Evaluation of a Telepresence Robot for the Elderly.
A Spanish Experience

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Abstract. This paper copes with the evaluation of a robotic telepresence application for the elderly. It presents the experiences on using the Giraff telepresence robot within three real testsites in Spain for more than a year. Results from this evaluation are the basis for future improvements of this technology which very likely will find a field of application in the enhancement of the quality of life of the elderly. This work is framed in the AAL European Joint Programme..

Keywords: Quality of Life Technologies, Robotic Telepresence, Elder Telecare.

1   Introduction

Recent technological advances open uncountable possibilities to improve the quality of life of users, especially those with emotional, physical and/or cognitive impairments. A particular segment of the society that claims a major attention is the elderly, given their dependence and risk of social isolation. In this light, the *Quality of Life Technologies* (QoLTs) concept has emerged to reify the application of different engineering disciplines like computer sciences, robotics, and others to productively improve the daily life of people.

A significant application of the QoLTs is the so-called *robotic telepresence*. Robotic telepresence refers to a combination of technologies that enables a person to be virtually present and to interact in a remote place by means of a robot. Shortly, a person, called *secondary user*, embodies a mobile robot, that is, s/he takes the full control of the robot which physically interacts with the person receiving the service, called *primary user* (see figure 1). The result is that the primary user identifies the robot as the person who is behind (embodied) and establishes a social relation as s/he was actually in the place. A typical scenario where robotic telepresence contributes in the improvement of the quality of life of the elderly is its use by healthcare personnel to regularly visit patients in order to check their general health and mental state.
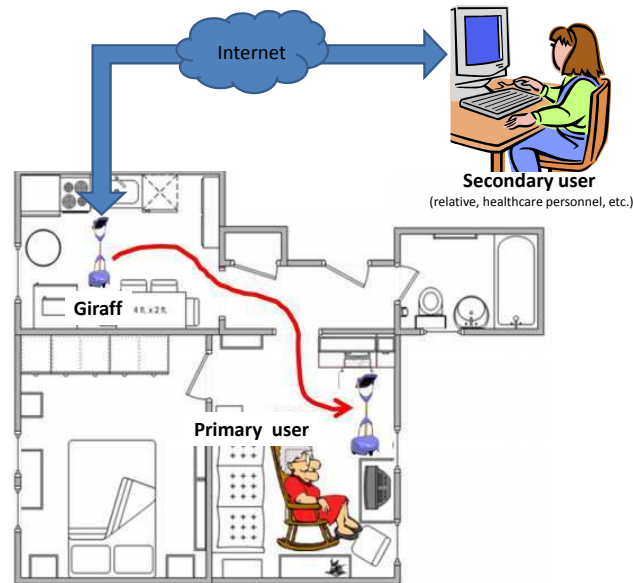
Fig. 1. Actors in a robotic telepresence application. The secondary user, a relative or healthcare personnel, remotely drives the robot deployed in the primary user's apartment and interacts with her through videoconferencing.

Robotics in general has striven for the development of assistant robots [13], and concretely in the last years, robotic telepresence, has received great attention from the community, especially applied to the social interaction and assistance of the elderly. Some examples are the Telepresence Robot for Interpersonal Communication (TRIC) [11], Telerobot [10], TeCaRob [12], Mebot [9], etc.

Under this perspective, robotic telepresence is a promising tool that strives for motivating social communication with relatives and friends, helping in mitigating the loneliness of the elderly population, and thus, contributing to improve their quality of life.

A clear example of the concern on developing QoLT is the Ambient Assisted Living (AAL) Joint Programme, an initiative promoted and funded by several AAL Partner States and the European Commission [7]. Under this programme, the work presented here is developed within the project ExCITE (Enabling Social Interaction Through Embodiment) [6]. The main objective of this project is the evaluation of the user requirements of social interaction that enables embodiment through robotic telepresence. For that, prototypes of a telepresence robot called *Giraff* (see figure 2a) are deployed at the elders' homes, enabling relatives and healthcare personnel to interact with the primary users.

The ExCITE project comes up as an answer to the new generation of senior citizen who are expected to be an active and productive part of the society long after their retirement. The proposed solution considers the robotic telepresence

as a manner to improve their quality of life and social interaction. The ExCITE project addresses a Pan-European scale study on the elderly acceptance of this technology. The study has been carried out in a number of test sites in Sweden, Italy, and Spain in collaboration with healthcare centers, municipalities and research organizations. In this paper we present the experiences and the evaluation of the use of the Giraff robot in a number of test sites in Spain.

The structure of the paper is as follows. Section 2 describes the Giraff telepresence robot. In section 3 the three testsites considered in this evaluation are presented. The general experience and the results of the evaluation is presented in section 4. Finally, conclusions and future work are outlined.

2   The Giraff telepresence robot

The Giraff robot, or simply Giraff, is a telepresence robot developed by the Giraff AB company [8]. It consists of a motorized wheeled platform endowed with a videoconferencing set, including camera, microphone, speaker and screen. Giraff permits a virtual visitor to move around, perceive the environment (audio and video), and chat with the primary user. The height of Giraff, the streaming of the visitor camera on the screen, and the possibility of tilting the Giraff's head help in establishing a friendly interaction with the user who can really experience that the visitor is at home.

a)   b)

Fig. 2. a) The Giraff telepresence robot. b) The Giraff Pilot application. The secondary user drives Giraff by simply clicking on the image.

From a technical point of view, Giraff relies on a low-cost, commercial computer onboard. The batteries of Giraff last, approximately, two hours and are charged by docking the robot at a station plugged to a normal wall socket of the house.

The Giraff manufacturer (Giraff Technologies AB) provides a software application, called the Giraff *Pilot*, to easily teleoperate the system. Pilot is essentially a graphical interface for driving the robot and controlling the standard videoconference options, i.e., to initiate/hang-up a call, to adjust the speaker and microphone volume, etc. (see figure 2b). At the Giraff side, a program is continually running, accepting calls and providing the necessary functionality for videoconferencing and motion commands. All the actions needed from the elder to handle Giraff can be very easily accomplished with a remote controller. Thus, one of the major advantages of the Giraff telepresence robot is that neither the user nor the visitor need any technological skill to use it, and they both can manage the system (Pilot and Giraff) in an intuitive and natural way.

3 Testsites

Within the context of the ExCITE project, one of the main objectives is to assess the reliability and usefulness of the Giraff telepresence robotic platform as a mean to support elderly and to foster their social interaction.

Rather than testing the system in laboratory setting, the robotic platform is placed in a real context of use. This approach is in line with several research that highlights how systems that work well in the lab are often less successful in real world environments [4]. The evaluation of robots made in a laboratory environment, even though useful, does not favor the emergence of robotic aid suitability to support elders who are able to stay in their own homes. For this reason an essential step is to assess the technology in the specific contexts in which the technology is supposed to be used [5].

Our field evaluation of Giraff is being carried out in three testsites in Spain. Participants were selected by the research team, upon personal interviews with the candidates. The selection criteria took into consideration their interest and motivation, technical and practical requirements of the house, but more importantly it considered their social and healthcare needs. As a result of this process, two women and a man from the province of Malaga (Spain) were selected. They all three are widowers, with ages from 65 to 80, living alone with different grades of dependency. Next, a detailed description of each test site is presented.

3.1 Testsite #1

Testsite #1, localized in the city of Malaga, started in May, 2011. The user is a 65 years old widow lady who lives with one of her sons, though spends a lot of time alone. Though she tries to be occupied in activities organized by the municipality, she misses more personal relations: she only meets some relatives from time to time, and communicates with them by phone on a weekly basis. She

is not a technological user, that is, she does not use computers at all, and is not familiarized with videoconferencing either. The main motivation of this person is to be connected to some of their relatives in a warmer and richer manner than a mere phone call.

A specific aim of this testsite is to evaluate the acceptance of a telepresence robot as a companion and communication solution for an active user with an acceptable health and mental state.

The particular layout of this testsite is shown in figure 3. The docking station is placed in the livingroom, where the user spends most of the time, from where visitors can drive Giraff up to the kitchen.

a)   b)
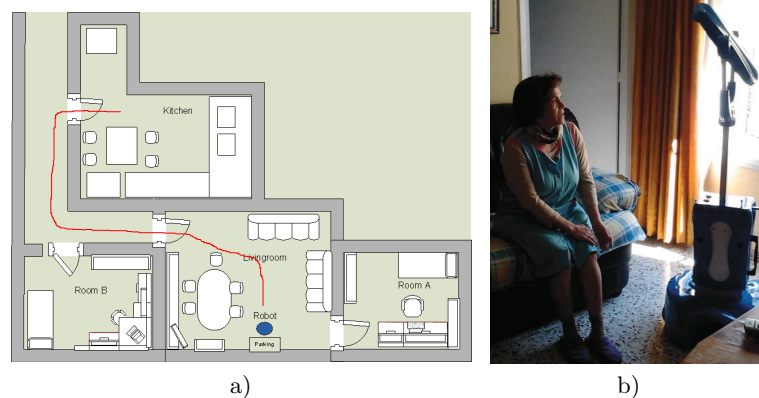
Fig. 3. Testsite #1. a) Apartment layout of the rooms covered by the wifi network. The small circle indicates the robot docked at the recharging station. The red trajectory shows the path followed by Giraff in the experience filmed in [2]. b) The elder communicating with a relative.

3.2 Testsite #2

This testsite started on November, 2011 in Estepona (Malaga). The primary user is a 80 years old widower who lives alone at home (see figure 4). He is self-sufficient but needs on-site attention by professional health providers, in order to check the evolution of their mental abilities, reviewing the medication, monitoring the blood pressure, temperature, blood sugar level, etc.

In this case, secondary users are, apart from relatives and friends, the professional team of a health center in Estepona, within the Andalusian Public Health Service ("Distrito Sanitario Costa del Sol - Servicio Andaluz de Salud").

3.3 Testsite #3

This testsite started on January, 2012 in Coín (Malaga) with a 77 years old widow as primary user (see figure 5). Since she is confined in a wheelchair, she
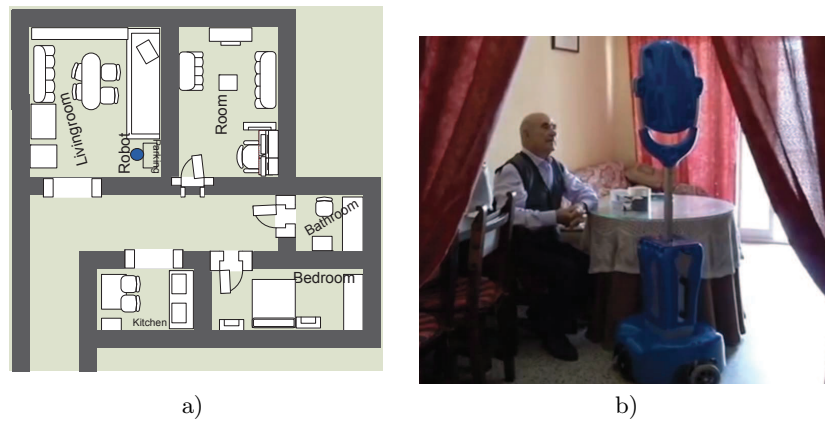
a)   b)

Fig. 4. Testsite #2. a) Apartment layout. b) A doctor visits the elder and chats about his medication.

is not self-sufficient and needs a caregiver at home 24 hours a day, who does the daily chores and assists her. The main motivation of this person to experience the Giraff telepresence robot is to have a closer contact with her relatives through the Giraff, especially with her sons and grandchildren who live in other cities. The user has not notions of computers and technology whatsoever.

a)   b)
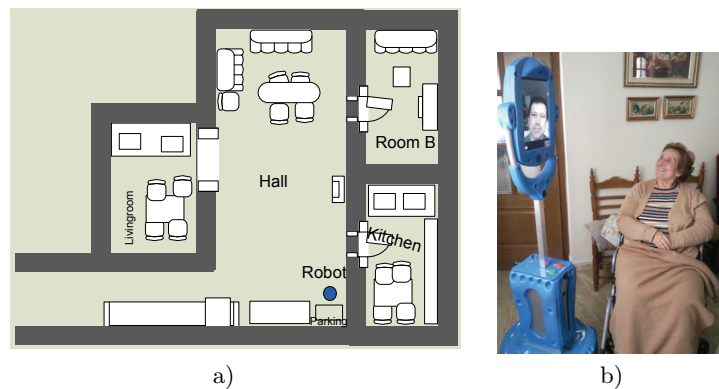
Fig. 5. Testsite #3. a) Apartment layout. b) The elder receives the visit of a relative.

4 Evaluation and Experiences

Setting up a testsite involves configuring, at the elderly's home, a pack composed by the Giraff robot, the recharging station, and a remote controller. An obvious,

mandatory requirement is the existence of a wifi network with a minimum bandwidth of 6Mb of download speed and 1Mb for uploading. From our experience, we have found that this might be a limitation, at least in Spain where many elder people have not wifi connection at home. In the case of secondary users they only have to install the Pilot software and run it in a computer with internet connection. Given that privacy is a paramount issue in this type of applications, the secondary user has to be approved to get access to a particular robot as well as to sign in the system with a given credential at every connection.

In order to collect useful feedback of the Giraff telepresence experience from the considered testsites described above we have regularly conducted personal interviews and questionnaires with both, primary and secondary users. They were inquired about suggestions for enhancements in both technical and human-machine interaction features.

4.1 Primary users

Primary users were asked about their feelings on having a robot at home as a communication mean, as well as about particular problems or inconveniences they have experienced. Results from our evaluations yield a positive view in general. They expressed the technology is easy and valuable, opening for them a new communication channel more interactive and appealing than traditional phone calls. Regarding the acceptance of a robot at home, they consider it as a new appliance that provides a service; the telepresence awareness is enough for them to really "feel" the robot as the person the robot is embodying, especially during long calls.

After our evaluation, the main drawbacks and concerns that primary users find in this technology are:

- The risk of losing the real contact with their relatives could delegate in telepresence instead of physically visiting them.
- Concerns on the electrical consumption of Giraff. The users were worried about this issue, although the normal power consumption of Giraff is reduced, around 100 W. when charging.
- The noise that Giraff robot produces. Internal fans of the robot produces the normal noise of a computer which can be annoying for some people, especially during the night.
- The size of Giraff and the need of placing the docking station in a wide and clear area. This is an inconvenience in small and cluttered houses.
- Impossibility of knowing the caller identity before answering the call.

4.2 Secondary users

From the secondary-users' point of view, the experience is gratifying in the sense that relatives who live far away from primary users can have the feeling of being in some way closer to them. That could relieve the guilty feeling of not putting

enough attention to the elder person, who is living alone. That is particularly important in Spanish and other Mediterranean cultures/societies, where the care of elderly has traditionally been assumed by the family. On the other hand, some of the secondary-users remark a guilty feeling because of the (partial) substitution of real visits for telepresence communication. From the technical side, a frequent complain is related to the quality of the connection which sometimes hinders a fluid communication.

Regarding the ease-of-use of the Giraff robot a number of tests have been conducted with 15 secondary users who have evaluated different aspects of their driving experiences in a scale from 1, (difficult), to 5, (easy). The average scores are shown in the table 1. Note that although the general impressions are positively assessed, most of the secondary users found problems when parking the robot, that is, attaching it to the docking station once the communication has finished. A solution to this issue has been already reported in [1].

Issue	Evaluation
First general impression	4.25
General driving experience	4
General appearance of the interface	4.25
Learning curve	4.75
Moving in straight line	4
Turning	3.75
Parking into the docking station	3.3

Table 1. Secondary users evaluation. Parking the robot after a visit has been reported as an unpleasant and sometimes annoying task.

4.3 Utilization

During the evaluation presented in this paper, visits' logs have been gathered though a web service provided by Giraff AB. Figure 6 shows the evolution on the utilization of the telepresence robot for each testsite. Notice that at the beginning of the experience the number of received calls and the total duration is higher than in the rest of the period. This is due to the number of testing calls during the setup and also to the initial interest of secondary users to try the technology. As the experience is no longer a something new, the relatives confessed that they sometimes prefer to communicate with the elder via phone rather than turning on the computer and connect to Giraff, and, in contrast, healthcare personnel preferred to maintain telepresence as it is a much better tool for assessment and monitoring health status. Also note the presence of errors in the communication, especially in the case of the testsite #3 (see figure 6c)). These errors, mostly due to problems with the internet connection, have a discouraging effect both for primary and secondary users. Additionally, notice an abrupt decrease in the number of calls and duration during holidays, e.g., around July and August.
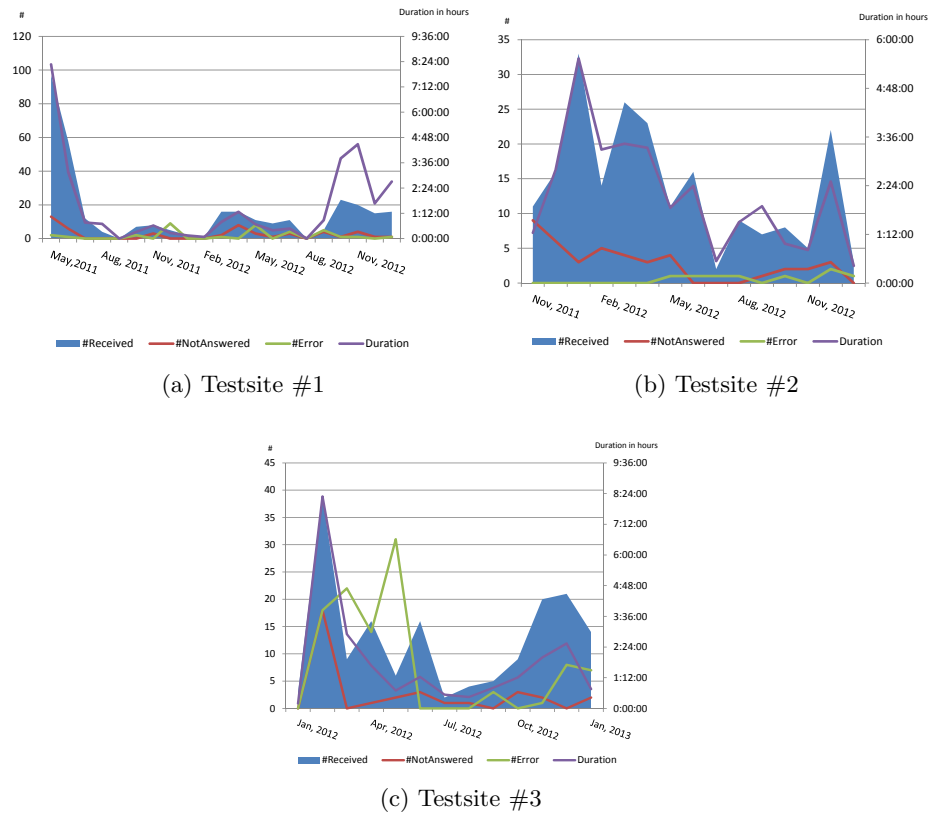
(a) Testsite #1

(b) Testsite #2

(c) Testsite #3

Fig. 6. Evolution of the utilization of telepresence for each testsite in terms of number of received, non-answered, and erroneous calls, and duration of effective communication.

5 Conclusions and discussion

In this paper we have presented an evaluation of the use of a telepresence robot for the elderly. The work presented here, framed in the ExCITE project, illustrates the experiences on three testsites in Spain with different profiles for the primary users, i.e. elders. The testsites, still running, span for almost a year the shortest to more than a year and a half, the longest. The evaluation carried out on them relies on questionnaires and interviews, and has proven the suitability of this technology for improving the quality of life of the elder population, though, of course, there are a number of issues to be addressed in order to make it even more acceptable.

Because of the social relevance of this promising technology, the experiences carried out within this work have caught the attention of the Spanish mass media. Apart from a number of press news, some tv programs have broadcasted this research. Some examples can be found in [2] where the testsite #1 was

presented, and in [3] where the testsite #2 was filmed, including, in both, a telepresence connection of a doctor.

Acknowledgements

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