The TeleAction Project

Submission for Emerging Technologies
SIGGRAPH 2001

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PURPOSES AND GOALS

The goal of the TeleAction project is to allow an online community to collaboratively and remotely experience and interact with a real-world environment.

In recent years, the rise of "reality" TV, featuring unscripted filming of ongoing events and (limited) audience participation, demonstrates that such programming attracts a sizeable audience. Television media, by its nature, is strikingly one-sided, and viewers of such reality TV shows cannot directly interact with the broadcast. Even online, real-world broadcasts via WebCam are view-only, which is at odds with the rich interactive experience of online games and social spaces.

TeleAction represents a new paradigm in television broadcasting. We combine an interactive social interface with a broadcast from the real world, and give the community within this online space the ability to direct a live Actor in the real world. With TeleAction, we turn viewers into Directors, and give them a strong sense of "being there," as their directions cause real actions to be enacted in the remote location.

INNOVATION

The TeleAction project focuses on three main areas of research and innovation:

- Developing the next step in immersive television
- Designing an intelligent tele-robot with agency
- Designing a system for collaborative remote control of a limited remote resource

Tele-robotic systems allow a single human operator to view and manipulate a robot in a remote environment. With the advent of the Web, a number of publicly accessible Internet-based tele-robots have been created[1]. Several of us have had considerable experience building tele-robots[2]. However, existing robots are complex, expensive, limited in mobility, and insufficiently reliable for sustained performance in demanding environments[3]. To address these problems, the TeleAction project makes use of a human instead of a robot. A human can improvise to avoid obstacles, add commentary, and interact with people. A human can also navigate complex situations that are far beyond the capabilities of any extant robot. Through the TeleAction project, we hope to gain new insight into the design of intelligent, remote-controlled, non-human agents.

There is also a substantial body of research on collaborative interfaces[3] and on interfaces for social interaction, such as ChatCircles[4]. Cinematrix[5] allows an audience to control motion projected on a screen by holding up color-coded paddles; large groups of untrained users are quickly able to coordinate aggregate motion, e.g. moving a cursor through a complex maze. Ouija2000[2] allows a distributed audience to collectively tele-operate an industrial robot arm via the Internet. Based on this previous research, the TeleAction project explores a more fluid and interactive form of collaborative remote control: We base collaborative decision-making on a voting model, which allows Directors to provide and select, as a group, the high level directions that are given to the remote Actor. The TeleAction project is a base upon which to explore different voting models and discover how they change the social dynamic within the Director community and between the Directors and the Actor.

INTERACTION

The TeleAction installation consists of a set of kiosks linked via a central server to each other and to the Actor. At the kiosks, users (called Directors) have an interface (the Director's application), that allows them to see live video from the Actor, communicate with each other, and direct the Actor through a system of goal setting and voting.

The Director's Application

Figure 1 shows the Director's Application. The video image, with accompanying audio, is broadcast live from the Actor's camera. The area around the video window is a chat space where the participants can discuss the ongoing action, lobby for particular goals, etc.

At frequent times, the Directors are asked to send directions to the Actor. Directors propose goals and vote on which goal should be sent to the Actor as his directive. Goal setting and voting is done on the video window itself: when a vote is happening, the image is frozen and the participants are able to propose goals in place on the image and to vote for goals by placing

Figure 1 The Director's Application

themselves on top of the chosen goal. Votes are held frequently, and typically last for 30-60 seconds.

During a vote, Directors are able to create goals on the video window. A goal in the TeleAction system is a direction that a Director wants the Actor to act out. Some examples of goals are: "Keep walking forward," "Buy a t-shirt," or "Go down the stairs." Goals appear as a line of text below a colored voting circle.

Once created, a goal remains in place until the vote is finished. Directors can vote for any goal on the screen simply by placing themselves into that goal's circle. When the time for voting runs out, the winning goal is then transmitted to the Actor. All goals disappear, and Directors can watch as the Actor acts out the winning goal.

The Actor

The Actor is a skilled human, outfitted with a video camera, a microphone, and all necessary computer and wireless technologies to transmit video and audio back to the Director's application. The Actor wears a notebook computer on his back that encodes the audio and video from the camera and microphone and then transmits this encoded signal over a wireless network link to a Broadcast server. The server then broadcasts this media signal to each Director.

To ensure that the Actor interprets the winning direction correctly (since the Actor cannot see the Director's application), the Actor's Assistant, who is a human using a special version of the Director's application, reads the goal to the Actor via a wireless earpiece. Since the Actor's Assistant constantly monitors the vote process, he can add appropriate contextual information to the direction, making the Directors' intentions clear to the Actor. The Assistant may, for example, tell the Actor to "Walk down the stairs that are directly to your right, heading into the basement," when the winning goal from the Directors is only "Go down the stairs." The Actor should experience minimal interruption of their immersion within their real-world environment from this verbal communication with the Assistant.

SIGGRAPH INSTALLATION

Ideally, 8–10 Directors would be using this system at any time. For Emerging Technologies, we suggest the following scenario for our installation: We provide three or more kiosks, each equipped with the Director's application, and distributed within the Emerging Technologies space. In addition, the Director's application will be available on the Web so that outside users can participate in the project. (It will be available from Berkeley and MIT and, ideally, from the SIGGRAPH website as well.) We will need sufficient outbound network bandwidth from SIGGRAPH to accommodate real-time A/V to outside users.

There will be 1 or 2 one-hour sessions of TeleAction over the course of each day. During these sessions, users will be able to use the kiosks to become Directors, and the Actor will actively broadcast audio and video.

The Actor's range is limited by the reach of the wireless network over which the audio and video is transmitted to the Broadcaster. We can move the Actor's live space each day, to provide a

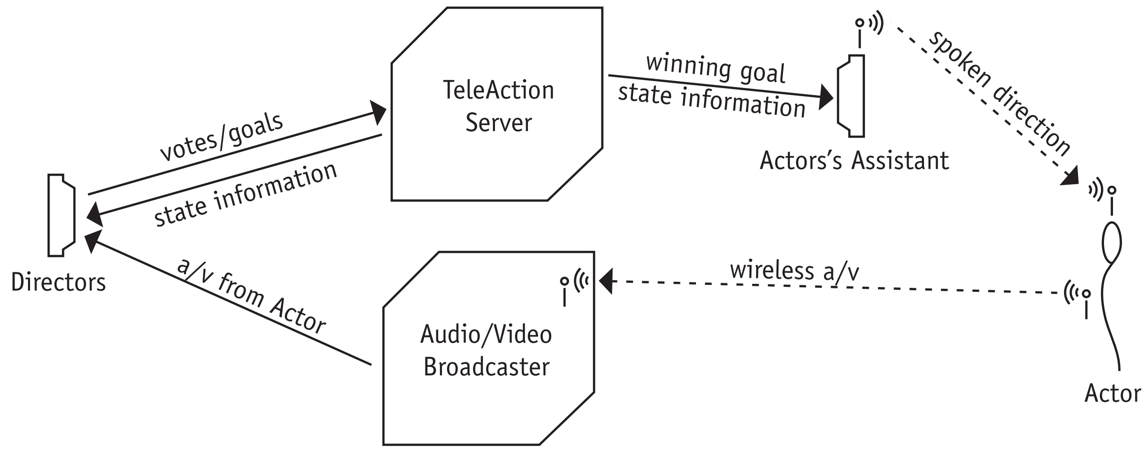

Figure 2 Information flow within the TeleAction system

changing scene for the Directors. Some of the sessions will be unscripted: Directors will use the Actor to freely explore a real-world space. Other sessions will be more structured with explicit objectives, such as a treasure hunt.

TECHNICAL REQUIREMENTS

Figure 2 shows the connections between the various elements of the TeleAction installation. Directors use PC based kiosks connected via a wired Ethernet network to the Server and the Audio/Video Broadcaster. Directors send votes, goals, and chat messages to the Server, and receive updated state information regarding other Directors' votes, goals, and chat messages. Additionally, streaming audio and video from the Actor is broadcast to each Director via the Broadcaster.

The Actor's backpack computer transmits a compressed QuickTime video and audio stream via 802.11b wireless Ethernet back to the Broadcaster. The installation will outfit the Emerging Technologies space with a sufficient number of wireless access points to provide coverage for the Actor's wireless audio/video transmission to the Broadcaster.

The Server is a PC running a custom Java server application. The Audio/Video Broadcaster is a PC or Macintosh G4 running the QuickTime Streaming Server software. Each kiosk contains a PC that runs the Director's application, which is written in Java. The Actor's Assistant uses specialized software with similar hardware and connectivity as a Director kiosk.

Each Director client uses, on average, 64 kbps of total bandwidth upstream and downstream to communicate with the Server, and receives a 300 kbps audio/video stream from the Broadcaster. With 10 Directors, the network requirements for the TeleAction installation are well within the capacity of a standard 100Mbps Ethernet network.

IMPLICATIONS

TeleAction is an intriguing model for a number of scenarios. It can be used to collectively and remotely explore all kinds of environments and situations, from exclusive parties to the surface of Mars. It can be useful in distance learning: the Directors can collectively decide upon questions and comments to be presented to the lecturer. It also has implications for the design of interactive games and television, both in its design for collective behavior and in its use of remotely scripted actions.

We also believe it will inspire fresh approaches to tele-robotics. TeleAction's use of a truly intelligent "agent" allows designers to focus on questions of collaboration and control, without being primarily constrained by a robot's limitations.

WHO WE ARE

The TeleAction project is a joint initiative between the MIT Media Lab and UC Berkeley. Our members are:

MIT Media Lab, Sociable Media Group

Judith Donath	project director
Dana Spiegel	software and hardware design and implementation
Matt Lee	software and hardware design and implementation
Kelly Dobson	conceptual design, hardware design

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Ken Goldberg	project director
Eric Paulos	conceptual design, hardware design
David Pescovitz	conceptual design
Rashmi Sinha	experimental design
Kalle Cook	hardware implementation
Billy Chen	software design and implementation
Dezhen Song	software and hardware design and implementation

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