Tele-presence using Kinect and an animated robotic face

Project specification for the bachelors essay in DD143X

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Introduction

Background

Telepresence is the subject of utilizing technology to allow people which are not physically present or near each other to feel as if they, in the context of some virtual environment, are present. This simulated sense of presence can occur in many forms, but requires that stimuli is provided to one or more of the users senses (hearing, vision, smell, touch or feel) to such extent that the appearance of presence is given to the user.
Telepresence can be found in fictive literature ranging all the way back from 1942[1], but it is in modern days that real usable applications have emerged along with technological advancement. Such applications range from research in medicine, where teleconferencing and even haptic feedback in remote surgery has been demonstrated in Regensburg, Germany[2], to businesses utilizing sophisticated telepresence videoconferencing to bring together distant personnel.

Telerobotics and animation with Kinect

Telerobotics, the field of telepresence with focus on remotely sensing and/or behaving in a distant environment using robotics, is an exciting topic of research today and we, the project group, feels it would be very interesting to merge the idea of telerobotics with that of videoconferencing to enhance the experience for distant communication between parties.
The idea of the project consists of using the Microsoft Kinect camera's face tracking functionality to capture and a project a (possibly) distant persons facial expressions onto an animated robotic face present to the receiving user to determine how well a persons emotional expressions can be preserved. Such an animated robotic face exists at KTH and his name is Furhat, whom we most likely will use during our project.

Problem statement

The project will consist of implementing a program that, given a video recorded through Microsoft Kinect, it will be possible to track the facial expressions of the person and transfer these to an animated face. This animated face will then be back-projected onto the face of the robot Furhat.

The following scenario could be possible:
Persons A and B are trying the new telepresence approach. Person A is sitting in front of his computer, using a Microsoft Kinect to record his facial expressions and head movements. Person B has a robot head with a video recorder at his place. The facial expressions of person A is projected onto the robot head present at person B, making the situation for person B much more realistic, while person A will simply see a video of person B.

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[1] http://en.wikipedia.org/wiki/Waldo_%28short_story%29

[2] Westwood et al. (Eds.) - Medicine meets Virtual Reality 12: Studies in Health Technology & Informatics - W. Kahled, S. Reichling, O.T. Bruhns, H. Böse, M. Baumann, S. Egersdörfer, D. Klein, A. Tunayer, H. Freimuth, A. Lorenz, A. Pessavento & H. Ermert - Palpation Imaging using a Haptic System for Virtual Reality applications in Medicine. - pp 147-153, IOS Press, 2004

The scientific value of the report will be an evaluation of the possibilities of transmitting communicative functions, such as emotions, through a slave unit.

Approach

The technical part of the project involves extracting a geometrical representation of a facial expression from a Microsoft Kinect camera and back-projecting it onto an animated face. This can be solved sequentially by first using the Kinect face-tracking API for Windows to extract the geometric face object. This routine will be written in C++ and will reside in an independent module. This module will communicate over a data-link to a parallel module that translates the geometric face object into suitable parameters that can be parsed with the Java API which will in turn produce the animated face. This animated face can then be projected directly onto the Furhat robot face.
The scientific part, which will treat the aspect of preserving human communicative functions through animation, can be done with human testing and evaluation. However, a framework for such an experiment is yet to be constructed.

References

The references found so far for working with the technical aspect of the project are the following:
The Microsoft Kinect face-tracking API: http://msdn.microsoft.com/en-us/library/jj130970.aspx
The robot face Furhat: http://www.speech.kth.se/furhat/
The Java API for rendering an animated face is yet to be provided by project supervisor

For the scientific aspect of Telepresence, the following references have been found:
General information about Telepresence: http://en.wikipedia.org/wiki/Telepresence
About uncanny valley, the discomfort when interacting with near-perfect androids: http://en.wikipedia.org/wiki/Uncanny_valley
MacDorman, Karl F.; Ishiguro, Hiroshi (2006), “The uncanny advantage of using androids in cognitive and social science research”: http://www.macdorman.com/kfm/writings/pubs/MacDorman2006AndroidScience.pdf

Time plan

5 Mars	Halfway meetings with project supervisor Gabriel Skantze
12 Mars	Estimated deadline for completion of software development
31 Mars	Estimated deadline for completion of scientific experiment
12 April	Essay hand in deadline
23 April	Review hand in deadline
TBA	Final version of essay