

# Collaborative Tele-directing

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## ABSTRACT

The Tele-Direction interface allows a physically remote and geographically distributed audience to collaboratively control a shared remote resource. It features contextualized user-driven goal setting and voting, an economy, and chat. In this paper we discuss the design considerations that led to this interface and describe our initial implementation.

## Keywords

Tele-direction, tele-presence, remote collaboration, voting, video, agents

## INTRODUCTION

Collaborative tele-direction is a relatively unexplored model for remote collaboration, whereby a physically remote and geographically distributed audience (the Directors) shares a real-time resource, in particular a remote agent (the Actor). The Actor can be a person, a robot or a program; the key is that it acts based on the wishes of the Directors. Of course, the Directors have individual and divergent wishes. The purpose of the tele-direction interface is to mediate among their individual goals and deliver a single direction to the Actor.

Tele-direction is useful for distance learning: the Directors can collectively suggest and vote on comments and questions to be presented to the lecturer. Tele-direction has applications in entertainment: video games are often played with a single person “driving” while friends gather around, advising and cheering; the tele-direction interface allows this interaction to take place among a geographically dispersed group. Tele-direction can also be used to collectively explore remote environments and situations. (Each of these applications has particular requirements that affect the interface design; these will be discussed in a later section).

## RELATED WORK

Tele-presence and tele-robotics research investigates interfaces and technologies for causing actions at a distance (see [1] for range of viewpoints on the technological, sociological and philosophical issues). Work in wearable computing has addressed transmission of personal viewpoints [3], but not in a collaborative context. The communication between a remote audience and speaker

and among the audience members is analyzed in distance learning research [2].

## TELE-DIRECTION INTERFACE DESIGN

The essential elements in a tele-direction system are the Actor, who exists in the target environment; the environment, which may be real or virtual; and the Directors, who collectively send directions to the Actor. An interface must be designed for the Actor to receive directions and for the Directors to see the Actor’s environment and provide those directions.

Our focus in this paper is on the design of the Directors’ interface. Our goal has been to make it flexible enough to support a range of possible applications and to identify the key modifications that can be made to customize it to a particular task.

## Design considerations

We wanted to give the remote Directors a strong sense of “being there”, as their directions are causing real actions to be enacted in the remote location. We thus chose to have the Directors’ interface feature a real-time view of the Actor’s immediate surroundings. Most of the action occurs in the context of this window.

We wanted to allow for wide variation in the types of commands that would be sent to the Actor and we wanted a simple, fair mechanism for taking diverse suggestions and

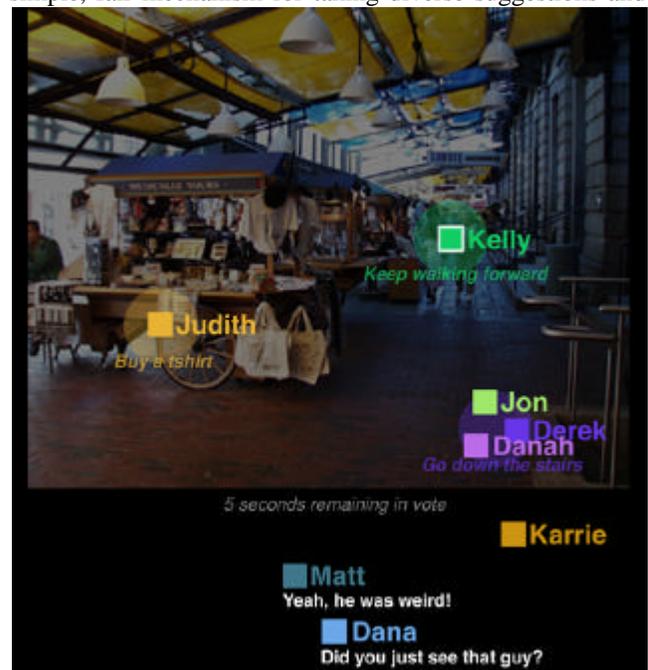


Figure 1 The Tele-direction interface.

turning them into a single command. Our solution is an interface that allows the individual users to create goals and then to vote among them. We also implemented a simple economy to encourage the proposing of interesting goals and the participation in the voting.

To allow Directors to interact with each other, the interface incorporates a chat system. For competitive applications, such as gaming, we anticipate that the chat feature will be used to gather support for one's proposed goals. For more cooperative applications, e.g. distance learning, it could be used to discuss the ongoing lecture and for the Directors to help answer some of each other's questions.

### IMPLEMENTATION

We have built an initial implementation of the tele-direction interface for collectively exploring a remote environment. Our implementation uses a human Actor, who may be moving in either a real world environment or a virtual one (such as the game *Riven*).

The interface is implemented as a Java applet, shown in *Figure 1*. In the middle of the applet is the stage, where a live audio/video (A/V) stream from the Actor plays. Outside of the stage is the chat area. Each Director is represented by a named, colored square that can be moved around within the Java applet window.

### Goals and voting

When a vote takes place, the live A/V stream is paused and the Directors can move onto the still image to post goals and to vote for them. Directors post goals by simply moving onto the stage and typing; the goals appear as text accompanied by a transparent circle, both in the poster's color. Posting the goals directly on the video stage allows them to be expressed in the context of the current scene: One can say "open this" rather than attempting to verbally identify which thing should be opened.

One votes for a goal simply by moving one's square into the appropriate circle. (In *Figure 1*, the goal "go down the stairs", posted by Danah, has three votes while the other 2 goals each have only one vote.) After a set time period, the goal with the most votes is sent to the Actor. Directors may post as many goals as they like, but can only vote for one per voting session (though they can change their vote mid-session simply by moving to another goal).

For most applications, goal setting and voting occurs in sessions that are frequent, but not continuous. In an exploration application with a moving Actor, a vote session pauses the video stream. Votes can be called at regular time intervals or at the request of the Actor, the Directors and/or an outside agent. In a learning environment it makes sense for the lecturer to initiate the call for questions, perhaps at natural stopping points in the presentation; it also makes sense for the Directors to be able send questions given a certain critical mass—an indication that the current topic is especially confusing or controversial. In a game, noticing when an interesting juncture or opportunity appears may be part of the Directors' role.

### Economy

We have also implemented a simple economy in which one must spend points to vote or post goals. Each Director starts with a limited number of points. One must pay to post a goal, to vote, and to change a vote. Votes are replenished over time and bonuses are given for voting for, or posting, the winning goal. This economy was designed for an exploration application; its purpose is to discourage spurious goal creation and encourage quick convergence on a decision. For other applications, a different economic model is needed. For instance, for distance learning, one would want to encourage all questions; even those questions that are not chosen for immediate presentation to the speaker might provide useful discussion points among the Directors.

### Chat

The directors can textually chat with each other in the area outside the video stage. One's words appear by one's name, and fade after a brief display [4]. In *Figure 1* Dana says, "Did you just see that guy" and Matt responds, "Yeah, he was weird!" The chat allows the participants to become more deeply engaged in the ongoing action and helps build their sense of being part of an audience though they are geographically scattered. It also provides participants with a means to construct meta-goals, form teams, and otherwise structure their experience.

### FURTHER WORK

Our basic design for a tele-direction interface allows for considerable variation. We are interested in exploring other forms, for instance looking at different ways the economy can be structured to support greater cooperation or competition. We have thus far been working mostly with a human Actor in a virtual environment (playing *Riven*) plus some limited experiments with an Actor in real spaces. We would like to implement this framework for a wide variety of scenarios. We also are working on how to evaluate the system, from both a quantitative (how long does it take the Directors to guide the Actor to a specific place) and a qualitative (how fun is it to explore a space via this sort of medium) perspective.

More information on the tele-direction project can be found at <http://smg.media.mit.edu/Projects/TeleDirection>.

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