Authors: Ott St., Spiegl W., Soutschek St., Maier A., Steidl St., Nöth E.

Home Assistance System for Elderly People

Abstract

In this paper, we describe our investigations on developing a home assistance system for elderly people. The aim of our system is to keep and advance independence of elderly people, and to increase the quality of support and services at home.

Introduction

Our system will make life at home easier for elderly people by assisting them with their daily routine. They can stay longer in their familiar environment and may not be required to move in a nursing home. To do so, the system supports the handling of devices (telephone, radio, TV, light, etc.) and applications (time, date, weather, etc.). For example in case of a memory decline or Alzheimer's disease visual or acoustical notes are generated when pharmaceuticals have to be taken.

Environment

To make the system attractive for elderly people, the system's interface needs to be easy and intuitive. What is more intuitive than continuous speech? The front-end (user interface) of our system is a dialog system [3], driven by spontaneous speech. The resident is able to control the provided services (e.g. light switches, TV) as if he is talking to another person. The developed prototype of our assistance system records the user input via headsets. It is clear headsets are not practical for continuous operation and no one wants to walk around the whole day with a headset. So for the final system it is planned to switch to ambient microphones.
To meet the requirements of spontaneous speech, we installed a slot-based dialog system where the user can present the relevant information to the system in arbitrary order and all at once, e.g. for scheduling an appointment the user can say: "Tomorrow at 12h I have an appointment with my physician at the clinic." The system recognizes the particular information items and fills the slots for internal representation: a) date: 'tomorrow', b) time: '12h', c) location: 'clinic', d) person: 'physician'.
The main advantage on our system is that it is highly adaptive to the need of elderly people. For this it is necessary to know what these needs are. In [2] four domains are identified: health care, housekeeping and maintenance, security and privacy and at last communication and the social field.
To meet the demands on adaptation to the needs of the elderly, it is not enough to simply control devices like radio and light by speech (which is nothing more than just a speech remote control). In the following, we present home security and health care scenarios where the user can control several devices by interacting with the system.

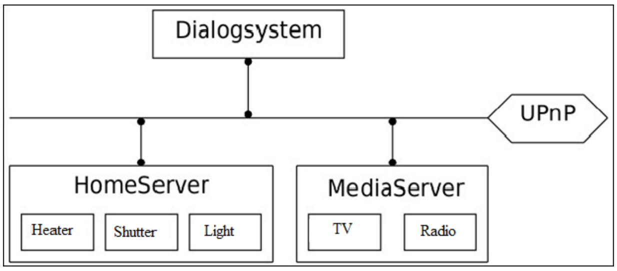

Fig. 1: Scheme of the UPnP system architecture

An example scenario in the area of security might be a simulated resident, while the user is on holiday or hospitalization. The light switches on in the evening, the shutter blinds go down, and when the system recognizes movement in front of the door or windows a recorded conversation is played.
In the area of health, our system will be able to check the health status of the resident e.g. by sensors integrated into a t-shirt (pulse, blood pressure, etc.). If the system detects any abnormalities, a specific person can be notified, for example the general practitioner or a family member. Mental training to prevent mental decline will be possible e.g. by playing chess versus an artificial intelligence over the TV screen. Another aspect in the area of health is physical fitness: The inhabitant exercises using a home trainer where the pulse is measured. For motivation, a movie is displayed. If he leaves a predefined range, the film is played slower (pulse is below the limit) or faster (the pulse is above the limit) [4].
Finally, a reminder function is available where the system tells the inhabitant in the morning which dates he has for the current day or the next week.
The communication between the different devices (TV, radio, light, etc) is realized per UPnP-Protocol (Universal Plug and Play). It conduces to control several devices. These devices can arbitrarily enter or leave the IP-based network without crashing the whole system. Devices are controlled per control points which send several actions (e.g. "power_on") to the specific device. In Figure 1 the scheme of the UPnP system architecture is shown. The Module 'Dialogsystem' is the control point and 'HomeServer' and 'MediaServer' are devices. When such a device enters the network it broadcasts an advertisement message which is noticed by the control point. Devices have to send "alive packages" in a frequency of about 1800 seconds to notice that they are still active. Control points send a discovery message when they enter the network and get response packages from the devices on the network with all the information they need to control the devices. With this technique we have a highly dynamic system and are able to adapt the environment very simple to the inhabitant.

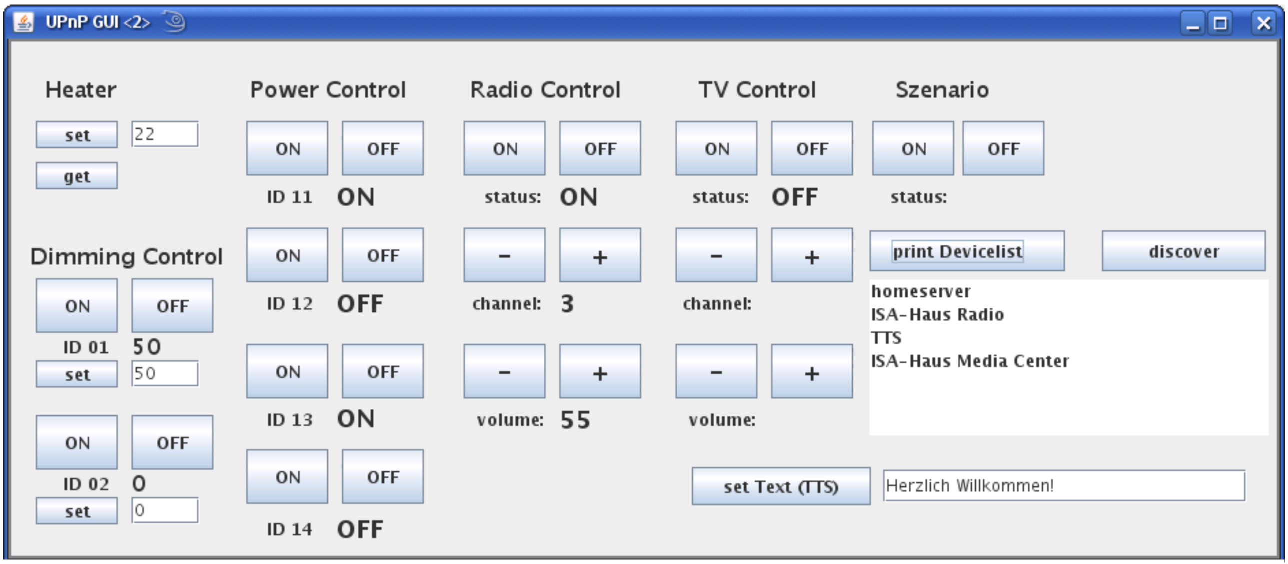

Fig. 2: UPnP GUI (Graphical User Interface) for controlling the UPnP devices in the Wizard-of-Oz Experiments

Methods

The usability, user-friendliness and acceptance of an installed home assistance system depend not only on the devices and applications a user can control. One critical point is the robustness of the system and the chance that a user query gets fulfilled in the requested way. For this it is important to know, how users interact with our home assistance system. Practical methods on investigating such human-machine-interaction are field experiments, meaning real probands have to test a preliminary system. With the obtained knowledge the system will be improved iteratively step-by-step. A very popular kind of field experiments are so-called Wizard-of-Oz experiments [1]: In the preliminary system a person (the wizard) takes over the controlling of the not yet implemented functionality, but without the knowledge of the test person. So the wizard is spatially separated from the proband to preserve the illusion of an autonomic acting computer system.

For our Wizard-of-Oz experiments potential residents of our home assistance system are asked to perform certain tasks in our demo room. The "protagonist" for example has to make a phone call at a specific time, where the system (in this case the wizard) reminds him via a command: "Mr. X, you wanted to call your daughter. Shall I set up the connection?" Therefore, the wizard controls the devices and reacts to the user-input by a graphical user interface (GUI). Fig. 2 shows the developed GUI for controlling the installed devices: power sockets, radio, TV, heater, predefined scenarios etc. Besides this the wizard can interact with the test person via text-to-speech. On the bottom right in Fig. 2 one can see the input field for text to say. The wizard types in the text, clicks the button with the 'set Text (TTS)'-caption and the user hears the text spoken by a computer voice.

By running the experiments all data is recorded: the audio data from the microphones, the text-to-speech messages the wizard has send, the events of controlling the devices and applications. Subsequently, the data will be analyzed and annotated on different levels to train and improve our home assistance system.

Summary

We have a demo system where a slot based dialog system is realized, several devices can be controlled and predefined scenarios exist. The Wizard-of-Oz experiment will deliver more information of how the user interacts with the dialog system to keep elderly people longer at home.

Literature

[1] Bernsen N. O., Dybkjaer H., Dybkjaer L.: Designing Interactive Speech Systems, Springer, 1998

[2] Georgieff, P.: Ambient Assisted Living, Marktpotenziale IT-unterstützer Pflege für ein selbstbestimmtes Altern, 2008, MFG Stiftung Baden-Württemberg

[3] McTear, F. M.: Spoken Dialogue Technology, Springer, 2002

[4] Soutschek S., Maier A., Hönig F., Spiegl W., Steidl S., Erzigkeit H., Hornegger J., Kornhuber J.: Audio-Visual Feedback System for Reward-Based Training Sessions of Elderly People in a Home Environment; Russian Bavarian Conference 2009, Munich, Germany, to appear.

Affiliation of the first Author

Stefan Ott
University of Erlangen-Nuremberg
Chair of Pattern Recognition
Martenstr. 3
Erlangen, 91058
Germany
sistottt@informatik.stud.uni-erlangen.de