Chapter 7
Artificial Humanoid for the Elderly People

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Abstract While frailty and other multi-scale factors have to be correlated during a geriatric assessment, few prototype robots have already been developed in order to measure and provide real-time information, concerning elderly daily activities. Cognitive impairment and alterations on daily functions should be immediate recognized from caregivers, in order to be prevented and probably treated. In this chapter we recognize the necessity of artificial robots during the personal service of the elderly population, not only as a mobile laboratory-geriatrician, but mainly as a socialized digital humanoid able to develop social behavior and activate memories and emotions.

Keywords Assistive interactive robots • Elderly • Frailty • Geriatrics • Caregivers • Nursing homes • BioArt • MEMS • Artificial intelligence • Weak quantum theory

7.1 Introduction

According to the World Health Organization, worldwide more than 35 million people live with dementia. This number is expected to double by 2030 and more than triple by 2050. Dementia affects people in all countries, with more than half (58 %) living in low- and middle-income countries. By 2050, this is likely to rise to more than 70 %. Additionally in the same report, by taking into consideration the financial component of this growth, treating and caring for people with dementia currently costs the world more than US $600 billion per year. This includes the cost of providing health and social care as well as the reduction or loss of income of people with dementia and their caregivers [1]. In the knowledge of the great economic depression of nowadays, there are a few announced projects and

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collaborative programs on Active and Healthy Ageing worldwide, like the European Innovation Partnership 2020, in order to improve the sustainability and efficiency of social and health care systems and boost citizens and markets to respond and win to the ageing challenge. While prevention, screening and early diagnosis is the key access for the healthy growth, many IT multidisciplinary applications have been already used for care and cure of the elderly; that is, neuroinformatics can play a pivotal role in human brain research leading to innovations in neuroscience, informatics and treatment of brain disorders [2].

Assistive technologies like e-care systems, proactive service systems, household interactive robots for pathophysiological testing and entertainment, as well as surveillance systems are already been used collaboratively with nursing staff and family members to form a life support network for older persons by offering emotional and physical relief [3–5].

In this chapter we study the use of assistive robots in elderly healthcare and provide some aspects for the theoretical framework, of the under construction "Geroid" (Fig. 7.1), a complex artificial humanoid for medical assistant and bidirectional communication. We describe the main features and its ability to serve alone in elderly's homes or in nursing houses, offering integrated geriatric evaluation of certain frailty's symptoms or produce psychological or emotional stimuli to the elderly.

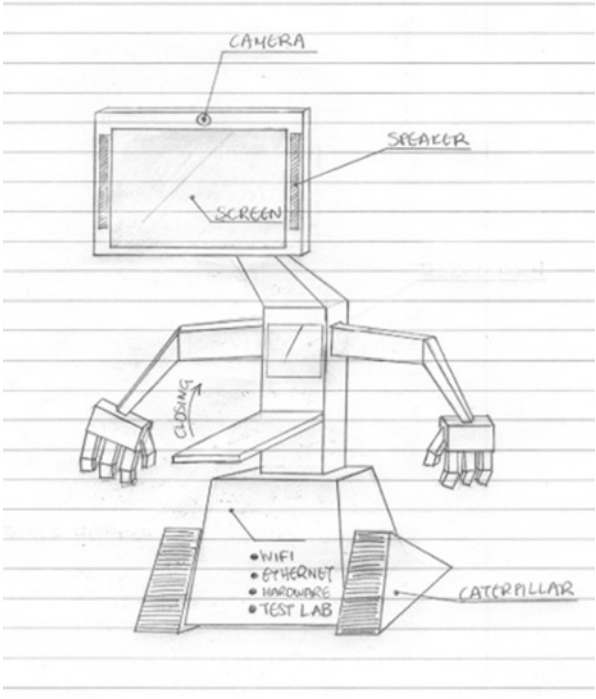

Fig. 7.1 "Geroid" (a blueprint 2014, courtesy of Alexiou A., Simos M., Simou P.)

With a short review, assistive robots for older persons can be categorized into rehabilitation robots and socially assistive robots [6, 7]. On the one hand rehabilitation robots provide physical assistance (artificial limbs, exoskeletons, smart wheelchairs, etc.) and the other socially assistive robots can either be companion-type robots or service-type robots [8]. While a few numbers of sociable oriented robots have been already produced and studied in elderly daily functions [9, 10], mostly satisfying the three basic rules of caregiving such as entertainment, security, and healthcare, obviously there is still a lot of issues to be addressed while the geriatric clinical medicine through frailty's symptomatic recognition is continuously evolving. Obviously interaction companions are clearly better than silence [11], but this is not enough, while good robotic behavioral design should be human centered, focusing upon understanding and satisfying the needs of the people who actually use the product [12].

7.2 Human Superiority and Ethical Decisions

The converging of science and technology has to serve humans, under the condition that humans serve always humanitarian ideas and principles [13]. According to humanism, human beings have the right and responsibility to give meaning and shape to their own lives, building a more humane society through an ethical orientation and free inquiry. The moral person guided from his evolving social behavior can easily comprehend and be committed to laws and principles that a scientific field, such as artificial intelligence (AI) set as a precondition, in order to improve the structural elements of human's biological existence [14].

A highly significant difference between human and humanoid concerns the humanoid's response to the finite number of programmed information and commands and the related finite number of actions and behaviors, even in the case of autonomous robots. On the opposite, human nature has the capability to adjust to any kind of complex mechanisms of thinking, perception and choice, capable to act according to critical judgment and very often through social or personal dilemmas or consciously actions not compatible (in many cases) to the society's rules.

When a caregiver is asked to provide care services to an elderly, may act sometimes voluntarily or spontaneously, depending on the circumstances, without referring to mechanical or predefined commands like a super intelligence system or application. While elderly, usually with high degree of frailty or dementia, may not be very cooperative with the care giver, the last one has to take initiatives several times that will save the life of elderly, without any kind of confirmation. Besides, humans under the interaction and familiarity with others can sense and understand any need or discomfort without be clearly concretize. But the human need to serve, even if there is no specific order or instruction, denotes choice and free will in most of the cases. The emotional help, the offer of joy and consolation, the willingness to listen or to tell a story, defines choice and care from the perspective of the caregiver. In few cases the choice of caregiver could be against the rules or regulations of the

nursing home, having always in minded that health care, security and entertainment must be offered for the benefit of the elderly.

Autonomous machines, interactive robots, and artificial intelligence's applications can be well programmed but unfortunately not educated or enriched with humanitarian or social principles. Let's assume the following imaginary occasion:

An elderly is directed to the bus-stop under conditions of particularly cold. It is just 20 m from a stop, near the traffic light and walks slowly and heavily.

The bus has already stopped at the specific bus-stop, embarking and disembarking passengers. The driver closes the doors and starts.

Approximately after 20 m the bus necessarily stops at the red light, exactly where the elderly stands. The elderly feels a great relief and make a sign to the bus driver to open the door.

Unfortunately the humanoid bus driver is already programmed and recognizes the specific bus-stops; therefore the door remains closed and after 1 min of waiting the traffic lights, the bus leaves.

Socially acceptable factors like the respect for the elderly fellow citizens and their potential frailty, the cold temperature, or any traditional or social accepted actions could not interrupt the humanoid's code.

The humanoid bus driver had no such choice, performing pre-scheduled commands according to a GPS coordinator. A human driver?

We consider as a crucial disadvantage the difficulty to establish a strong and reliable emotional relationship between elderly population and assistive robots, while robots cannot make ethical decisions [15] or analyze weighted data in order to extract critical thoughts and always benefit the elderly. Even in the case of independent or non-independent decision systems, we are not able to process emotions or transfer the moral and ethical way of acting and living, into humanoids. According to scientists (even the most optimistic), it is highly unlikely in the future for any type of super-robot to have these properties while engineers cannot apply mental processes in an executable level.

In our opinion, humanoid's progressive development is most likely to depend to the establishment of quantum processes in ICT systems, far away from the classic Turing Machine or the Von Neumann's architecture. It is clearly that either we refer to Plato Dianoia and Noesis (*Phaedo and Timaeus*) or Aristotle wisdom (*Nicomachean Ethics*), human intelligence and its subsystems, are more characterized via the quantum randomness, uniqueness and entanglement rather than the classic information bit.

Weak quantum theory (WQT) [16] can serve as the theoretical framework of modeling future interactive assistive robots in a more socialized and emotional way. A more successful way of applying the ordinary's quantum theory assumptions, in order to model and program psychiatrists' treatments into robots, seems to be characterized mainly form the terms of complementarity and entanglement [17], transference and countertransference [18]. Although for many medical doctors and theoretical scientists, the application of quantum axioms in medical evaluation and treatment seems impossible, Freud had already observed strange interpersonal experiences which he called transference and countertransference, where patients

transfer or activate past experiences into the present or even more a problematic pattern could be recognized.

It is obvious that Geroid and Elderly define such a concept of complementarity and a relationship of polarity between apparently opposing organisms.

7.3 The Interactive Autonomous "Geroid" for Elderly

There are few clinical studies and review papers [8] concerning behavioral and technological issues of assistive robots in elderly population. We can mention the studies of Van Dijk [19] who discovered that older persons' acceptance level and motivation to use technological devices rise, when they discover that the devices are convenient and have useful features, Venkatesh et al. [20] who resulted that women's computer self-efficacy is deemed to be lower, which makes it more difficult for them to see the advantages of using such devices, Czaja et al. [21] who claimed that education and technological experience influence access, acceptance and the usage of new technologies, Kidd et al. [11] who consider that robot must interact not only to a single elderly but mainly to interact to the overall social support network of the individual, Mitzner et al. [22], Schermerhorn et al. [23], and Gaul et al. [24] who discovered the influence of social factors like age, gender and background to the positive acceptance of the robot.

Several times assistive robots, as an extension of elderly physical existence, e.g., a robot chair, may offer independence against kinetically problems and increase the sense of security and self-confidence. Additionally, elderly can be emotionally strengthened, mentally improved and negate the frustration of disintegration of the aged human body. The positive psychology stimulates the body and stimulates the mood for life.

The mechanical supported elderly can feel stronger in the presence of technology and might be able to offer actively to its environment, by self-handling any personal daily activities and needs or even more offering to his own family, when residing with them. A friendly walking discussion and a sense of sharing social experiences and memories between a robot and its elderly owner, it is most likely to remind us science fiction movies, where robotic mechanical accessories serves as autonomous care units care, evaluating health conditions or simply entertain and keep active thinking and creativity of older people, even it is nowadays a reality. Obviously, if we overcome a few crucial aspects, such that the probable fear in a percentage of older adults to technological appliances [22], the gender differences on technology acceptance and usage [25], the correlation between education level, sociodemographic background, and usage of technological devices [21, 26] we can certainly support that assistive interactive robots offer a great relief to the elderly and empowerment of their dignity and positive self-regard.

Having in mind that dementia and frailty represent a complex entropy system of multidisciplinary factors like physiological, psychological, genetic, environmental, genetic, cardiovascular, comorbidity, and ageing biomarkers, "Geroid" has been

designed as a humanoid recognizable robot (not human). It is equipped with a media installation of personalized memories and knowledge, able to socially interact with his/her ("Geroid" can mimic voices and uses female or male speaking language) elderly companion, awakening the past and establishing a close relationship. Obviously the "Geroid" robot is able to recognize symptoms and body expressions and serve as a medical doctor, caregiver, and mobile laboratory. It can be adjusted in matters of religion and culture, nationalities issues, daily habits, and hobbies; therefore the elderly's background and any personalized memories are already "uploaded" in the "Geroid" from the familiar environment or the "Geroid" can recognize expressions and be educated in the case of unknown persons.

We believed that the "Geroid" must not mimic or attempt to act like another human animal or even more an animal, while there were a lot of cases where elderly were scared and felled awkward on its presence [27].

This artificial caregiver is not just a programmed super intelligent application. Is more likely to play the role of an artificial Medical Doctor, able to offer confidence and secure dealing with frailty symptoms, but also to represent a 24/7/365 familiar character programmed to share memories or to be linked via a common Wi-Fi access to a close relative.

Alexiou et al. (Fig. 7.1) have already designed "Geroid" (*under patent approval*) as a voice-controlled and -operated digital robot, with a dual module for gender recognition and expression and the representation of audio visual stimuli, using familiar voices, galleries of personal photos and videos, as well as artistic, cultural, social, economic or even political representations. As a complex Micro-Electro-Mechanical-System (MEMS), "Geroid" is able to satisfy difficult medical tasks like MRI or EEG and analyse frailty biomarkers without external assistant in order to lift or stabilize the elderly patient.

Apart from the operational scheduling of the "Geroid" we were very concerned about the appearance of the robot—caregiver. While our humanoid is definitely represents a BioArt product, its physical appearance and the possibility of emotional expression plays an important role for its acceptance from the elderly population.

Starting from the industry, robots are nowadays capable to participate in medical surgical treatment and even more to control personalized diagnosis and screening far away from hospitals or doctors' offices. The collaboration of engineers, medical doctors, caregivers, and artists will definitely establish a new inspired field of assistive robots, where a great technological gap have to be filled concerning the older generations of the previous century. It is has been already stated that BioArt can apply innovative techniques in cases of disabled people, and serves as an educational medium for the integration of AI products into society. BioArtists can share the knowledge of presenting the products of AI in an acceptable way for the human brain, providing also a set of principles and rules such as: aesthetics, behavioral properties, boundaries and functions, adaptation, and harmonization in customs [28].

Conclusion

Is it possible to define the degree of influence of human conscience, dignity, rights, and fundamental freedom by merging human and machine? Is it possible to achieve and control confidentiality and privacy on genetic or personal data, without of course increasing tremendously the high quality treatment cost [13]?

It seems that the necessity of creating metallic assistants-robots constitutes a spontaneous attribute of human culture and temperament with roots reaching back to the dawn of our civilization [28].

It is much more difficult to accept a not-human-compatible body, even in the case of an artificial servant. We need to educate society, in order to accept this new kind of relationships, where partner or companion is not human or even Transhuman, pet or an ordinary object (sometimes humans are associated with objects giving them human characteristics) but instead is a product or application of super intelligence's that provides cure, care, and social interaction.

Apparently, man can easily accept contact with organisms (alive or artificial) in which human features can be endowed. This makes him feel more comfortable in order to establish strong relations with a specific object.

Which are the main conditions in order to make a humanoid caregiver acceptable to the elderly population, concerning its exterior surface and the aesthetics of its functionalities? Do we have really to place beside the time defended and crummy elderly due to his comorbidities, a strong and immortal human (a dressed with human clothes remote-controlled Android System [29]), which is most likely to generate negative thoughts for his mortality, and perishable body or a humanoid-oriented voice-controlled robot (clearly metallic construction) that even the old human will see as an inferior structure?

References

1. World Health Organization. http://www.who.int/en/
2. Alexiou A, Theocharopoulou G, Vlamos P (2013) Ethical issues in neuroinformatics, 9th artificial intelligence applications and innovations conference, 1st workshop on ethics and philosophy in artificial intelligence. In: Papadopoulos H et al. (eds) AIAI 2013, IFIP AICT 364, pp. 297–302, 2013, © IFIP International Federation for Information Processing 2013, Springer, Heidelberg, Paphos Cyprus
3. Broadbent E, Stafford R, MacDonald B (2009) Acceptance of healthcare robots for the older population: review and future directions. Int J Soc Robot 1:319–330
4. Wada K, Shibata T, Saito T, Tanie K (2003) Effects of robot assisted activity to elderly people who stay at a health service facility for the aged. Proc IEEE Int Conf Intell Robot Syst 3:2847–2852

5. Sasaki J, Yamada K, Tanaka M, Funyu Y (2007) An experiment of the life support network for elderly people living in a rural area. In: Proceedings of the 7th WSEAS international conference on applied computer science, vol. 7. World Scientific and Engineering Academy and Society (WSEAS), Venice, Italy, pp 316–321
6. Broekens J, Heerink M, Rosendal H (2009) Assistive social robots in elderly care: a review. Gerontechnology 8:94–103
7. Feil-Seifer D, Mataric MJ (2005) Defining socially assistive robotics. In: Proceedings of the IEEE 9th international conference on rehabilitation robotics, Chicago, IL, USA
8. Flandorfer P (2012) Population ageing and socially assistive robots for elderly persons: the importance of sociodemographic factors for user acceptance, Hindawi Publishing Corporation, International Journal of Population Research, vol 2012, Article ID 829835, 13 pages, doi:10.1155/2012/829835
9. Shibata T, Yoshida M, Yamato J (1997) Artificial emotional creature for human-machine interaction. In: IEEE international conference on systems, man and cybernetics, vol 3. pp 2269–2274
10. Taggart W, Turkle S, Kidd CD (2005) An interactive robot in a nursing home: preliminary remarks. In: Toward social mechanisms of android science. Cognitive Science Society, Stresa, Italy
11. Kidd CD, Taggart W, Turkle S (2006) A sociable robot to encourage social interaction among the elderly, ICRA 2006. Proceedings 2006 I.E. international conference on robotics and automation, pp 3972–3976, 15–19 May 2006. doi:10.1109/ROBOT.2006.1642311
12. Norman DA (2004) Emotional design: why we love (or hate) everyday things. Basic Books, New York
13. Alexiou A, Vlamos P (2009) Ethics at the crossroads of bioinformatics and nanotechnology, 8th international conference of computer ethics & philosophical enquiry (CEPE). Corfu, Greece
14. Alexiou A, Psiha M, Vlamos P (2011) Ethical Issues of Artificial Biomedical Applications, 8th Artificial Intelligence Applications & Innovations. In: Papadopoulos H et al (eds) EANN/AIAI 2011, part II. IFIP AICT, vol 364, pp 297–302, © IFIP International Federation for Information Processing 2011, Springer, Heidelberg, Corfu Greece
15. Kavathatzopoulos I, Asai R (2013) Can machines make ethical decisions?, 9th artificial intelligence applications and innovations conference, 1st workshop on ethics and philosophy in artificial intelligence. In: Papadopoulos H et al (eds): AIAI 2013, IFIP AICT 412, pp 693–699, 2013, © IFIP International Federation for Information Processing 2013, Springer, Heidelberg, Paphos Cyprus
16. Atmanspacher H, Roemer H, Walach H (2001) Weak quantum theory: complementarity and entanglement in physics and beyond, arXiv:quant-ph/0104109. Found Phys 32(2002):379–406
17. Bohr N (1948) On the notions of causality and complementarity. Dialectica 2:312–319
18. Freud S (1992) Vorlesungen zur Einf˙uhrung in die Psychoanalyse. Fischer, Frankfurt
19. van Dijk JAGM (2006) Digital divide research, achievements and shortcomings. Poetics 34 (4–5):221–235
20. Venkatesh V, Morris MG (2000) Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. Manag Inform Syst 24 (1):115–136
21. Czaja SJ, Charness N, Fisk AD et al (2006) Factors predicting the use of technology: findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). Psychol Aging 21(2):333–352
22. Mitzner TL, Boron JB, Fausset CB et al (2010) Older adults talk technology: technology usage and attitudes. Comput Hum Behav 26(6):1710–1721
23. Gaul S, Wilkowska W, Ziefle M (2010) Accounting for user diversity in the acceptance of medical assistive technologies. In: Proceedings of the 3rd international ICST conference on electronic healthcare for the 21st century, Casablanca, Morocco

24. Schermerhorn P, Scheutz M, Crowell CR (2008) Robot social presence and gender: do females view robots differently than males? In: Proceedings of the 3rd ACM/IEEE international conference on human-robot interaction (HRI '08), pp 263–270, Amsterdam, The Netherlands, March 2008
25. Sun H, Zhang P (2006) The role of moderating factors in user technology acceptance. Int J Hum Comput Stud 64(2):53–78
26. Ellis RD, Allaire JC (1999) Modeling computer interest in older adults: the role of age, education, computer knowledge, and computer anxiety. Hum Factors 41(3):345–355
27. Turkle S (2004) Relational artifacts. National Science Foundation, Cambridge, MA, Tech. Rep. NSF Grant SES-0115668
28. Simou P, Tiligadis K, Alexiou A (2013) Exploring artificial intelligence utilizing BioArt, 9th artificial intelligence applications and innovations conference, 1st workshop on ethics and philosophy in artificial intelligence. Papadopoulos H et al (eds): AIAI 2013, IFIP AICT 412, pp. 687–692, 2013, © IFIP International Federation for Information Processing 2013, Springer, Heidelberg, Paphos Cyprus
29. Sakamoto D, Ishiguro H (2009) Geminoid: remote-controlled android system for studying human presence. Kansei Eng Int 8(1):3–9