THE AMBIENT ADAPTABLE LIVING ASSISTANT IS MEETING ITS USERS

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Abstract

The need for communication is essential especially for elderly people living alone. In this paper, we introduce the current achievements of the ALIAS project which aims to create a robotic communication platform. This platform will enhance the social inclusion of elderly people by providing them a variety of services to stay in touch with their social environment. To realize this objective, two major tasks – technical development and user inclusion – have to be harmonized by bringing together experts from both fields. The technical realization for creating a robotic platform featuring a multimodal communication and an interactive behaviour raises challenges from different research directions covering audio and image processing, multimedia technology, human factors, control engineering, etc. The user inclusion has to tackle the problem that elderly people are a heterogeneous group with different wishes and needs. This goal is realized by applying different forms of user surveys ranging from questionnaires, interactive workshops and user trials.

Keywords: service robotics; communication for quality of live; user inclusion; business models

1. Introduction

European societies are affected by a dramatic demographic change taking place in the years to come [1,2]. The Ambient Assisted Living (AAL) research programme tries to compensate the drawbacks of the aging society by applying modern information and communication technologies (ICTs). The AAL-JP call2 funded project **Adaptable Ambient LIving ASsistant (ALIAS)** aims to improve the communication of elderly

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people ensuring a safe and long independent life in their own home. ALIAS is embodied by a mobile robot platform without manipulation capabilities.

Objectives and Approach
The ALIAS robot serves as a communication platform for improving the social inclusion of the user by offering a wide range of services. These services comprise an intuitive and natural dialog system which is able of handling natural speech and several web applications that support basic communication, cognitive games, web search or multimedia presentation centred around events. To realize these services, the ALIAS robot is equipped with sensing devices including cameras, microphones, a touchscreen and a Brain Computer Interface (BCI) to perceive the user's input. ALIAS can also interact with users using different modalities: audio output via loudspeakers, a graphical user interface on a screen and proactive and autonomous navigation. User inclusion is a core aspect within the entire ALIAS development cycle in order to ensure that the robotic platform meets the requirements and needs of elderly people. Different use case scenarios have been drawn within the project providing a roadmap for the technical development.

Related Work
ALIAS is not the only project applying robotics in the field of AAL [3]. Hence, robots are developed to directly assist elderly people, or the nursing staff, or both. Paro[1] is a robot in form of a baby harp seal that is developed for people with dementia. The robotic platform Nao from Aldebaran Robotics[2] is an humanoid robot which can be used for different use cases, e.g. in the project ROBO M.D. [4], it is used for remote health applications. The Care-O-bot®3 platform [5] is designed as a butler for assisting people and like the Nao, it can be used for different AAL applications. The remainder of this paper is organized as follows. We present our user inclusion approach in Section 2. The functionalities of ALIAS are described in Section 3. We give an overview of activities to evaluate the ALIAS system in real world environments in Section 4. Finally, we conclude and outline future work in Section 5.

2. An User Inclusion Approach

2.1 User Inclusion Process

To account for the acceptance of a mobile robot system by the elderly people, one focus of the project lies on social acceptance of robot systems in general and within specific user groups in particular. Therefore specific methods of open innovation processes are used. In the project ALIAS, we use a participative approach of open innovation. The early and sustained involvement of potential users as well as professionals in the field of care ensures that the modules and functions of the robot platform are developed adequately and in line with demand. Therefore one aim is to improve the acceptance of the final product by identifying requirements in early stages

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[1] http://www.parorobots.com

[2] http://www.aldebaran-robotics.com

of design, testing the prototypes throughout the innovation process and giving feedback to technicians to optimize the robot. We use specific methods of open innovation processes to integrate users from the very beginning. Several realities of men and women and differences between different age groups, lifestyles and life stages have a relevant impact on the development of products and their implementation. In the scientific view of gender relations, the analysis of causes and backgrounds of gender differences and their impact on social phenomena is highly valued. Elderly people cannot be seen as a homogenous group, even if "the elderly" are addressed in public debate often as one group with common goals and interests. The user inclusion is not limited to the end user itself, but also including potential markets/stakeholders (such as care staff, family members, etc.).

A challenge of ALIAS is the continuous involvement of users and their relatives to identify their needs and preferences as well as analysing the environmental conditions for future use of robots. The sum of generated user feedback through a series of written and oral evidence runs directly in the development of prototypes of the robot. The user's perspectives were measured early in the course of the project and led into the technical development process, to improve the acceptance of the ALIAS platform. Quantitative (e.g. surveys) and qualitative (e.g. brain writing, Walt-Disney-Method) research methods were used. Secondary analysis, surveys, interviews and workshops enable to further specify the needs, wishes, technical requirements and environmental conditions of the elderly. The results were permanently fed back to the technical partners and used for the development of the robot. The robot itself is then tested in field trials with the seniors. Through this permanent feedback between the seniors, social scientists and engineers it is possible to ensure a mobile platform of high quality for the end users.

2.2 Scenarios

Various scenarios have been elaborated during workshops with elderly people. We provide below two representative use cases supported by ALIAS.

Emergency Call
The ALIAS robot can call for remote help via telephone when the user needs assistance. In this case, a telephone connection with a video call to a doctor can for instance be established. To trigger this function, the user can shout a vocal command “ALIAS Help!”. ALIAS will start a countdown of 20 seconds while the user can stop the emergency call by either saying “Stop” or clicking an icon on the screen. If the countdown is not stopped, the video call will be established. From the technical side, this video call is handled like a regular telephone call. Additionally, the person called can be enabled to remote control the robot – e.g. to get a clear picture of the users' state and its surrounding. The emergency call functionality is an important feature, because it provides a sense of security for elderly people.

Entertainment Scenario
Online communities are publishing an increasing volume of multimedia content on the Web, but finding pictures or videos that we once shared is a challenge. This is one of the objectives of the EventMedia application installed on ALIAS. By publishing multimedia content on the web or private photos coming from a family member, the EventMedia application is organizing those media items around the notion of events where those media were originally captured. The application enables then to re-live a past event by showing different galleries. It can also support search for upcoming events and pro-actively suggest activities to do such as organizing a birthday party for a nephew or inviting friends for an upcoming exhibition of a favourite artist.

3. ALIAS Functionalities

For realizing a natural and intuitive communication with the user, the ALIAS robot has to cover a wide range of functionalities that we present in this section.

3.1 Autonomous Navigation

The key benefit of a mobile robot (see Figure 1) is the capability to move autonomously. To do so, the robot is able to recognize its surrounding environment (and obstacles) by using a laser range scanner, a sonar array, and a set of cameras. These sensors are also used to detect persons. The robot contains a map of its environment and could transform its own position and recognized person hypotheses into this map. The person hypotheses are used to form a safety zone around each person. During autonomous movement, the robot is able to plan its path towards a goal by taking into account the recognized persons and to avoid obstacles using the E* planning approach [6].

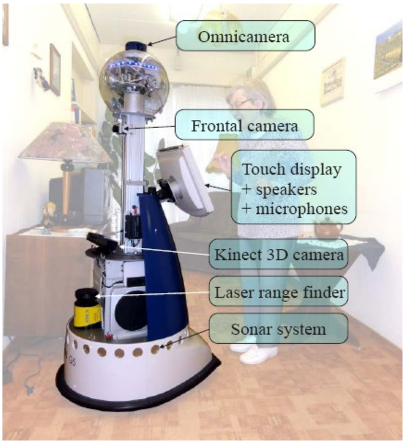

Figure 1: Image of the robot with its sensors and interaction devices.

The robot can also actively approach a person in a polite manner to support interaction with the user [7,8]. The robot is able to reconfigure the navigation system to enable a remote user to control the robot in a way, where only the collision avoidance is active, and the remote user is able to drive the robot around. This is an important safety feature of a robot system, which static systems could not provide. The navigation system reports its state to the dialog system by sending events and is entirely controlled by the dialog manager.

3.2 Interaction

A natural and intuitive human-robot interaction with ALIAS is realized via a dialog system. The dialog system itself is composed of different components which can be described in terms of input and output modalities. For the input modalities, there are cameras, microphones, the BCI and the touchscreen. For the output modalities the ALIAS system has the touchscreen and loudspeakers as well as actuated eyes and animated lights in its head.

Dialog Manager
In order to be controlled in a reasonable way, the dialog system has a so-called dialog manager which handles the interplay between input and output modalities of the ALIAS robot. Therefore, the dialog manager communicates with all involved modules of ALIAS and controls them and thus is the central decision making unit for the behaviour of the ALIAS robot and its interactions with the human user.

Touchscreen
The touchscreen of the ALIAS robot is mounted on a flexible arm. It is used to display graphical user interfaces (GUI). Different widgets and elements of the GUI can be controlled via single touch events of the user, such as general web applications (mail, calendar, web browser) or specific ones (EventMedia).

Automatic Speech Recognition
The ALIAS robot uses two automatic speech recognition (ASR) systems that work in parallel as depicted in Figure 2. The first ASR system has smaller vocabulary size and very strict input expectations. This ASR system can be considered as a keyword spotter. The second recognizer continuously analyses the spoken content. By this two-way approach, the keyword spotting system can do a reliable search for important catchwords, whereby the second recognizer tries to understand more contexts from the spoken sentence which can then be further analyzed by the dialog manager for its decision processing. More details can be found in [9,10].

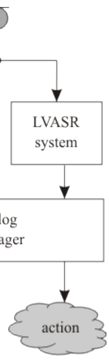

Figure 2: Parallel ASR systems for ALIAS

BCI

The Brain Computer Interface (BCI) provides another input modality for the ALIAS robot [11]. A BCI uses electroencephalography (EEG) to acquire signals for controlling the ALIAS robot. The usage of the BCI is advisable if the user suffered a stroke and has problems with speaking or using the touchscreen. The ALIAS BCI system applies two different approaches: steady state visual evoked potentials and induction of P300 response in the EEG signals. The entire ALIAS user interface can be controlled by the BCI system.

4. Evaluation in Real Settings

4.1 Workshop and Field Trials

We have evaluated ALIAS during multiple workshops and field trials. Through workshops, the requirements regarding the needs and preferences of the seniors have been assessed leading to various scenarios. During the first field trials in fall 2011 and now in fall 2012, the usability, user friendliness and system performance of the ALIAS robot have been tested with three scenarios (emergency call, games and e-ticket purchase for an event). The results of the first trials showed that the seniors are pleased with the functions of the robot but requested some modifications. These changes have been implemented and are now evaluated in the second field trial campaign focusing on task oriented test processes.

4.2 Market Study

The overall goal of the ALIAS project is to reach market maturity 2-3 years after the end of the project. Currently we are conducting a detailed market study and develop an associated business model. However, in discussions already now it clearly shows that the market potential of the ALIAS robots depends on two factors: the price and the benefits of using the system in accordance with the customers' expectations. There are two potential customer groups: single persons living at home and nursing homes.

5. Summary and Conclusions

We have presented the current achievements of the ALIAS project that aims to create a robot which serves as a communication platform and provides a variety of services for the elderly users. To achieve this goal, a user-centred design approach involving elderly users in the entire development cycle has been followed. To establish a natural and intuitive human-robot interaction, especially for elderly users, the technical realization of the robot has to take their needs and wishes into account. The interaction between the ALIAS robot and the user relies on different communication channels (touchscreen, natural speech and BCI) whereas the robot has loudspeakers, a screen and autonomous navigation for realizing a proactive interaction. To fulfil its promise, a real communication platform has to provide the user a variety of applications ranging from gaming, web browsing, event search, video-telephony etc. for staying in touch with the wider world. Final project goal is to reach market maturity within two to three years after the project's end.

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