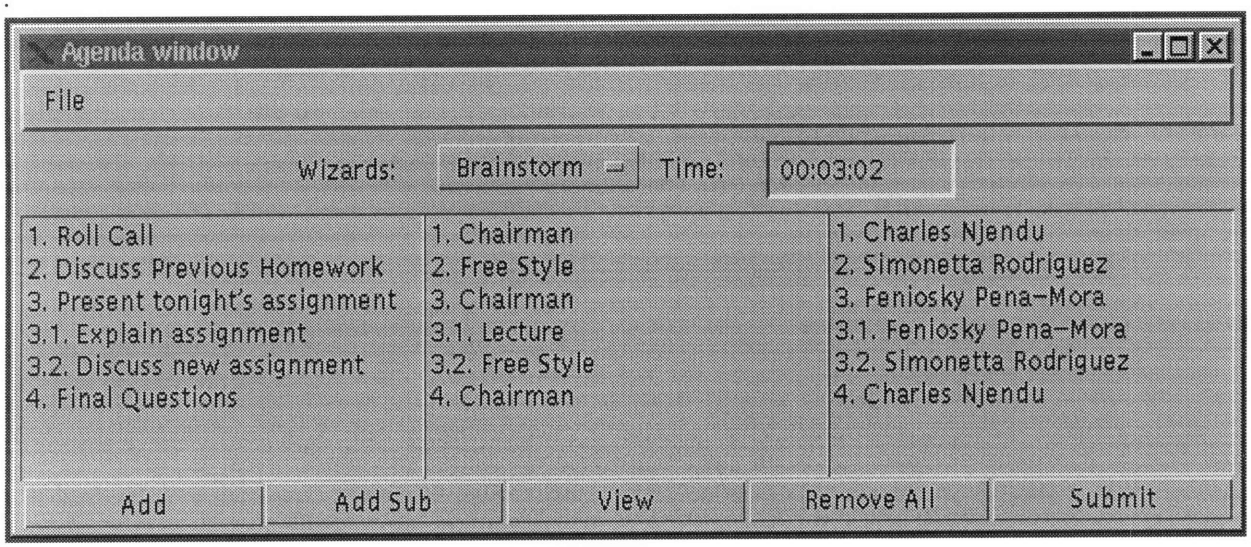

FIGURE 17. User interface for agenda editing

4.4.4 WizardRunner

If a user selects on of the wizard choices from the AgendaEditor object, the Wizard-Runner object is instantiated. The WizardRunner object takes the user through an encoded agenda, allowing certain fields of each agenda item to be edited. The title for the agenda item as well as the meeting control structure used are initially fixed as per the meeting process definition. The user is required to specify which member of the meeting will be in charge of that particular agenda item, and how many minutes should be spent on the agenda item. For flexibility, all fields in an agenda item are eventually editable through the AgendaEditor object once the wizard has finished running. Fig. 18 shows a sample step in the agenda wizard for a brainstorm meeting process.

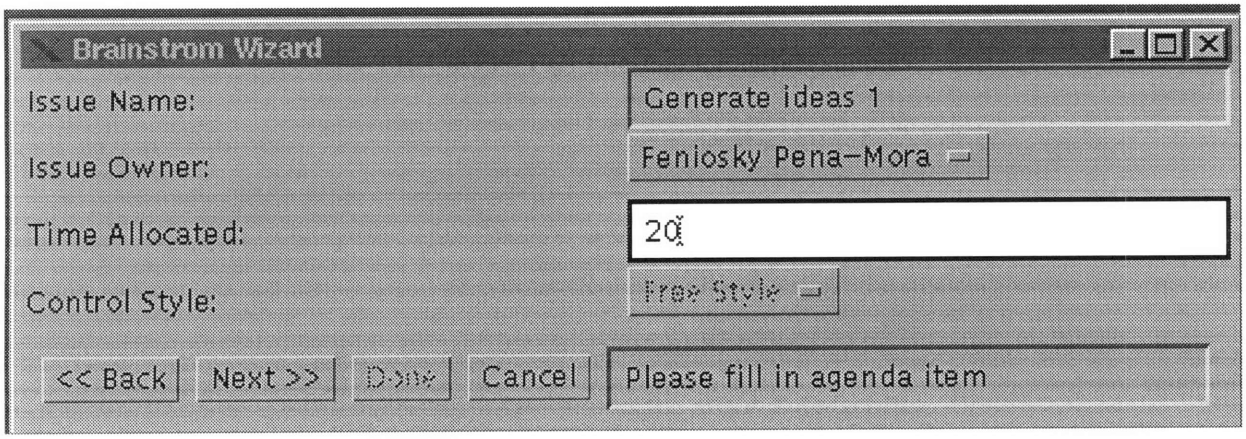

FIGURE 18. Wizard user interface for agenda editing

A rather important quality of the wizard concept is that it is "idiot proof". The goal of a agenda process wizard is that it should guide the user through the entire agenda definition phase, and the result should be a workable usable agenda. In order to help accomplish this goal of a robust and useful agenda wizard, the wizard provides error checking on the fields on each agenda item. In addition, an agenda can not be submitted unless all agenda items have been filled in with appropriate information.

The last quality of the agenda wizards is its extensibility. As alluded to before, once a user has finished creating an agenda using a wizard, the current agenda is still editable using the AgendaEditor. Users can take predefined processes and extend or customize the resulting agenda to better fit their needs.

4.5 Example

As was done with the actual CAIRO conferencing system, a brief example is provided to illustrate the functionality of the implement agenda, agenda editing system, process wizards, and process definitions. This example involves a software engineering group that is looking to generate ideas for the design of their system. The head of the design team, an experienced project manager named Bob, is responsible for setting an agenda for a distributed meeting that will be employing the CAIRO system. Bob starts the agenda setting tool in the CAIRO system and proceeds to create an agenda.

Once Bob has selected all of the members for the meeting and has provided all the pertinent meeting information, including start time and the title for the meeting, he is now ready to establish the agenda for the meeting. Because Bob is an extremely competent project manager, he knows that the design team will be trying to gather ideas for the product design. Bob decides the design team will be involved in a brainstorming session. However, he is not too sure what steps are involved in a productive brainstorming meeting. Fortunately for Bob, the CAIRO system has the brainstorming. Fortunately for Bob, the CAIRO system has the brainstorming process already encoded.

Bob then selects the brainstorming wizard. The wizard then takes Bob through the encoded agenda, suggesting times and meeting control structures for each agenda item. Once

Bob finishes running the wizard he has an agenda ready to be used for the meeting. Finally, Bob selects the Initiate Forum button on the CAIRO agenda tool. Fig. 19 shows the tool which displays the three previously discussed steps to creating an agenda. Now the forum object is on the internet, ready for the members of the meeting to login and start the meeting.

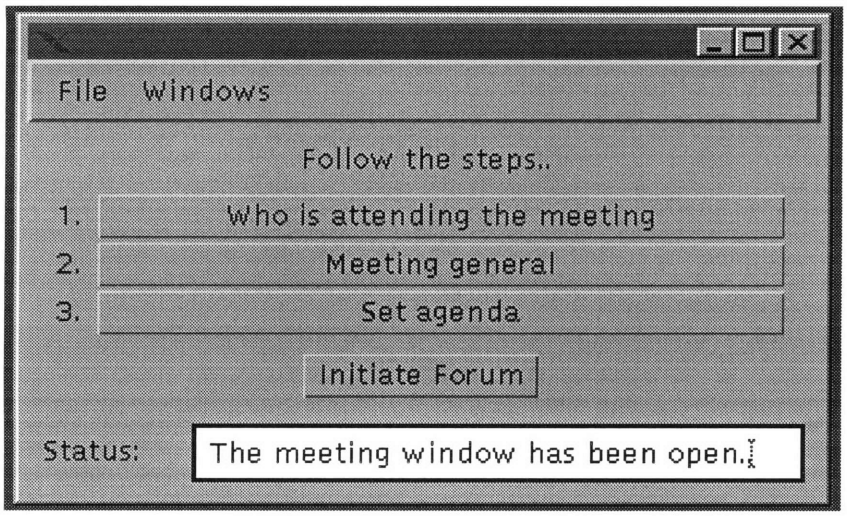

FIGURE 19. Interface for creating an agenda

Chapter 5

5.0 Conclusion

The proposed thesis for this research can be split into two parts. First, it was hypothesized that well characterized meeting processes could be defined. A literature review as well as observations made during a distributed class clearly showed that such processes can and have been accurately documented. The effects of the dynamic nature of meeting processes, in that a meeting's focus can change during the course of the meeting, is partially accounted for in the general nature of the process definition and also is accounted for in the CAIRO system itself. Even though every forum has an associated agenda, it is not absolutely necessary that the agenda be followed precisely. Meeting members can choose to change meeting control structures if need be, even if it is not in full agreement with agenda.

The second part of the proposed hypothesis was that the newly encoded processes would improve the effectiveness of the distributed meetings conducted through CAIRO. It would seem that the best way to test this part of the hypothesis is through testing and real world use of the CAIRO system. At the very least, by adding agenda, an agenda editing, wizards, and process definitions, the CAIRO system can only add structure and form to the distributed meeting process.

Despite the success of this research project to define meeting processes, much can still be done. To continue in the area of process definitions, additional research could be conducted to identify other meeting processes that are more specialized. Certain processes exist that are specifically tailored to the engineering environment. After all, the initial purpose of the Da Vinci initiative was to manage the changes that occur during the life cycle of large scale engineering projects. Perhaps certain methods and practices have been established in the engineering community that

make the entire engineering process a more efficient one. If so, these processes also need to be identified and encoded into the CAIRO system to increase its usability.

The next logical step for this research, and perhaps the CAIRO system as a whole, would be to actually apply these meeting processes to real situations. This could be accomplished by distributing the CAIRO system to a group of engineers. A few key areas need to be monitored during the field testing of the system. First and foremost, observations need to be made on the frequency of use of the system by the group. Frequent use of the CAIRO system would suggest that the system is a viable option for collaboration. However, it may be discovered that a distributed group has to have in-person meetings to be successful or that the quality of collaboration through the CAIRO is poor. Whatever the case may be, how often the CAIRO system is used is a critical observation to be made.

The second area of focus during the field test, which is more related to this research, is to find a way of quantifying the quality of the meetings conducted through the system. More importantly, it would be necessary to see if the process definitions provided do indeed aid in the quality and productivity of the meetings. Users could be asked to conduct meetings with and without the process definitions, to achieve a more direct comparison between the two methods. In all, field testing is paramount in verifying the CAIRO system.

Ultimately, the additions of an agenda, an agenda editing system, wizards, and process definitions have made the CAIRO system a more productive and useful system, making the CAIRO system an option for supporting distributed meetings as part of the larger Da Vinci initiative.

References

Benjamin, Kareem A. *Interface Development for Remote Conferencing Tools.* Bachelor Thesis: Massachusetts Institute of Technology, 1997.

Doyle, Michael et al. *How To Make Meetings Work.* New York: Jove Books, 1982.

Epple, August. *Organizing Scientific Meetings.* United Kingdom: University Press, 1997.

Fisher, Roger et al. *Getting to Yes - Negotiating Agreement Without Giving In.* New York: Penguin Books, 1991.

Hussein, Karim. *Computer Supported Interaction in Distributed Design Teams.* Scd Thesis: Massachusetts Institute of Technology, 1998.

Kerr, Elaine B. *Computer-Mediated Communication Systems - Status and Evaluation.* New York: Academic Press, 1982.

Larsen, Deena et al. *Brainstorming - Toolbox (Decision Process Guide).* http://www.usbr.gov/Decision-Process/toolbox/brainsto.htm#goon, 1996.

Levasseur, Robert E. *Breakthrough Business Meetings - Shared Leadership in Action.* Holbrook MA: Bob Adams Inc. 1994.

Menktelow, James et al. *Mind Tools - Brainstorming.* http://www.psych-web.com/mtsite/brainstm.html, 1998.

Nadler, Leonard et al. *The Comprehensive Guide to Successful Conferences and Meetings.* San Francisco: Jossey-Bass, 1987.

Peña-Mora, Feniosky et al. *Interaction Dynamics in Collaborative Civil Engineering Design Discourse: Applications in Computer Mediated Communication.* Microcomputer in Civil Engineering Journal, 1998.

Peña-Mora, Feniosky. *The Da Vinci Vision.* http://ganesh, 1996.

Running Effective Meetings. U.S. General Accounting Office-Office of Organization and Human Development, 1984.

Zelko, Harold P. *The Business Conference: Leadership and Participation.* New York: McGraw-Hill, 1969.

Appendix A - Agenda OMT Diagram