Human Factors in Aging and Special Needs, Vol. 133, 2024, 51–60
https://doi.org/10.54941/ahfe1004893

Elderly and Digital Health Technologies: The Relationship Between Gerontechnology and Design for Active and Healthy Ageing

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ABSTRACT

The proliferation of new interactive, digital and connected objects is bringing about significant transformations in our world, generating new ways of living and new channels of access to communication. The healthcare sector is one of the sectors most affected by this digital revolution. Gerontechnology, a relatively recent field of research, studies the interaction between increasing longevity and the development of emerging health technologies. Therefore, from a theoretical point of view, digital health technologies can support successful ageing, but in practice, the results fall short of the expectations of elderly users, as the elderly population is less able to access new technologies and is less open to innovation. In order to limit the Grey Digital Divide, in recent years, the design of gerontechnologies has been influenced by the anthropocentric approach, a design approach that places older adults within the design process by considering them as a social resource. In this article, the authors introduce the first results of the research project "Age-It Ageing well in an ageing society", a project funded under the National Recovery and Resilence Plan.

Keywords: Human-centred design, Design for health, Gerontechnology, Grey digital divide, Digital literacy, Ageing, Technology

INTRODUCTION

The potential and opportunities offered by scientific progress and technological innovation make it possible, on many levels, to address present and future challenges, including environmental crisis, global waste management, new pandemics, migration and, finally, the ageing and growing world population. According to the latest United Nations projections (2021), the world population could grow to around 8.5 billion in 2030, 9.7 billion in 2050 and reach 10 billion in 2100. As in the rest of the world and other European countries (EU, 2023), an ageing population is evident in Italy. Data show an increasing number of older adults in Italy, which may continue in the future (Istat, 2022a; Istat, 2022b), placing it among the countries with the most older adults in the world. While demographic trends differ among the world's countries, population ageing and its well-known consequences are becoming more of a challenge in both developed and developing countries.

The digital revolution, which has as one of its direct consequences the proliferation of new interactive, digital and connected objects, is bringing about significant transformations in the world we live in, generating new ways of living and new channels of access to communication. The health and wellness sector is most affected by this change. There is, therefore, a shift *from caring - to taking care*. This gives rise to the need and demand for products and services that improve health conditions and thus promote active and healthy ageing.

The gerontechnology sector is gaining interest, showing potential in promoting the well-being of the older adults and facilitating active ageing. For these reasons, in this paper the authors describe the first results of the research project "Age-It Ageing well in an ageing society" funded within the framework of the National Recovery and Resilience Plan. The project aims to reduce the digital divide between generations by developing project guidelines that can help older adults use digital health technologies consciously and safely.

THE ROLE OF GERONTECHNOLOGY IN SUPPORTING WELL-BEING AND HEALTH

Gerontechnology is defined by Graafmans and Bouma (1993) as "the research and development of techniques and technological products, based on the knowledge of aging process, for the benefit of a prefereed living and working environment and adapted medical care for the elderly". It is a relatively recent field of research (Bouma et al., 2007; Chen, 2020) and is regarded as a response to an ageing population and the rapid advancement of technology (van Bronswijk et al., 2009).

There is no universally accepted classification of gerontechnology in the scientific literature. Halicka & Surel (2021) divide gerontechnology into nine domains: Health (i.e. products and services to monitor and care for human health and well-being), Education (i.e. products and services intended for education and learning), Interpersonal Communication (i.e. products and services to support communication between older adults); Safety (i.e. products and services for monitoring and security inside and outside the home), Mobility (i.e. products and services for the mobility of older people such as aids and assistive technologies), Care (i.e. products and services for the care of older people such as social robots), Leisure Care (i.e. products and services for leisure), Housing (includes products and services for the safety of older people such as monitoring, detection, alarm and communication devices) and Digital Accessibility (includes highly digitised products and services such as smartphones, tablets and wearables). At the same time, van Bronswijk et al. (2009) divide gerontechnology into four intervention domains: enrichment and satisfaction, prevention and engagement, compensation and substitution, care support, and care organisation. The four application domains combine with the five intervention domains of human activities, including health and self-esteem, housing and daily living, mobility and transport, communication and governance and work and leisure. Other authors (Peek et al., 2014; Haufe et al., 2019) categorise gerontechnology as assistive technologies intended

for the support of daily activities, facilitation of social ties, communication, mobility, personal health, physical and cognitive activity and finally, safety. Ultimately, gerontechnology encompasses the field of products and services applied to human beings, insofar as they aim to increase the quality of life in the most advanced segments.

Table 1. Classification of gerontechnologies on the basis of intended use.

Domains of application and scope of gerontechnology	**Author (s) (year of publication)**	**Purpose of the artefact**
9 Domains of application	Halicka & Surel (2021)	1. Health 2. Education 3. Interpersonal communication 4. Safety 5. Mobility 6. Leisure 7. Care 8. Housing 9. Digital Accessibility
4 Domains of application	van Bronswijk et al. (2009)	1. Enrichment and satisfaction 2. Prevention and engagement 3. Compensation and substitution 4. Care support and care organization
6 Domains of application	Peek et al. (2014) Haufe et al. (2019)	1. Everyday activities 2. Facilitation of social ties 3. Communication 4. Mobility 5. Personal health 6. Physical and cognitive activity

TECHNOLOGY ACCEPTABILITY

It is evident that gerontechnology can be a valuable tool to support active and healthy ageing. However, several studies highlight the problems of products and services developed for older people. Indeed, sometimes there is a lack of adaptation between the everyday life of older people, their needs and the available technologies (Greenhalgh et al., 2015; Sanders et al., 2012). In other cases, low product adoption rates by older people may be due to inefficient interface design, privacy or security concerns (Yusif et al., 2016) or economic or socio-cultural barriers (Wang et al., 2016). Many solutions are identified in the greater inclusion of older people and formal and/or informal caregivers in the design processes, e.g. through co-design sessions (Beringer et al., 2011), but also through an evaluation of such systems based on the age and real needs of the end-users (Pietrzak et al., 2014).

In fact, over the past two decades, gerontechnology design has been shaped in part by approaches such as the human-centred approach (Manchester &

Jarke, 2022), an approach to gerontechnology design that questions assumptions about older adults and includes them in the design process, taking their daily lives and concerns seriously (Baker et al., 2019; Vines et al., 2015; Wallace et al., 2020). The acceptability of technology, especially for older adults, is currently a sensitive issue, the evaluation parameters of which offer many challenges to design research. The higher the level of acceptance, the more frequently a technology will be used. According to Richardson (1987), extrinsic and intrinsic factors can determine acceptability. They are of two types: the characteristics of acceptable technologies, i.e. those identified by Rogers (2010) and the characteristics of accepting users. The latter, concerning the study by Alavi & Joachimsthaler (1992) are:

- cognitive style (how individuals process and use information);
- personality traits (people's need for success, level of defensiveness, control and propensity to take risks);
- demographic variables (age and education);
- user-specific variables (training, experience and involvement).

Gray Digital Divide

Accepting the thesis that gerontechnology can be crucial for an ageing society, the scientific literature focuses on the gap in digital access, skills and opportunities of older people, called the Gray Digital Divide. This concept highlights how older people have more significant difficulties interacting with digital technologies and the internet than younger people and identifies new challenges to be addressed and solved in the near future to improve the health, well-being and social participation of older people in everyday life. The EU (European Commission, 2022) report on the digitisation of the economy and society (DESI) places Italy 18th among the 27 EU Member States (20th place in 2021), which can be attributed to the relative lack of literacy of Italian older adults.

Several authors (Manchester, Jake, 2022; Manchester, 2021; Peine et al., 2015; Wanka, Gallistl, 2018) suggest that technology designs for an ageing society have not lived up to expectations, and there are increasing calls for new approaches to technology design that do not view older people as necessarily vulnerable, in need of care or unskilled in the use of technology. These persistent negative images of the older adults stand in the way of profound changes being made to better design for older people. This is especially true for the design of digital technologies, tools and services, whose designers often have the misconception that older people are not, or have not been in the past, very technologically adept. However, Mitzner et al. (2010) do not point out that it is a misconception to think that the over-50s are technologically challenged and disconnected, but rather, older consumers are tech-savvy and eager to learn more.

THE ROLE OF DESIGN IN SUPPORTING ACTIVE AND HEALTHY AGEING

In order to limit the Grey Digital Divide and increase the access, skills and digital opportunities of older people, the design of gerontechnology in

recent years has been influenced by the anthropocentric approach, a design approach that places older people within the design process (Baker et al., 2019; Vines et al., 2015; Wallace et al., 2020) by considering them as a social resource and not as frail, sick and dependent. Design, and in particular the Human-Centred Design (HCD) approach, can play a crucial role both in understanding the needs of the older adults population and in translating these needs into digital products that are more suitable and relevant to their purpose. For example, the Tangible Memories project (Manchester, Jarke, 2022) aimed to investigate technology's use, effectiveness, and acceptability in care settings. The project team explored older adults residents' relationships with specific wrist sensors and alarms and found that, although problematic for some, they helped others feel safe to be alone in their rooms and flats. Other interesting projects are Amulet Device (Batsis et al., 2018) and CloudIA (Tosi et al., 2021), wearable devices that monitor people's health status, movement, and falls. The Emilia-Romagna region has carried out the specific Pane and Internet programme (www.paneeinternet.it) to help older adults use and master new technologies through digital skills training.

The ReMember-Me project (www.aal-europe.eu) was launched by eight partners in six European countries to develop a solution to detect and prevent cognitive decline at an early stage. The solution consists of a robot, on-screen games and sensors, which acquire real-time data on a person's state by engaging the user in interesting brain training schemes customised according to their routines and preferences. Leage (Nap et al., 2014) is a digital game project that aims to help older adults improve their skills by exercising and expanding their knowledge of history, geography, nutrition and health issues through motivating exercises and memory training. The TrentinoSalute 4.0 project (Barbabella et al., 2022) aims at valorising physical activity to maintain good health in old age, as well as a social and recreational opportunity, through implementing a geocaching App for group walks. Finally, robotics is a fast-growing field in which the discipline of design, and ergonomics in particular, are contributing to the design of technologies capable of responding to the needs of older adults. In the near future, robots could perform many of the tasks currently performed by healthcare professionals, such as helping older adults get around. Robear is a nursing robot that can help older adults by lifting them from a bed to a wheelchair and supporting them while standing (www.riken.jp). At the same time, the Care-O-bot (www.care-o-bot.de) robot can help older adults in their daily lives. This affordable care option has six models that can be configured according to available budget and needs.

AGE-IT RESEARCH PROJECT

The authors of the article are involved in the research programme "Age-It Ageing well in ageing society", an extended partnership funded within the framework of the National Recovery and Resilience Plan, more specifically in Spoke 9, whose overall objective is the study of advanced gerontechnologies for active and healthy ageing. The objective is to reduce the digital divide between generations by developing design guidelines to help older adults consciously and safely use digital health technologies.

For these reasons, the research focuses on persons aged 55 and over who are residents in Italy. The age limit focuses on the Active Ageing Index (UNECE, 2012), an indicator the European Community promotes to assess and monitor the results of active ageing in a specific geographical context. As argued in the previous paragraphs, technologies such as the internet, medical devices, and smart devices can support active and healthy ageing.

For the drafting of the guidelines, standard technologies will be considered as the object of study, usable even without specific medical knowledge, suitable for the promotion and monitoring of the person's state of health and well-being, including: personal computers, tablets, smartwatches, smart TVs, digital assistants (Google Home, Echo Dot Alexa, Home Pod, etc.), Artificial intelligence (Siri, Cortana, etc.), well-being Apps, nutrition Apps, sports Apps, smart clothing, subcutaneous devices, glucometer, pulse oximeter, ECG and spirometer.

For each product, the following aspects will be assessed by applying HCD methods: experience, emotional aspects, interaction, element of preference, usefulness, comprehension, reliability and difficulty of use.

The emerging data will allow the research team to plan and draft design matrix guidelines in the coming months based on the analysis of extrinsic and intrinsic factors that may determine the acceptability of the technology from the end user's point of view. Finally, the guidelines may support stakeholders (designers, engineers, R&D centres, SMEs, academies, and private and public institutions) during new healthcare technologies' design and production phase.

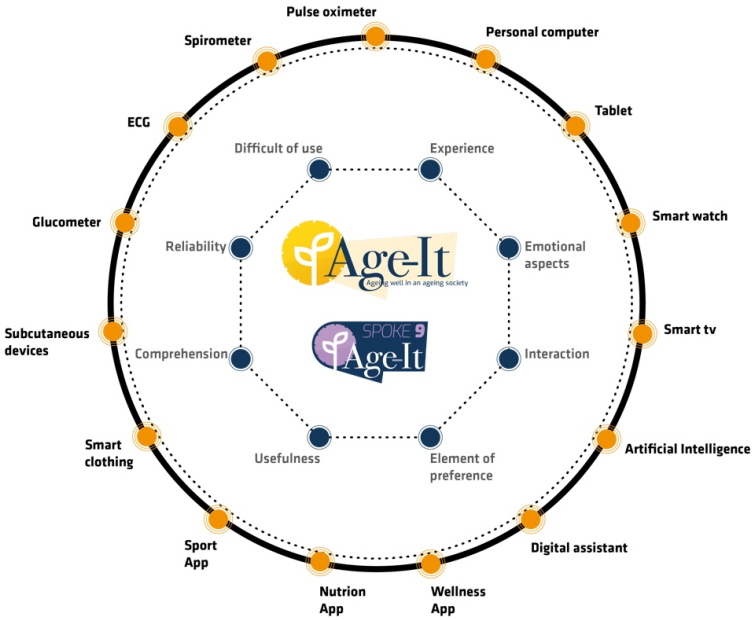

Figure 1: Subject of study and areas of intervention of the research programme "Age-It Ageing well in ageing society".

CONCLUSIONS AND FUTURE DEVELOPMENTS

Scientific and technological progress has had and will impact people's ageing and longevity. This condition is confirmed by the literature review, as many currently developed health technologies (sensors, smart home, artificial intelligence, smart products, Big Data, etc.) can have a twofold impact: (personal impact) they can be effective in the promotion, management and monitoring of a person's state of health and wellbeing, especially for the older adult, thus promoting active and healthy ageing; (social impact) they can limit health care expenditures on national health services, as care, diagnosis and monitoring practices in the private home are favoured and opportunities for involvement, inclusion and active participation in many spheres of the social sphere, such as the labour market, volunteering, social relations, lifelong education, leisure and hobbies are strengthened over time.

The scientific literature also highlights the generation gap, as the older adults population cannot access new health technologies. It, therefore, becomes necessary to design health technologies that are useful, usable and accessible to as many people as possible. In this regard, the discipline of Design, particularly the anthropocentric approach, in synergy with other scientific disciplines, allows designing *for* and *with* the end user through observation, empathy and active listening.

For these reasons, the research programme foresees, in the near future, the realisation of specific research activities, including: (phase 1) literature review (concluded); (phase 2) exploratory questionnaire with a national approach (ongoing); (phase 3) codesign sessions with a sample of residents in Tuscany; (phase 4) drafting of the guidelines; finally, (phase 5) dissemination of the results achieved.

AUTHOR CONTRIBUTIONS

Scientific director of the research F.T.; Research planning M.P. and C.B.; All authors contributed to the draft and accepted the published version of the manuscript.

FUNDING

Research was pursued within the Age-It Ageing well in an ageing society project (European Union NextGeneration EU, Ministreo dell'Università e della Ricerca, CUP B83C22004800006).

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