A SOCIAL ASSISTIVE ROBOT IN AN INTELLIGENT ENVIRONMENT

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Abstract: *In the HOBBIT project Ambient Assisted Living (AAL) sensors and actuators establish an intelligent environment within which a socially assistive robot supports old users in daily living. Robot and AAL environment together construct a shared context and benefit from complementing each other for enhancing context awareness and interaction with the user. Scenarios for user interaction were developed and demonstrated in a smart room in order to explore the benefits for the intended user groups.*

Keywords: *AAL, robotics, activity monitoring, socially assistive robots, smart home*

Introduction

The Ambient Assisted Living (AAL) approach also supports the research area of assistive robotics [1], [2]. In the HOBBIT project a robot is developed which assists independently living older persons at their own home. HOBBIT introduces a new concept called "Mutual Care" [3] which is based on the assumption that it is easier for older persons to accept assistance from a robot when in certain situations the user can also assist the robot. The HOBBIT project aims at offering practical and tangible benefits for the user at relatively low cost.

Autonomous Mobile Robot

Figure 1: The HOBBIT robot without (left) and with cover as used during the first user trials (right) [3]

The HOBBIT robot provides autonomous navigation, a manipulator with a gripper and a multi-modal user interface (UI) allowing interaction via speech, gesture and touch screen. The UI provides easy access to information in the web, video phone service, serious games, control of robot functions (e.g. the manipulator), emergency call features and access to the AAL environment in an accessible and consistent way. Additionally a small display on top of the robot presents emotions by expression of eye and mouth.

The autonomous robot as the mobile element of HOBBIT is additionally supplied with information from the intelligent environment in which it is operating in order to establish enriched context awareness and can make use of actuators in the environment to extend its capabilities.

AAL Intelligent Environment

In HOBBIT both (a) existing installations of home automation, health assessment or personal alarms shall be integrated as well as (b) new add-on installations shall be supported for the majority of trial sites. For utmost flexibility a generic open interface is provided. Within the project a typical small scale AAL environment was set up in an AAL laboratory.

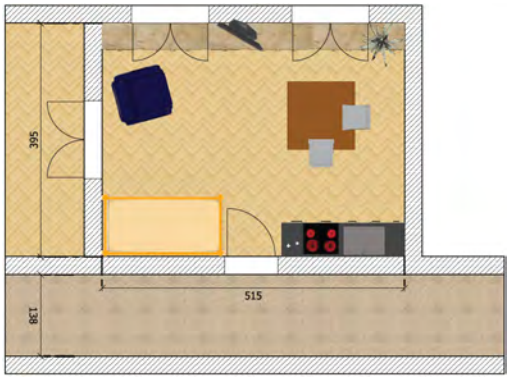

Figure 2: AAL environment with four areas: cooking, eating, living (TV), sleeping (bed) and adjacent rooms

As opposed to other lab environments only a small number of devices is foreseen to keep costs reasonably low while providing the following features:

Presence and activity: AAL sensors allow the HOBBIT system to know if the user is at home and if s/he is currently awake, active or sleeping (in bedroom) and in which room. For HOBBIT this is important background knowledge for many procedures and enriches the "shared context".

Safety at night: AAL sensors can detect that the user is getting up from bed when the light is switched off and switch on the light to prevent falls.

Safety in restroom: When the user goes to the restroom HOBBIT will recognize this and can check if the user stays there for unusual long time [4-6]. The user can then be prompted and if she/he does not react within some time (come out) an emergency call can be started.

Faster search in emergency case: The last known user location allows HOBBIT to begin its search for the user at that place and thus increases the chances to find the user within shorter time.

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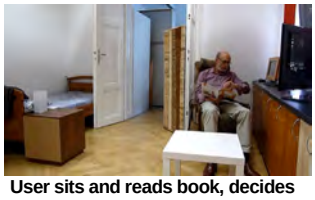
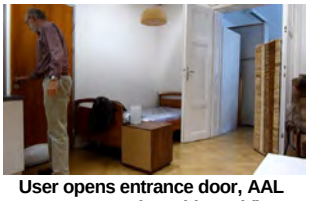


User sits and reads book, decides to leave



User opens entrance door, AAL sensor recognises this and fires

Robot enters room, reminds user, cooker still on (AAL stove sensor)

User turns off cooking plate, User leaves, R. says: "Have a nice day"

Figure 3: Still pictures from video demonstration of the safety / stove reminder scenario in AAL laboratory

Reminders for stove or iron: HOBBIT can remind the user to switch off heat sources after unusual long time or when leaving the flat or do it for the user. Smoke detectors can additionally cause HOBBIT to alert the user.
Reminders for medication or activities: If no kitchen activity, taking medicine, performing health self-checks etc. is detected within defined time spans the user can be prompted to perform such actions. Note that objects like pill boxes can be "smart objects" which are tagged and such can be identified by the HOBBIT arm.
Opening doors: HOBBIT can control door openers to open doors on demand for the user and for itself. This can both, help the robot to enter rooms and prevent situations where the user needs to deal with a walking stick and the door at the same time.
Call buttons: Wireless buttons in fixed places can be used to call HOBBIT to a certain place or small mobile call buttons worn by the user can be used to call HOBBIT to the user by searching the user in the last known room.
Link with personal alarms: HOBBIT can be linked with a personal alarm device (optionally including fall detector) and can go to the user in need of help for a first check and provide remote assistance from a service centre.
Robot localisation: The smart room can optionally assist the robot to know in which place it is or help in fine orientation towards a specific point (sensors or landmarks).
Comfort functions: Besides a general integration of remote control for whatever actuators in the UI HOBBIT can make use of actuators to enrich the scenarios by e.g. controlling light level appropriately when the user wants to be played a video or music or the TV to be switched on, or in the opposite case.
Identification of smart objects: Tagged objects in the environment can be identified which allows distinguishing objects that otherwise would be too similar.
Monitoring of health measurements: HOBBIT can be linked with devices for self-assessment of health status (e.g. blood pressure meters, glucose meters or weight scales), monitor usage and remind to use them regularly.

Preliminary Results and Discussion

A basic implementation of a smart AAL environment was set up (Fig. 2) being equipped with a limited number of moderate cost AAL actuators and sensors (Tab.1). Demo scenarios (Fig.3) showing the robot in the smart environment interacting with a user were developed and recorded for discussion purpose during HOBBIT development. The integration into the second prototype of HOBBIT is ongoing.

Important supports for the robot provided by the AAL environment are (a) location information (helping the robot to find the user quicker by starting its search in the area of last recognised user position), (b) activity and non-activity information and (c) detection of user context and abnormal situations (e.g. getting up, too long stay in rest room [5]). Vice versa the robot (considered as mobile sensor) can deliver activity information (e.g. user touches screen) to the AAL environment.

Table 1: Sensors and actuators installed in AAL laboratory.

Location	(S)ensor / (A)ctuator	Type, technology, manufacturer
Door	S	Contact sensor
Door	S	Presence and activity
Door	A	Door opener (Abotic)
Cooking plate	S & A	Sensor for power consumption and switch (mains)
Kitchen	S	Presence and activity
Bed	S	Presence and activity
Bed	A	Actuator for light
Bed	S	Stationary call button
TV	S	Presence and activity
--	S	Mobile call button (worn by user)

Acknowledgement

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