Telepresence Robot With User Recorded Arm Gestures:
Adding More Realistic Nonverbal Communication To The Telerobotic Experience

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1. **Introduction:** Studies have shown conclusive evidence that expressive robots which can communicate nonverbally as well as verbally can do so more effectively. Elements like trust and sympathy are established less by verbal communication and more by nonverbal communication. What we have proposed with our research is to create a telepresence robot that can communicate more effectively by using the arm movements of the user to generate similar arm movements in the telepresence robot.

2. **In This Paper We Will Present:**
   - **a.** Background: Some background research supporting this project, why nonverbal communication is important, and why our approach is unique.
   - **b.** What we hope to accomplish: The specific goals we expect our telepresence robot and supporting software will achieve.
   - **c.** How we plan to execute our objective: The details of how we plan to achieve our goals.
   - **d.** System design: This section will explain the details of our telepresence robot prototype. Hardware materials we will be using to accomplish our goals and the software platforms will use to support our hardware

3. **Background:** Many of the early and commercially prevalent telepresence robots are, what is referred to as, “skype on wheels”. Essentially, these models are a monitor (allowing the environment to see the user) and camera (allowing the user to see the environment) on top of a transport device (allowing the user to move the monitor/camera around the environment from a remote location).

   Some newer telepresence robot designs have included arms. Most of these models use an arm, or set of arms, to manipulate objects in the environment in a functional way. The arm carrying telepresence robots can pick up items, open doors, and drop items in a specific location. Some of the users of these robots operate the arms by joystick, some by gloves with sensors, and others with buttons on their monitor. These robots, though functionally useful for some tasks, are not ideal for nonverbal communication.

   The book *Nonverbal Communication* states, “Depending on the study, the estimated amount of information communicated nonverbally ranges between 65% and 95% of the total messages conveyed”(Nonverbal Communication)
   Research published by the University of Minnesota discussed the concept of illustrators and emblems. Emblems are hand gestures like a “thumbs up” or a “shoulder shrug” and can be used to replace a verbal message. The study said, “Illustrators are the most common

type of gesture and are used to illustrate the verbal message they accompany. For example, you might use hand gestures to indicate the size or shape of an object. Unlike emblems, illustrators do not typically have meaning on their own and are used more subconsciously then emblems. These largely involuntary and seemingly natural gestures flow from us as we speak but vary in terms of intensity and frequency based on context."(*Communication In The Real World*)

The MeBot designed by MIT was built for the explicit purpose of communicating verbally and nonverbally. This robot has the capability to perform head and arm gestures. The head gestures are performed using facial mapping technology. As the user leans into their computer, that head position and orientation is captured and translated into the matching coordinates for the robots head position and orientation. This allows the MeBot to look up, look down, and rotate it's head as the user is doing the same thing with their own head. The arms of the MeBot are controlled using joystick controls. As the user moves the left and right joystick, the left and right arms move respectively. The difficulty with this method is that most hand gestures during nonverbal communication are often done subconsciously. A person may not think to move the arms manually with a joystick as quickly or as naturally as they would their own arms.

4. **What we hope to accomplish:** The use of arms for robotic nonverbal communication has not yet been accomplished in a way that is natural and subconscious to the user. The goal of our research is to create a telepresence robot that can communicate nonverbally with use of it's arms by capturing the actual movement of the user's arms during the course of their conversation. We will do this by capturing the position and orientation of the user's arms and translating that data to the position and orientation of the robot's arms.

5. **4. How we plan to execute our objective:** The user will interact with an environment from a remote location using a computer and a body camera. The computer will be used to move the robot. The computer will also capture the user's voice and face by video and display the image and audio from the robot's monitor. The body camera will capture the upper body image of the user, translate the arm orientation and movement into the same arm orientation and movement for the robot's arms, and send the data to the robot. The robot will then use the sent data to manipulate its arms in the exact same manner as the user.

5. System Design:

a. Robot: For our robot design we are using a Double telepresence robot. This model comes with no arms, but we are going to attach arms to the robot. The arms are made of pvc pipes and Dynamixel MX-64 and MX-106 servo motors.
b. Capturing the user's body motion:
    i. Hardware: to accomplish this task we used an XBox 360 camera connected to
    ii. Software: Presence 2.1.1
c. Moving the robot arms

i. Software: Robotis Opencm

Sources

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