Assistance and telepresence robots: a solution for elderly people

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Abstract— **This paper presents a study of using telepresence and assistance robots in caring for elderly people. We have presented the requirements for these types of robots and possible application fields. Few models of robots will be presented, analyzing technical requirements of assistance robots and their applications. Hereinafter is presented a robot model being under design and development.**

Key words **—elderly, robots, assistance robot.**

I. INTRODUCTION

The number of elderly citizens is growing considerably and expected to grow even more over the coming decades throughout the entire industrialized world. It was estimated that now, one from nine people are 60 or older, that means 810 million people, and this number will increase to one in five by 2050, so more than 2 billion (Fig.1). The report of UN request governments to concentrate their efforts to protect the elderly and ensure they can age with good health and dignity.

The increase of the elderly population along with increased of costs pose extreme challenges that include projects that explore the applicability of technological advances like intelligent systems that enable elderly people to live independently.

Elderly citizens would need less human assistance or need human assistance at a much later stage in their aging process. The project is simply motivated by the desire to make our old age more comfortable. The use of intelligent technology for elderly addresses their needs in three fields: physical, cognitive and socially. The physical needs are met with solutions like intelligent wheelchairs, walking aids, exoskeletons and robotic butlers. The cognitive needs are addressed with monitoring systems and adaptive reminder devices.

The numerous projects mark the beginning of assistive technology that will become a part of the lives of aging citizens. This specific technology that is, due to its easiness of use and very suitable to be applied to this specific context: assistive social robots.

We can thus conclude that for assistive technology in general, robots have a high potential to play a role in eldercare in the near future, by improving the quality of eldercare, providing services that are beyond human staff capabilities.

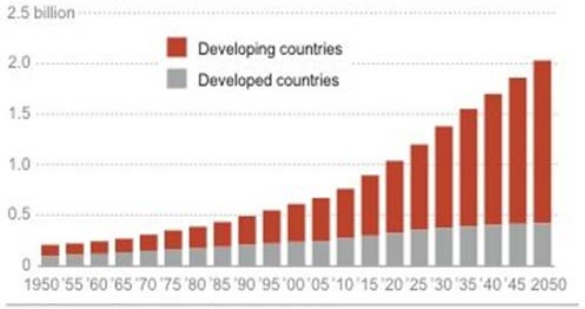

Fig.1. Global rise in aging population (Source: United Nation Population Fund)

Older adults have to be willing to actually use this type of technology: robots have to be accepted. Several research projects concerning assistive technologies show that a large category of elders may be open to assistive technologies. The acceptance of technology still remains a delicate subject.

Social robots description was made by Fong et al. in [9]: *social robots are those that people apply a social model to in order to interact with and understand*.

II. ASSISTIVE ROBOTS

An assistive robot has to have certain characteristics [2]:

- Express and/or perceive emotions (emotions can be expressed by facial expressions, by sounds or by speech - they can be perceived for example by analysis of facial expressions or sounds).
- Communicate with high level dialogue (e.g. the abilities to ask questions and to use dialogue to solve problems mutually).
- Learn/recognize models of other agents.
- Establish/maintain social relationships.
- Use natural cues (e.g. gaze, gestures).
- Exhibit distinctive personality and character.
- May learn/develop social competencies

This list contains characteristics that can be made operational by implementing social abilities in robots.

Assistive robots can be divided into two subcategories: they can either be non social robots or social robots. The first type concerns physical assistive technology that is for example developed for rehabilitation and that is not in any way socially interactive. The second type of assistive

robots is socially interactive. These robots are systems that can be perceived as social entities that communicate with the user or are communicated with by the user as such (including touching and sensing).

Assistive social robots can also be divided in two subcategories. First, there are robots that we will refer to as service robots. They are used as functional devices and are not primarily designed for social support.

Functionalities are related to the support of independent living by supporting basic activities (eating, bathing, toileting and getting dressed) and mobility (including navigation), providing household maintenance, monitoring of those who need continuous attention and maintaining safety.

A second type of assistive social robots used in eldercare, are the so called companion robots: they provide pet-like companionship which is possibly beneficial to the health and wellbeing of elderly users, but they do not provide functional assistance.

These two types are not exclusive, for many robots can hardly be categorized strictly in either one of these two groups.

In addition, to be accepted by elderly users it could be helpful for an assistive robot to have some social abilities that would be typical for companion robots. In Fig.2 we present a possible classification of robots and robotic devices.

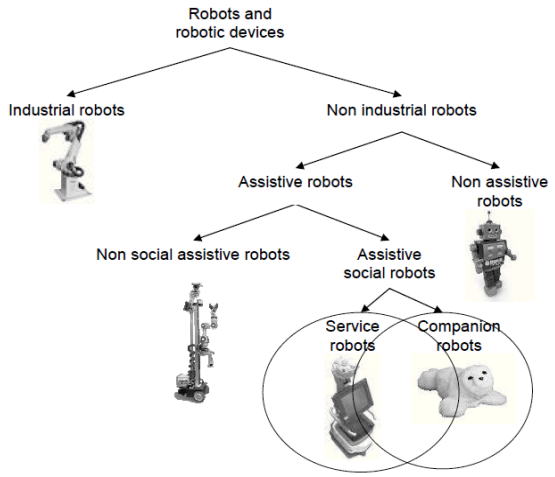

Fig.2. The classification of robots and robotic devices [2].

III. ASSISTIVE SOCIAL ROBOTS

Assistive social robots are the robots capable of exhibiting natural behavior, moving and acting autonomously, interact with users and communicate in a social and adaptive manner.

Assistive social robots have the potential to enhance the quality of life for wide range of elderly and users with cognitive disabilities or physical impairments and those in rehabilitation therapy [1].

The principle application domains of assistive social robots which have been identified are [1]:

1) Care of the Elderly

The ageing population needs physical and cognitive assistance but already the space and staff deficit at care facilities are already an issue today. The grow of elderly population needs a great deal of attention and research dedicated to assistive systems, facilitating living independently in one's own home as long as possible.

Therefore, assistive robotic systems for the elderly require more natural communication methods such as speech or gestures to be capable of assisting with daily activities as dressing, feeding or moving independently.

2) Care of Individuals with Physical Impairments, in Convalescent Care and Training Needs

Assistive social robots technology has the potential to offer new ways for monitoring, motivating, and coaching because, motivation is one of the most significant challenges in rehabilitation and training. One of the largest potential application domains is the post-stroke rehabilitation, being well known that stroke is a dominant cause of severe disability in the growing ageing population.

3) Care of Individuals with Cognitive Disorders

Individuals with cognitive disabilities, developmental and social disorders benefit from assistive robot in the contexts of special education, therapy, and training. Autism Spectrum Disorder (ASD) is one of the areas where socially assistive research has focused. The response of children with autism to robots has demonstrated. The robots generate a high degree of motivation and engagement in subjects, including subjects who doesn't like or doesn't will to interact socially with human therapists. Assistive robots offer a unique opportunity for quantifying social behavior.

This three application domains constitute today the largest potential beneficiary populations for the socially assistive robots. It is expected that other uses and benefits of the technology will continue to emerge as the field grows.

The researchers in the field of assistive social robots propose to organize the challenges around six research topics: embodiment, personality, empathy, engagement, adaptation, and transfer [1].

IV. OVERVIEW OF TELEPRESENCE AND ASSISTIVE ROBOTS

"The Boss Is Robotic, and Rolling Up Behind You", this is the motto of the developed robots in our days. The new researches are made of many companies over the entired world. As we say in above, a new challenge for majority countries of the world is to take care for elderly peoples, according with the rapidly increase of this populations and their needs.

Telepresence and assistive robots are a possible solution and it must accord with the principles above presented.

Lots of solutions to solve the requirements of these types of robots are developed, but majority of this, technically are the same base architecture (Fig.3).

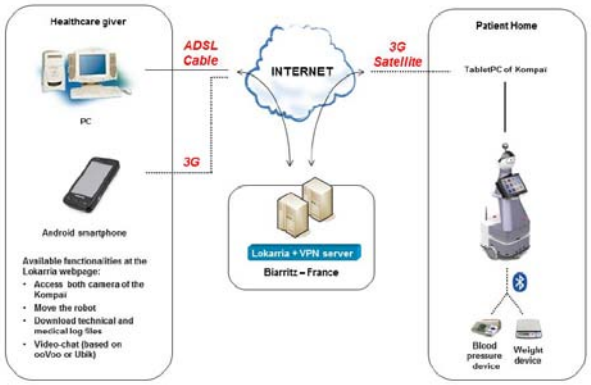

Fig.3. Typically architecture for telepresence and assistive robots [9]

This typically architecture can be found in majority of robots that are produced. It include two main parts: one named ”healthcare giver” which can use an android smartphone or a PC, and one named ”Patient Home” which can be a mobile robot. These two parts of the system communicate via internet.

Some types of assistive and telepresence robots and few of their technical and economic characteristics are presented in Fig.4 [4].

From Left: AnyBots QB, RoboDynamics TiLR, Gostai Jazz Connect, Mantaro's Mantaro Bot, and VGo

Bot:	QB	TiLR	Jazz Connect	Mantaro Bot	VGo
Manufacturer:	AnyBots	RoboDynamics	Gostai	Mantaro	VGo
Availability Date:	March 2011	Summer 2008	January 2011	March 2011	November 2010
Price Tag & Per Month Charges if any:	$15,000 / $0	$10,000 /$0-$100/mo/user	$11,000 / $0	$3,500 / $0	$5,995 / $100
Height & Weight:	Height Adjusts: 30-74" 35 lbs	42" and 48" 60lbs	40" / 18lbs	63" / 40 lbs 15.5" x 15.5" footprint	48" tall, 13"x15" footprint / 18 lbs
Top Speed:	5.13 feet/sec	3.5 feet/sec	3.65 feet/sec	2.05 feet/sec	2.5 feet/sec
Video Resolution:	640 x 480, 30fps full-duplex	Up to 640x480p at 25fps	Up to 720p	640 x 480	
Bandwidth Required:	600 kbps (SD) to 3 Mbps (HD)	85kbps (min) 500kbps (rec)	480Kbps up & down recommended	1Mbps	768K up and down (connections are typically about 400K, still functions as low as 100K)

Fig.4. Types of assistive and telepresence robots [4]

The above presented robots are available since 2008 - TiLR produced by RoboDynamics, 2010 - VGo produced by VGo Company and 2011 - QB produced by AnyBots, Montaro Bot produced by Montaro and Jazz Connect produced by Gostai.

The price of the robots and their height and weight are closely related with the requirements of these.

The robots from iRobot and InTouch Health companies presented in Fig.5, allows physicians to perform real-time consults with the patients and other physicians or healthcare providers using secure control station interface.

Fig.5. Assistive robots produced by iRobot and InTouch Health companies [6]

These companies provide clinical software applications and collaboration tools that easily integrate with and improve the efficiency of hospital workflow processes to improve clinical performance and enhance profitability.

The world's most advanced and easy-to-use remote presence robots are created by these companies. These robots are capable of coordinating and assisting with team care in a wide range of clinically demanding environments. These platforms are capable of achieving multiple high-value patient care objectives today.

Another indoor mobile platform used as a generic platform and designed to ease the development of advanced robotics solutions, are robuMATE/Kompai.

The robot, presented in Fig.6, can be used by two kinds of people.

- The persons who must be assisted, in this case they will use the voice or tactile control of the HMI on tablet PC.
- The operators for telepresence and doubt relevant that uses a web interface called Lokarria.

Fig.6. Indoor mobile platform robuMATE/Kompaï [9]

In case of assisted persons, there is an access graphic interface to control the robot, presented in Fig.7.

Fig. 7. Main menu of robuMATE graphic interface [9]

This graphic interface present nine simple functionalities provided by robuMATE/Kompai to help people into the daily life. Informative data like battery level and internet connectivity and two button related to speech interaction control are also available.

V. TECHNICAL REQUIREMENTS OF ASSISTIVE ROBOTS

Technical requirements of the different types of assistive robots contain two parts: hardware and software specifications.

Hardware specifications contain requirements related to: Head options, Computer, MCU and Motor Controller, Drive motors, Tablet Holder, Infrared Obstacle Detection, Battery, Optional Accessories.

Software specification covers the requirements of remote users, such as: the type of operating system, internet connections, control application.

An example of hardware design is presented in Fig.8.

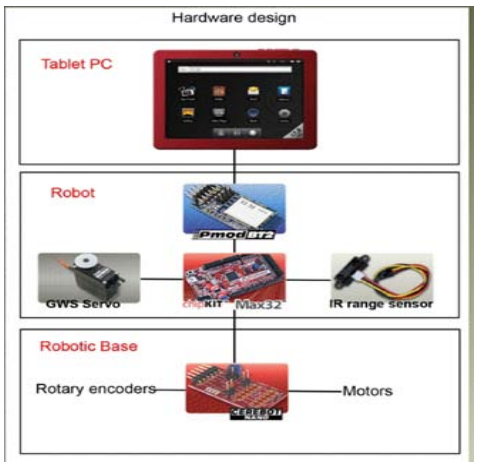

Fig.8. Hardware design for an assistive robot [10]

Description of some basic requirements:

- Capability to communicate using prerecorded or synthesized voice messages;
- Follow-me function using IR modules;
- High-low temperature warning;
- Daily program assistance: reminder for taking drugs, drinking water;
- Verifying and check the need for an emergency call in case of failure;
- Sensors: ambient sensors, temperature sensor, gas detector, motion sensor;
- Telepresence system: video camera, AV streaming;

Some examples of messages:

- Did you fall? (triggered by acceleration sensor in the bracelet)
- If not, please press the button ... otherwise I'll get help (repeated 3 times, if not canceled, the call is made).
- You feel good (bad)?
- You want to call someone?
- Do you want to listen some music?
- It is ... (time) you must take the pills (Repeated until the bracelet with a RFID is identified by the robot having a RFID reader)
- You need to drink water! (Idem as above).

VI. CONCLUSIONS

- A new generation of robots make it possible to be in effect, in two places at once
- From anywhere with a computer and a Wi-Fi connection the operator can use the robot to hear, talk, see and be seen and move around a workplace far away
- The new assistive robots generation offers a wide range of robots
- The robots range differ in size, features and price according to the application
- The benefits of telemedicine, electronic healthcare records and other healthcare benefits depend of assistive robots.

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