EMBODIED CONVERSATIONAL INTERFACES FOR THE ELDERLY USER

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Principal investigators

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Abstract

In this project, you will collaborate in a team of five or six people (including the project leader). The team works on the design and development of a bi-bodied conversational agent for elderly users, i.e. an agent that has a robotic as well as a virtual body.

Both bodies should be likeable and acceptable by the target group, which means that the team will invite a representative sample of elderly users for weekly visits to the lab. During these visits, the elderly users are asked to offer their input regarding the design of the bodies.

In addition to the bodies, the team will work on a control panel to be used by a "Wizard of Oz", i.e. a tele-operator that controls the robot/avatar from a distance, thereby simulating the intelligence of the agent.

The project will result in a test set-up enabling experimenters to compare the effects of a virtual body vs. a robotic body in human-agent interaction studies.

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Design rationale and project objectives

The world today is filled with advanced technology. The younger and the middle-aged in our society have grown up using such technology, and as technology slowly advanced throughout the years, most of them have been able to stay up to speed with recent developments. But elderly people often have little to no experience with technology; it didn't exist when they grew up and they have trouble keeping up with today's technological advancements. For example, all too often elderly people are unfamiliar with the use of a keyboard, mouse, or touchscreen.

At the same time, societies are struggling with aging populations causing a major increase in burden placed with our health care systems. And the state-of-the-art solutions developed as part of elderly (health) care solutions and interventions, such as smart homes and eHealth applications, often contain complex technology, which users are expected to interact with.

Briefly put, there is a need for an intuitive interface for elderly people to interact with the smart technologies that are slowly penetrating contemporary (health) care systems. A possible solution to this issue might be the use of an embodied conversational agent (a virtual personal assistant) that functions as the user interface to these applications. Research has shown that elderly people have no trouble interacting with an embodied conversational agent (ECA). In other words, if we can use an ECA as a user interface for elderly people, they may be able to interact with their high-tech environments in a natural and intuitive manner.

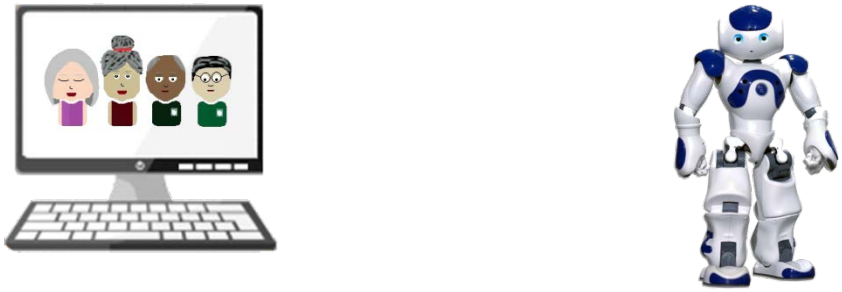


Figure 1: The embodied conversational agent should have two bodies: an avatar and a robot. In contrast to these two examples, the to-be-developed bodies should be consistent in their looks and behaviours.

The body of an ECA can be either a physical body (robot) or a virtual body (avatar). Both have their advantages and disadvantages, and both are expected to affect the relation between the user and the agent in different ways. To investigate such differences, we would like to develop an experimental set-up that enables us to compare these two bodies in a variety of settings, such as:

- Having people interact with either the robot or the avatar in similar tasks and settings to investigate: What is the effect of having an agent with a physical presence compared to an agent with a virtual presence? Do people form a different type of relation over time with an avatar compared to a robot?
- Having people initially interact with the robot, then have several follow-ups where they interact with the avatar as a virtual presence of the robot; or having people interact *only* with the avatar. This set-up would enable us to investigate whether and how the perception of an agent is influenced by having `met the robot in person'.
- Having people interact both with the robot and with the avatar to investigate: Do people perceive the robot and the avatar as the same entity?

An important requirement for the to-be-developed bodies is that they should be acceptable and likeable by elderly users. Features that should be addressed by the design are: body movement, appearance, and voice. Another requirement is that the robotic and the avatar body of the agent are consistent with each other in their looks and behaviour.

The key objective of this research project is to develop two bodies for one and the same ECA:

- One virtual and one robotic body
- The two bodies are to be consistent
- The bodies should be perceived as acceptable and likeable by elderly users
- The two bodies can be controlled by a "Wizard-of-Oz" through a control panel
- The agent should be capable of using both bodies to perform similar behaviours in the realm of music-related activities (i.e. talking about music, playing and listening to music, dancing, clapping):
    - Smile
    - Frown
    - Look sad
    - Attentive listening
    - Talk
    - Blink
    - Move arms and legs
    - Dance/wave to the music
    - Clap
    - Nod
    - Shake head
    - Be happy/excited

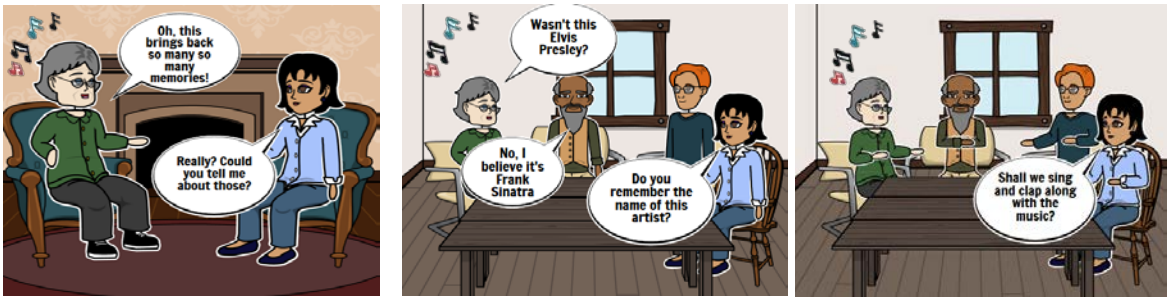


Figure 2: Various music-related activities that elderly people might engage in with the agent are: (1) reminiscing about ` the old days' while listening to music, (2) recalling factual information about the music, or (3) engaging in physical/musical activities such as simple exercises, dancing, clapping, or singing.

Detailed technical description

A. Technical description

The team will engage in participatory design with the target group (elderly users) to come to the design of both bodies. The project will start with a study of the literature and a needs assessment to elicit user requirements. An initial prototype - that incorporates this *requirements baseline* - will be created through rapid prototyping (e.g. paper-based and/or Arduino). Such prototypes can be quickly shared and evaluated with the target group, enabling fast readjustment and refinement of the requirements and resulting prototypes after each cycle.

The robot body will be developed using an Arduino UNO micro-computer and servo-motors.

The avatar body will be developed using the Virtual Human Toolkit/Unity.

The to-be-developed control platform should enable a so-called 'Wizard of Oz' to control either body from a laptop or PC, and respond to the user's instructions, questions, and remarks. As Arduino is not a very appropriate platform for audio output, a separate (body-independent) output channel will be connected to enable the agent to "speak". For now, we will assume the 'wizard' to be located in the same room as the agent and its user, so the 'wizard' will be able to hear what the user is saying - no need for audio input processing.

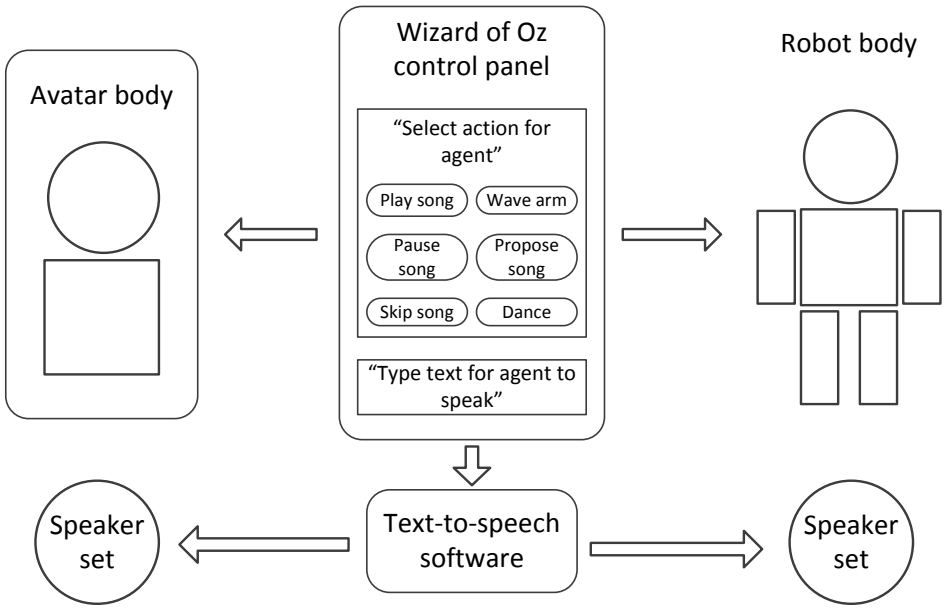


Figure 3: Conceptual architecture of the to-be-developed system.

B. Resources needed: facility, equipment, software, staff

Facilities:

- a working area for the project team
- access to elderly people who are willing to participate in the design project (e.g. focus groups, needs assessment, rapid prototyping, evaluations)

Hardware required from organization (not provided by project leader):

- Arduino UNO (plus USB cable)
- Breadboard
- Acrylic sheet(s)
- LED's
- Resistors (various (k)Ohm)
- Capacitors (various uF)
- Servo motors
- Jumper wires
- Screws, bolts, small drill
- Screwdriver
- Soldering iron

Hardware brought by project leader:

- Coloured cardboard / hobby rubber
- Glue/adhesive materials/double-sided foam tape
- Speaker set

Software (open source / freeware):

- Virtual Human Toolkit/Unity
- Text-to-speech software

C. Project management

The project is preferably carried out by a team of six people (including the project leader), working on the following work packages:

WP1 - Project leadership

Keep track of the bigger picture, i.e. the alignment of all components and the overall requirements placed on both the robotic and avatar body. Pay close attention to the timeline, construct contingency plans, and ensure that the team meats its deadlines. Manage the team's communication, and the overall coordination of individual activities.

WP2 – Overall architecture and behaviour capabilities

Interfacing between the various components, i.e. agent bodies, text-to-speech software & speaker set, and Wizard-of-Oz control panel. Input/output variables should be specified for all components, along with a specification of the behaviours that should be supported throughout the system (e.g. facial expressions, wave, node etc.).

WP3 – Design and development of the robot body

Partial overlap with WP4, wrt the participatory design with the elderly user target group: Together with a representative sample of users decide what is needed for the robot body to be likeable and acceptable to elderly users. Align design of the robot body with the design of the avatar body to ensure consistency in the look and feel. Develop prototypes of the robot body using the Arduino UNO, servo motors, and cardboard/hobby rubber. Use Arduino programming language to develop behaviours for the avatar body, e.g. facial expressions, wave, nod.

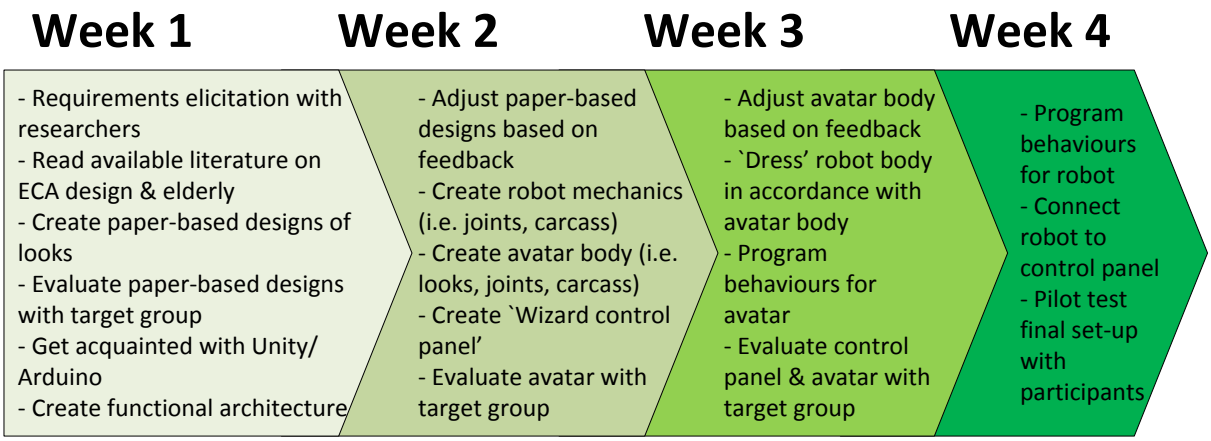
WP4 – Design and development of the avatar body

Partial overlap with WP3, wrt the participatory design with the elderly user target group: Together with a representative sample of users decide what is needed for the avatar body to be likeable and acceptable to elderly users. Align design of the avatar body with the design of the robot body to ensure consistency in the look and feel. Develop prototypes of the avatar body using the Virtual Human Toolkit / Unity. Use the VHK/Unity to develop behaviours for the avatar body, e.g. facial expressions, wave, nod.

WP5 – Wizard of Oz control panel, including text-to-speech software

Develop a simple GUI for the Wizard to control either of the bodies, depending on which body is connected to the control panel. Part of this control panel is also the functionality of "talking" to the user through a speaker set (independent of robot body), by typing text into the control panel and using text-to-speech synthesis software.

Timeline



Benefits and impact of the research

The to-be-developed software can aid HCI researchers in conducting experiments with elderly users as it enables them to have an elderly user interact with a likeable and acceptable ECA in two comparable bodies, one virtual and one robotic.

In addition, the research will result in insights regarding the preferences of elderly users regarding the design of both a virtual and a robotic ECA, resulting in a range of user requirements that can be reused in future experiments involving ECA for elderly users.

Profile team

A. Leader

Dr. M.M.M. Peeters m.m.m.peeters@tudelft.nl http://mariekepeeters.com/

Dr. Peeters works in the 3TU.Humans&Technology research centre as a postdoc researcher. Her research position is mainly carried out within the Interactive Intelligence group at Delft University of Technology.

She combines her knowledge of both human cognition and artificial intelligence in her research. Her research focuses on long-term human-agent interaction and the establishment of personal, equal, confidential, and secure human-agent relationships. In addition, she thinks about scientific methods that allow for the systematic design, analysis, and evaluation of human-technology interaction. She has a special interest in the application domains of education & training, and healthcare.

B. Other researchers needed

Team candidates are expected to have experience working in teams. Furthermore, candidates will need to have experience with

Specifically, the project needs the following people:

1) Someone with experience in user-centred design and/or rapid prototyping.
2) Someone with experience in building robots with Arduino and Arduino programming.
3) Someone with a talent for drawing and design.
4) Someone with experience in programming (e.g. Java or C#).

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