Monkey Business:

Creating social awareness among distributed group members, using a network of animatronic agents

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Proposal for degree of Master of Science – Fall 2005

November 23, 2005

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1.0 Abstract

Members of a geographically distributed group of colleagues are not normally aware of each other's current activities. For example, two members of a team may be working on the same project, but they may have offices on different floors or in different parts of a building. This geographical separation prevents them from knowing when the other has arrived in the morning, if the other is busy or available, and it generally leads to a lack of awareness about the other's activities. It also tends to limit spontaneous and informal interaction between teammates.

For this thesis, I propose building a system that will keep distributed members of a group aware of each other's presence and activities, while striving to remain non-intrusive. The system will also aim to facilitate unplanned and informal communication among distributed colleagues. It will consist of a network of animatronic agents that will be situated in the offices of each member of a group. Through subtle movements, gestures and sounds, the agents will indicate the current activities of the other members of the group. The agents are meant to be ambient, at the periphery of one's attention. But they can also be used more proactively as communication mechanisms, and promote informal exchanges between members of a distributed team.

The objective of this research is to consider whether such a system can be helpful in keeping members of groups more connected and in providing greater social awareness and cohesiveness among them. I also want to explore whether animatronic agents can communicate useful ambient information in a non-disruptive manner, and if they are capable of facilitating spontaneous communication.

2.0 Introduction

2.1 Problem

Working in the same physical environment helps foster a sense of community and connectedness among colleagues. Co-located people often benefit from chance encounters and spontaneous discussions [1, 4], which enable them to discover shared interests and to exchange information in an informal and non-intrusive manner. It is possible for colleagues to prevent miscommunications and avoid potential problems through implicit knowledge about the state of each other's work [10]. Working in the same physical space also minimizes the need for interruptions; for example, there is no need to ask what somebody else is doing at the moment, as this information can be gleaned by a quick glance.

Many colleagues, however, are not co-located – their offices may be in different parts of a building, on different floors, or even in different buildings altogether. Physically distributed colleagues must exert extra effort to stay aware of their teammates' progress and activities. Communication necessarily becomes more planned, and as a result, more formal [10]. The physical separation tends to limit the spontaneous and informal exchange of ideas, and as a result, undermines the overall cohesiveness of the group.

2.2 Proposed Solution

I plan to build a system that will attempt to keep distributed groups of colleagues more connected and aware of each other's activities; the system will aim to facilitate informal and spontaneous communication, while minimizing interruption at inopportune times. The system will consist of a network of animatronic agents, one of which will reside in the office of each member of a distributed group. I have chosen the embodiment of a monkey for the form of these agents; hence Monkey Business as the title of this work.

The agent will use a combination of microphones and sensors to recognize the activity in the office that it occupies. If there is a change in state of the office activity, the agent will broadcast the information out to the network of other agents. The other agents, through subtle gestures, movements, and sounds, will indicate the change of state of the broadcasting office. Thus all members of the group, through their respective agents, will be made aware of each other's activities in an ambient manner.

If the agent in one office makes its owner aware of a particularly interesting event or conversation in another office, the owner may wish to learn more about the activity in the other office. He may indicate his interest by interacting with the agent, perhaps by leaning closer to it, which the agent would sense with a proximity sensor. The agent could respond by widening the communication channels between the two offices, and even allowing the worker to listen in on the activity in the other office, through direct audio feed. The owner could then decide if he wants to participate somehow, either by using the intercom capabilities of the agent to communicate through it, by calling the other office, or by dropping in. He can be reasonably confident that he will be contributing to, rather than interrupting, any important work in the other office, since he is already aware of the interruptible state of that office.

3.0 Background

Other research groups have completed projects that share the goal of promoting awareness and informal interaction among distributed group members; Thunderwire [6], Cruiser [4], and Portholes [3] are good examples. Each of these projects uses a different medium; Thunderwire uses an audio-only channel, Cruiser uses an audio/video conferencing system, and Portholes uses images on a computer screen. The novelty of this proposal lies in the fact that I am using a speaker-equipped physically embodied agent as an awareness tool, which can communicate through both movement and sound.

There are several reasons for choosing a physically embodied animatronic agent as an awareness tool. First of all, physically embodied devices have the advantage of being able to display information in an ambient manner [6]. An ambient display can portray nonessential information at the periphery of one's attention that will not compete with the more important information that one focuses on in the foreground [8]. Since one goal of this project is to display information in a non-intrusive manner, it makes sense to use a device that is less likely to disrupt one's primary area of focus. However, animatronics also possess the capability to make enough movement and sound to push their way into the foreground, if it becomes necessary to catch someone's attention. Thus, an animatronic device can be either ambient or attention-getting, as required by the situation.

Another advantage of physically embodied devices is that they are publicly viewable, and can convey information to several people at once [6]. Thus, for my purposes, a physically embodied device may be preferable to a more private expression

of information, such as a computer screen, or audio that is broadcast through headphones. Information presented on a computer screen is primarily intended to be viewed by the one person seated in front of the screen, and audio broadcast through headphones is only intended for the wearer of the headphones; in contrast, the information conveyed by a speaker-equipped physically embodied agent is easily accessible to everyone in the room. Therefore, the agent enables greater ease of information sharing among co-located members of a group; for example, if several people are gathered in one office, the information that the agent communicates will be available to all of them at once.

Why did I choose a monkey in particular as the agent in this project? Not only do I find the monkeys to be cute and lovable, and thus appealing as office adornments, but monkeys also have more intelligence than most animals. Thus, it seems logical that humans will trust monkey agents to convey intelligent information more than they might trust other animal embodiments. Monkeys also suggest an air of light-hearted playfulness. This light-heartedness complements the informal nature of communication that the system promotes. However, my choice of a monkey as an animatronic agent was largely personal, and if the agent proves to be a valuable tool in general, it would be perfectly acceptable for it to assume different physical forms. Marti notes that diverse embodiments of agents are expected because users will exhibit individual preferences for different animatronic forms [11].

4.0 System Description

The animatronic monkeys are constructed out of monkey puppets. They each contain five servo motors: one for the head, one for each of the arms, one to make the monkey turn from left to right, and one to enable him to swing from his tail, giving the monkey a total of five degrees of freedom. The monkey hangs upside down from his tail on a rod, as shown in Figure 1.

The monkey has an internal speaker and microphone, so that he can both listen to office noise, and broadcast sounds. He is not wireless, but rather is connected to a computer via a serial port; this configuration was chosen in part as a cost-saving measure, and in part to avoid having to continually recharge batteries. An animatronics server software application on the computer sends out signals over the serial port to a microcontroller board, also located in the monkey, which then controls the servos and makes the monkey move. The monkey's microphone will be used to gather audio data

from his surroundings. The monkey may also be equipped with motion and proximity sensors. It will use this combination of audio and sensor data to recognize what is going on in the office it inhabits.

Figure 1: Animatronic monkey swings by its tail in an office

The states I propose to have the agent recognize are those that occur when someone enters the office, leaves the office, has a phone conversation, types at the computer, and has a conversation with other co-located people in the office. The agent will execute a specific sequence of movements to indicate each office state. When the sequence of movements is complete, the agent will return to its default, or resting, position.

The agent may make sounds to indicate office activity as well, depending upon whether the sounds are deemed to be helpful or disruptive. One option under consideration is to allow the owner of each agent to specify a level of intrusiveness for his agent. For example, a user who knows that she will have a very busy day, during which she will not want to be interrupted except for something crucial, may choose a "low intrusiveness" setting. In this case, perhaps the monkey will not make sounds, and will not represent all changes in office state, but will only react to specific activities in other offices. Another co-worker who may not have a heavy workload on a particular day, and who is therefore more available, may specify a "high intrusiveness" setting. This would cause the monkey to alert him to all events, and to use sounds as well as gestures.

5.0 Challenges

The major challenge of this project is to determine the right combination of motion, gesture and sound snippets for the monkeys to communicate information effectively and not disruptively, in order to encourage greater informal interaction between distributed group members. I have to figure out how to represent different office states with animatronic monkeys, as well as which office states are the most important to represent. I want the monkey's actions to be as intuitive to humans as possible, but I recognize that it may not be possible to intuitively represent certain states, and that people may have to learn that a certain sequence of movements represents a particular event.

A second challenge is to establish a method of indicating which office the agent is currently representing. For example, if a monkey moves to let its owner know that someone has just entered an office, the monkey's owner will probably want to know which office was entered. One possibility is to associate each office with a particular audio cue, so that whenever the monkey moves to show a change in state, it also makes a noise to indicate which office the change in state refers to. Another possibility is to only disclose this information via audio cues if the owner explicitly expresses an interest in knowing. The owner might exhibit this interest by moving closer to the monkey, which the monkey would recognize with proximity sensors, or we might equip the monkey with a switch in its paw, which the user could press to request additional information.

6.0 Evaluation

Because it is highly unusual to have a moving animatronic device in one's office displaying information, anyone who participates in a user study will probably be especially mindful of the monkey. The monkey will consequently be more in the forefront of one's attention, instead of at the periphery. Therefore, it is necessary to conduct an extended study over a period of two to four weeks. The initial phases of the study will primarily serve the purpose of getting the users accustomed to having a moving monkey in their office, to the point where they do not notice it anymore, or regard it as unusual. It is important to note that the period of time that the user requires to adjust to the animatronic agent may be extended by the fact that visitors to the user's office will also react to the novelty of the monkey.

After this initial adjustment period, I will start testing different monkey representations of office activity to determine how the monkeys can convey this information in a non-intrusive and ambient way, such as not to interfere with the users' work and everyday tasks. I plan to do contextual interviews of the subjects over time to gauge their reaction to the monkey. I may also conduct a test of the levels of intrusiveness to see if the "low intrusive" setting is truly less disruptive than the "high intrusive" setting.

7.0 Deliverables

- Four to five animatronic monkeys, capable of representing various states through gesture and sound, and also capable of sensing movement, listening to office

noise and extracting salient cues that indicate what is currently happening in a particular office.

- Code that takes in audio and sensor data as input and determines when the state of an office has changed based on this input. When a state change has occurred, this information will be broadcast to every animatronic agent in the network, each of which will then move and make noise to indicate the change in state.
- An evaluation to determine whether an animatronic device can be subtle and ambient enough to constantly provide updates without being disruptive.
- A video depicting a scenario of how the system is used
- An explanatory webpage about the system

8.0 Schedule

December – mid-January: Complete construction of monkeys, test motion and proximity sensors to determine how to include them in monkeys, design monkey movements and audio to represent office states, work on code for recognizing office states and broadcasting them to the network

Mid-January – February: Run long-term user studies, modify monkey behaviors and code as necessary based on results and user preferences, create webpage

March: Analyze results of studies, complete webpage, plan video scenario

April – May: Write thesis document, shoot and edit video

9.0 References

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10.0 Reader Biographies

Joseph Dvorak, Ph.D.

Dr. Joseph Dvorak has over 8 years of experience in wearable technology and design. He is currently the lead technologist for wearables for Motorola iDEN and is the principal investigator for conformables, which are highly wearable devices and systems. He leads the development of the principles governing conformable design and has several awarded patents in the area of wearables. He is an Adjunct Professor at Florida Atlantic University, teaching courses in wearable technology and systems. He received a Ph.D. in Computer Science from the University of Illinois at Chicago.