A First Study on Applications of Social Assistive Robots for Alzheimer’s Disease Patients and Their Caregivers

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ABSTRACT
Robots have begun to assist elders and, in particular, patients suffering dementia. Many works have shown how robots can improve patients’ daily life. But none of these works aims to improve also the caregivers’ quality of life.

The RobAlz project focuses on how social robots can assist Alzheimer’s Disease patients and their caregivers at home. This project is divided in three phases: the definition of the requirements and scenarios, the development of a new robotic platform, and the evaluation. This work presents a resume of the results obtained in the first phase.

In the first phase, several meetings were conducted with a set of multidisciplinary experts in the areas of Alzheimer’s Disease and social robots: members of the Spanish Alzheimer Foundation, psychologists, therapists, professional caregivers, family caregivers, and robotic experts. The meetings were classified according to the application areas they covered: general aspects, safety, entertainment, personal assistance, and stimulation. The meetings ended up with a repertory of scenarios approved by all the experts where robots can be successfully applied to Alzheimer’s patients and their caregivers at their home.

Keywords
alzheimer, social assistive robot, social robot, assistive robot

1. INTRODUCTION
According to [1], nowadays the Alzheimer’s Disease (AD) is the most common cause of dementia. In fact, in the report published in 2012 by the WHO (World Health Organiza-

tion)[5], it was stated that 36.5 millions of persons suffer from dementia in the world, i.e. 0.5% of the total population (data from 2010).

Alzheimer’s Disease is a progressive disease, divided into three stages:

1. Early (Mild): The most noticeable deficit is memory loss, which affects more short-time memory (inability to remember recently learned facts and acquire new information).

2. Moderate: In this stage the patient becomes unable to perform most common activities of daily living.

3. Advanced (Severe): During the final stage of AD, the person is completely dependent upon caregivers.

The majority of the affected people age 65 years or older and they need to be looked after by caregivers. Besides, they mostly prefer to stay at home instead of being at nursery homes [2]. This implies that their caregivers are frequently their family members and, in most cases, this is very stressing for them, physically and emotionally.

Tapus et al. [3] defined Social Assistive Robots (SAR) as robots which main goal is to assist human users through social interaction. This kind of robots has already been used for designing therapies for people with dementia (including AD) [8, 9]. The results of these studies show that some patients improved their cognitive attention, their cortical neurons activity, their feelings and their ability to overcome stress. Moreover, the patients needed less supervision while interacting with the robot and, consequently, their caregivers also reduced their stress levels [9, 7].

In this paper, the authors present a set of scenarios where a SAR can successfully assist AD patients during the mild stage and their caregivers when they are at home.

This work has been developed under the frame of the RobAlz project, where the RoboticsLab, at the Carlos III University
of Madrid (Spain), and FAE (the Spanish Alzheimer Foundation) are involved. The goal of this project is to develop a SAR to be used at the AD patient’s home. Its purpose is not only to assist the patient by carrying out certain tasks, but also the caregiver by facilitating his daily labour and giving him some free time.

This project has been separated into three phases:

1. Definition of the scenarios and the robot requirements.
2. Robot design and construction.
3. Experiments and evaluation with real AD patients and caregivers in their environment.

This paper presents part of the results of the first phase, achieved after several meetings of a team of experts. The meetings were used to discuss different features and tasks of the robot in the fields of security, personal assistance, entertainment and stimulation. Based on them, a set of scenarios where robots can daily support the AD patient and the caregiver were defined.

2. METHOD

As mentioned in Section 1, this paper is focused on the first phase of the RobAlz project. The goal of this phase is to define the aspect, functionality, and interaction system of a new SAR, and the scenarios where it will be applied. In order to do this, a group of experts had several periodic multidisciplinary meetings during five months. Each of the participants contributed with their different insights into how a robot can help the patient and the caregiver. These attendees to the meetings were experts from different areas related to AD and social robots: two members of FAE, two psychologists, two therapists, a professional caregiver, four family caregivers, and six robotic experts from the Carlos III University of Madrid.

This group has been created with the goal of covering a wide variety of backgrounds with different perspectives of the AD patients, their environment, and their everyday life. Then, from the first phase, all these experts have been involved.

The topics addressed in the meetings ranged from the discussion of general aspects and functionalities of the robot to specific tasks. The meetings were classified according to the application areas they covered.

The work methodology was established as follows:

1. Initially, the principal fields of interest, or application areas, were defined: safety, personal assistance, entertainment, and stimulation.
2. The meetings were used as a brain-storming process in which the functionalities and the characteristics of the robot were discussed for each defined field.
3. The robotic experts took these ideas and defined a set of possible usage scenarios of the robot, as well as some general aspects to include in its design.

4. The scenarios were evaluated and approved by the group in a subsequent meeting. The scenarios were reviewed until they were accepted by all the experts.

These features and scenarios will be used as the base to obtain the technical requirements of the robot.

3. SCENARIOS

In this section, the different usage scenarios obtained from the meetings are introduced. Table 1 shows the list of usage scenarios classified according to the application area they belong to. Following, these scenarios are detailed.

3.0.1 Safety

These scenarios are related to the security of the patient.

- **Static Watcher Robot** The objective of this scenario is the surveillance of the patient’s position inside one room of his home by a robot situated in a predefined location. The robot can watch one room at a time, but it can be moved among a set of predefined spots in different places of the house. For example, it can be placed in the bedside table to check if the patient leaves the room during the night. It can also be placed at certain locations to watch some dangerous areas of the house, such as the kitchen (stove, sharp knives, etc.). The caregiver can define these forbidden areas. If the robot detects that the AD patient is in one of them, it tries to persuade the patient with an acoustic message and also warns the caregiver (acoustically or with a call or text message). The acoustic messages are
uttersances to change the current patient's intention. For example, "Don't leave me alone", or "I want you to stay closer to me".

- **Mobile Watcher Robot** This scenario is similar to the previous one but, in this case, the robot can move around the house and keep the patient watched at any time by following him.

- **Interface Robot** In this case the goal is to keep all the house watched by means of home automation services. The robot is used as a friendly interface for the caregiver, who can use it to manage these systems. Different sensors would be placed in all the rooms and hallways of the patient's house to keep him watched. If the patient performs some dangerous activity or approaches a risky area of the house, the robot warns the caregiver.

- **GPS Interface Robot** The robot performs an outdoors tracking of the patient by means of a GPS-based system. The patient should wear a sensor, located in a bracelet or similar, to track him by using GPS data and provide this information to the caregiver. For example, if the patient goes out and takes longer than expected to come back, the robot can give the caregiver the exact location of the patient at that moment.

### 3.0.2 Personal Assistance

The following scenarios describe situations where the robot helps the patient with his daily activities. The caregiver provides in advance all the information required to accomplish these activities (preferences, likes/dislikes, and so on). He is responsible for the supervision so the robot does not have to monitor the activities.

- **Static Location of Objects** The robot keeps a list of the most used objects of the patient (e.g. toothbrush or glasses) and their usual location. Moreover, if the patient asks for any of them, the robot will give indications about its location. These indications are voice information with the aid of images or videos.

- **Mobile Location of Objects** This scenario is similar to the previous one, but in this case a mobile robot goes to the place where the object is located instead of just explaining it.

- **Reassuring Robot when AD Patient is Alone** The job of the robot in this scenario is to keep the patient calmed when he is alone. When the caregiver needs to go out leaving the AD patient alone at home, he can get agitated. In these situations the robot will say calming sentences or will establish a phone or video call with the caregiver. The call can be established upon request of the patient, or automatically when the robot considers necessary.

- **Activity and Major Events Reminder** The robot can be useful for the caregiver by helping to remind the patient of his routine. It will explain him the activity he must carry out at each moment of the day and how to accomplish it if necessary. This can be done giving simple instructions or visual aid, such as images or videos. Examples of these routines can be the different meals or when to take the medicines. Besides, the robot can also remind the patient of important dates or events. This can be complemented with pictures of the person or thing involved in the event; e.g. the robot says "Today is the birthday of Teresa, your daughter" while showing a picture of Teresa in a screen.

- **Locate the Patients themselves** Some patients frequently get disoriented and ask about their current location. This could be indicated by the robot with simple explanations. For example, the robot could say: "you are in Madrid, at your house in Castellana street", or even refer to the room where they are located.

- **Make Simple Decisions** AD patients can get anxious or nervous when they have to make decisions on how to perform daily activities. For example, if it is difficult for them to decide what to wear; in this situation the robot may help him with suggestions based on the weather forecast by voice and images.

- **Answer Frequent Questions** AD patients often ask the same questions several times during the day, like "what time is it?", or "what day is today?". For his caregiver, it can be a burden to answer all the times with the same reply. In this case, the robot can be in charge of answering these frequent questions.

### 3.0.3 Entertainment

The idea of these scenarios is that the robot has a collection of enjoyable activities tailored for each AD patient. As already stated, this customization is performed with the help of the caregiver or relatives, who provides information about the patient’s life. Then, in its daily use, the caregiver can program the robot for a period of time combining these activities in order to keep the patient entertained.

- **Story-Telling** In this scenario, the robot has a collection of stories, curiosities, anecdotes, poems, facts or events of the patient’s life, that he likes. The caregiver can choose some of them to keep the patient entertained during a period of time (a first approach of this idea was presented in [6]). The robot can keep a dynamic record of the patient’s favorite stories, to adapt to his preferences in the future.

- **Active Listening** The goal of this scenario is that the robot performs an active listening by making the AD patient talk about his favorite topics. The robot can have a set of predefined topics it can ask the patient about (e.g. stories about his life, relatives, work, or hobbies). The robot can start the conversation with predefined sentences and then detect when the patient stops talking and invite him to talk more, using some conversational fillers such as "right?", or "tell me more about that". Gestures and expressions can create the impression that the robot understands and listens to the patient.

- **Conversation between the Patient and the Robot** The objective of this scenario is that the robot and the
AD patient can hold a natural conversation in which the robot “understands” what the patient says and reacts accordingly (similar to a chatbot).

- **Games** In this scenario, the robot entertains the patient by playing with him to different voice games, depending on the patient’s preferences. The games can range from general (e.g. guessing a character [4]) to personal ones (recognizing objects of the patient’s environment, or photos of close relatives).

- **Newscaster Robot** In this scenario the robot tells the AD patient the latest news about his favorite topics: sports, culture, weather, etc. The robot can take an Internet feed and provides the news by voice or even show them visually in a screen depending on the patient’s preferences.

- **Multimedia Player** The robot entertains the patient with different multimedia content: TV shows, radio programs, personal photos, patient’s favorite music, historical or religious events, or even home-made videos (e.g. birthdays of the family, or weddings). The contents can be thus obtained locally or from the Internet, permitting to the patient watch his favorite programs, independently of when they are broadcasted.

- **Affective Engagement** The goal of this scenario is to make the AD patient feel needed and loved by a robot which requires his attention. For example, the robot needs to be fed, makes compliments to the patient, or likes to be caressed. In this scenario, the robot should inspire tenderness in order to create an affective bond with the user, like a pet. Therefore, for this specific application its appearance prevails over other constrains.

### 3.0.4 Stimulation

During this first phase of the project, this area of research was not completely developed. This requires further study by specialists in this area, and an accurate record of the activities and the evolution of the patient. In the future, specialists in AD patient stimulation will join the group of experts in order to perform a deeper study in this area.

### 4. CONCLUSIONS

In this paper we have presented a wide set of usage scenarios for a SAR specially developed for AD patients and their caregivers. These scenarios are the result of several meetings of experts, contributing with their knowledge and experiences. It is important to remark that these scenarios have been approved by all the experts involved because they believe that can contribute to improve the AD patient’s and his caregiver’s quality of life at home.

The satisfactory implementation of these scenarios will arise several questions and modifications. All these questions will be answered just by empirical tests in the third phase of the RobAlz project, after the new SAR is designed and built (second phase).

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### 6. REFERENCES


