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XIX INTERNATIONAL FORUM

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Carmine Gambardella
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Le Vie dei Mercanti
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Scholars has been invited to submit researches on theoretical and methodological aspects related to Smart Design, Planning and Technologies, and show real applications and experiences carried out on this themes. Based on blind peer review, abstracts has been accepted,conditionally accepted, or rejected. Authors of accepted and conditionally accepted papers has been invited to submit full papers. These has been again peer-reviewed and selected for the oral session and publication, or only for the publication in the conference proceedings.

Conference report

300 abstracts and 550 authors from 40 countries:

Albania, Arizona, Australia, Belgium, Bosnia and Herzegovina, Brasil, Bulgaria, California, Chile, China, Cipro, Cuba, Egypt, France, Germany, Greece, India, Italy, Japan, Jordan, Lebanon, Malta, Massachusetts, Michigan, Montenegro, Montserrat, New Jersey, New York, New Zealand, Poland, Portugal, Russian Federation, Serbia, Slovakia, Spain, Switzerland, Texas, Tunisia, Turkey, United Kingdom.

WORLD HERITAGE anf DESIGN for HEALTH

The innocent eye sees nothing (Ernst Gombrich)

In this particular time characterized by a pandemic due to the expansion of the Covid-19 virus throughout a globalized world, the destinies of everybody have suddenly changed behavior, lifestyles, interpersonal relationships, production methods as well as the governing of the territory; the priority of investing in the healthcare sector has become increasingly urgent and indifferent with reference to a political management of the communities that prevents and does not suffer, as unprepared, the emergencies that increasingly afflict the community. Furthermore, in these months of "quarantine", the Planet has shown a Resilience that makes us hope for the future. A response to the Culture of Emergency, which finds its generative ground not only in the healthcare sector but also in the governance of the territory, relates to the hydrogeological aspects, pollution of soils, air, water, illegal construction, the exploitation of energy resources faced with the use of the integral of scientific and managerial skills based on meritocracy. The XIX International Forum of Study 'World Heritage and Design for Health' addresses the issues related to the global pandemic in a multidisciplinary and systemic logic, as indicated by the UNESCO and the United Nations 2030 Agenda for the definition of projects and concrete actions that include the Welfare and Health of the Community. Therefore, the Forum aims to create a transversal critical dialogue, open to cultural contamination and 'without limits', in a logic of integration between skills that extends, and is not limited to, the following disciplines: Architecture, Culture, Environment, Agriculture, Health, Landscape, Design, Territorial Governance, Archeology, Economy, History, Sociology, Security, e-Learning. The Scientific Community of the Forum is composed of about seven thousand Professors and Researchers from one hundred Universities and Research Centers in the world, from institutional representatives, from the business sector and from the representatives of the 830 UNESCO Chairs (UNITWIN Program) thanks to the WebGIS created and managed by the UNESCO Chair at the Benecon University Consortium. The location of the Forum is of excellence. Campania Region with six World Heritage Properties, two Unesco Man and Biospheres, three assets registered on the Intangible Heritage List is one of the richest Regions in the world for cultural and landscape heritage, particularly 'contaminated' by Mediterranean cultures. No coincidence that the Forum takes place in Naples and Capri, with site visits and presentations of scientific research and operational projects by the Benecon University

Consortium, consisting of five Italian Universities, head office of my UNESCO Chair on Landscape, Cultural Heritage and Territorial Governance. The papers, selected by the Forum's Scientific Committee, will be published in the Proceedings of international relevance (candidate to be indexed Isi Web of Science). Furthermore, the most innovative research and projects will be published in the 'Quaderni' of the A Class international magazine 'Abitare la Terra / Dwelling on Earth'.

Prof. Carmine Gambardella
General Chair XIX Forum 'World Heritage and Design for Health'
President and CEO of the Benecon University Consortium
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and Territorial Governance

WORLD HERITAGE and DESIGN for HEALTH

The innocent eye sees nothing (Ernst Gombrich)

In questo particolare tempo connotato da una pandemia dovuta dall'espansione del virus Covid-19 in un mondo globalizzato, i destini delle Persone improvvisamente sono stati modificati nei comportamenti, negli stili di vita, nei rapporti interpersonali, nei modi di produzione, nel governo del territorio; le priorità degli investimenti nel comparto Salute, diventa sempre più urgente e indifferibile con riferimento a una gestione politica delle Comunità che prevenga e non subisca, in quanto impreparata, le emergenze che sempre più affliggono la Collettività. Inoltre, in questi mesi di "quarantena", il Pianeta ha dimostrato una capacità di Resilienza che ci fa bene sperare per il futuro. Una risposta alla Cultura dell'Emergenza che trova il suo terreno generativo non solo nel campo della Salute ma nel governo del territorio per quanto riguarda gli aspetti idrogeologici, l'inquinamento dei suoli, dell'aria, dell'acqua, l'abusivismo edilizio, lo sfruttamento delle risorse energetiche affrontato con l'utilizzo dell'integrale delle competenze scientifiche e gestionali fondate sulla meritocrazia.
Il XIX Forum Internazionale di Studi World Heritage and Design for Health affronta le problematiche legate alla pandemia globale in una logica pluridisciplinare e di sistema, così come indicato dall'UNESCO e dall'Agenda 2030 delle Nazioni Unite per la definizione di progetti e azioni concrete che includano il Benessere e la Salute della Collettività. Il Forum si propone quindi di creare un dialogo critico trasversale, aperto alle contaminazioni culturali e 'senza limiti', in una logica di integrazione fra le competenze che si estende, e non si limita, alle seguenti discipline: Architecture, Culture, Environment, Agriculture, Health, Landscape, Design, Territorial Governance, Archeology, Economy, History, Sociology, Security, e-Learning.
La Comunità Scientifica del Forum è costituita da circa settemila Docenti e Ricercatori di cento Università e Centri di Ricerca nel mondo, da rappresentanti istituzionali, del settore dell'impresa e dai referenti delle 830 Cattedre UNESCO (UNITWIN Programme) grazie al WebGIS realizzato e gestito dalla Cattedra UNESCO incardinata al Consorzio Universitario Benecon.
La location del Forum è d'eccezione. La Campania con sei siti iscritti nella lista del Patrimonio Mondiale, due Man and Biospheres UNESCO, tre beni iscritti nella Lista del Patrimonio immateriale è una delle regioni più ricche al mondo per beni culturali e paesaggistici, particolarmente 'contaminata' delle culture del Mediterraneo. Non a caso il Forum si svolge a Napoli e Capri, con sopralluoghi e presentazioni di ricerche scientifiche

e progetti operativi a cura della Consorzio Universitario Benecon, costituito da cinque Atenei italiani, sede della Cattedra Unesco su Paesaggio, Beni Culturali e Governo del Territorio. I paper, selezionati dal Comitato Scientifico del Forum, saranno pubblicati negli Atti di rilevanza internazionale (candidati all'indicizzazione Isi Web of Science). Inoltre, le ricerche e i progetti più innovativi saranno pubblicati nei 'Quaderni' della Rivista internazionale di Classe A 'Abitare la Terra/Dwelling on Earth'.

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The role of Design for Health and of the Human-Centered Design approach for an ethical and conscious development of innovative *Quality of Life Technologies.*

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Abstract
In recent years, wearable and robotic technologies are making significant advances in a variety of fields, including medicine and social and health care. The development of research in robotics marks the end of its segregation to mere industrial fields: society is increasingly open to the everyday use of safe and reliable technologies for cooperation and human assistance [1].
On this basis, the key role of designers in the development of human-centered assistive technologies is evident: technologies should be designed according to fundamental human rights and to the needs and expectations of people, supporting their independence and improving their quality of life. The scientific and methodological approaches of Human-Centred Design and Ergonomics for Design can provide a fundamental contribution in the development of technologies that embody universal ethical and socio-cultural values.
This paper explores the areas of intervention and the role of design for assistive technologies, with a focus on the national state of the art. This paper also investigates the contribution of design both from a practical point of view (i.e. operational strategies and methodological approaches), and from a research perspective: it underlines the role of the designers as responsible for the dissemination of technologies aimed to support and not to replace the human work.

Keywords: Design for health, Human-Centred Design, Ergonomics for Design, Robotics, Older people

1. Introduction
In recent years, the increase in average life expectancy and low birth rates led to the well-known phenomenon of global population aging [2]. This trend is one of the most critical of the coming decades and will have a significant social and economic impact, requiring a joint effort by all governments, international agencies, professionals, research organizations and private citizens to improve the quality of life of older people and the communities in which they live.
Data from Italy confirm European trends: the average age of the population is 45.7 years and the percentage of people over 65 is 23.1% (2.7 points more than in 2010). In addition, the increase in life expectancy also determines the increase in the population of the over 85: they are the 3.6% of the population and Italy holds, together with France, the European record for the number of ultra-centenarians [3].
The planning of political and social initiatives addressed to the aging population is globally widespread [4]. In Europe there are countless intervention plans to support healthy and independent aging: the implementation of social policies addressed to the over-65 population fits within the scope of the Sustainable Development Goals (SDGs) established by the 2030 Agenda; the 2002 Madrid International Plan of Action on Ageing (MIPAA) highlights the contributions that older generations can have for society, both from a family and a work perspective, by actively participating in the socio-economic development of the communities in which they live; the *Decade of Healthy Aging 2020-2030* highlights the urgency of implementing within a decade all the SDGs addressed to the aging population and the improvement of their quality of life.

High life expectancy is possible thanks to advances in medicine and preventive approaches, greater attention to nutrition, education and economic well-being. However, an older population also means an increase in subjects with pathologies or disabilities and, therefore, problems of economic sustainability for the National Health System. In Italy, the elderly who report suffering from three or more chronic diseases are the 42.3% while the 22% lives with severe limitations in performing daily activities [5].
Aging can cause a decline in physical and cognitive abilities which may lead the person to need a formal or informal caregiver, temporarily or continuously, both for health care services and to perform the Activities of Daily Living (ADLs) [9]. This condition can also lead to the displacement of the elderly from his/her own home to nursing homes, which can be a traumatic event, a source of stress or otherwise highly destabilizing [6]. The environment in which one lives, intended both as the physical one but especially as a set of socio-emotional meanings that it contains, is crucial to the psycho-physical well-being of ageing people [7]. For this reason, most older people want to stay at home as long as possible, maintaining the highest level of autonomy and independence [8]. However, the domestic environment cannot always provide the necessary security or be suitable for the needs that change with ageing. In addition, living at home greatly increases the risk of household accidents but also enhances the sense of isolation and loneliness in older adults.
On this basis, digital technologies will have a significant impact on individual aging in the future and may revolutionize healthcare provision. In fact, research and production in the area of robotic systems and wearable devices are widely addressing the issue of *ageing in place*, offering solutions aimed at maintaining the autonomy of people at home for as long as possible [10] and supporting caregivers in performing their activities. Digital technologies are certainly a resource for aging and an opportunity for research and practice in design. While society is increasingly open to the everyday use of safe and reliable technologies for human cooperation and care [1] designers are responsible for ensuring that technologies are developed with respect for basic human rights and that they embody universal ethical and socio-cultural values [11, 12].
This article explores the areas of intervention and the contribution of design for new technologies, by analyzing the main research trends in national and international contexts and investigating the fundamental contribution of the scientific and methodological approaches of Human-Centred Design and Ergonomics for Design for the development of technologies designed from the real needs of people.

2. Digital technologies: a powerful tool to support *ageing in place*

The elderly is a priority target for the design and development of technological products and services aimed at improving the quality of life and supporting people's health and autonomy.
According to the latest report by SAPEA (Science Advice for Policy by European Academics), the main areas of implementation of new technologies for aging are [13]: (1) mobile applications for physical, social and cognitive health: these make *m-health* play an increasingly important role in monitoring health and supporting the adoption of correct lifestyles, from a preventive point of view; (2) designing smart domestic environment, according to the principles of Inclusive Design, promotes aging at home and provides greater security and support to the ADLs and social connection. A key contribution is also offered by the rapid diffusion of social and assistive robots, wearables and/or interconnected systems according to the Internet of Things (IoT) paradigm; (3) assistive technologies and wearable devices facilitate ongoing follow-up of health status, chronic clinical conditions, and functional capacity through remote monitoring, home physical rehabilitation, brain training, and medication intake/administration control; (4) technology can also transform diagnostic and surgical procedures. Applications of machine learning algorithms and Artificial Intelligence (AI) in the field of aging research offer huge possibilities.
The attention of the scientific community towards these issues is underlined by the presence of a research area focused on the topic of technologies for older people: the *Gerontechnology*, defined by the International Society of Gerontechnologies as "the field of scientific research in which technology is directed towards the aspirations and opportunities for the older persons. Gerontechnology aims at good health, full social participation and independent living up to a high age, be it research, development or design of products and services to increase the quality of life. Gerontechnology lives at the crossroads of advancing technology and advancing age" [14].
This field of interdisciplinary research represents the meeting point between innovative technologies and ageing: new technologies can help people to maintain autonomy and good health, but only if they can be used effectively, efficiently and to the satisfaction of the elderly in the long term.
Several studies prove that new technologies can help to resolve or relieve all those problems related to aging: for example, they can compensate for the decline in physical and/or cognitive abilities [15], sensors and wireless networks can support physiological monitoring in a domestic environment [16], the development of telemedicine can help people in receiving medical care at home [17]. In addition, there are many now-traditional technologies aimed at supporting basic ADLs at home and social interactions in order to fight the isolation of older people [18], and communication technologies such as smartphones or computers connected to the Internet can improve and increase communication with friends and family [19].

The increase in demand for services to support ageing in place, results in the rise of several solutions in the field of Ambient Assisted Living (AAL). They include the possibility of integrating wireless sensor networks, robots and wearable technologies for a wide variety of purposes such as user security, home surveillance, environmental monitoring, social interaction, the installation of personal alarms, reminders of events on the agenda, etc. [20, 8].
Quality of Life technologies (QoLs) offer a variety of solutions aimed at maintaining people's independence for as long as possible. Specifically, they have three main functions [21]: monitoring of the person or the surrounding environment; diagnosis and screening of the health status of the elderly; and treatment of the detected health conditions. They impact five domains: psychophysical health monitoring (e.g., heart rate, blood pressure); mobility (e.g., gait speed, gait support); social connections (e.g., monitoring frequency of interactions, counteracting isolation); safety (monitoring falls and activating alert systems); and ADLs support (e.g., taking medications or helping with various tasks).

2.1 Wearable devices and IoT to support the *Active and Healthy Ageing*

Due to engineering advances in hardware and software, digital technologies, including wearable devices and interconnected products under the IoT paradigm, can support aging at home and maintain people's independence for as long as possible, providing a viable and less expensive alternative to institutionalized care [22].
In recent years, the development and rapid diffusion of interactive devices (e.g., computers, smartphones, and wearable devices) generated a true digital revolution. IoT refers to the connection of devices and products to the Internet, including home appliances, healthcare devices, motor vehicles, etc. Once connected, each product can store and process information on the network independently but also communicate with other devices belonging to the network. It seems clear, therefore, that IoT technologies can be a valuable tool to support *ageing in place*, both in smart houses and in telemedicine and remote monitoring.
The market for devices and objects connected to the network and therefore connected to each other is set to grow exponentially: in 2015, there were more than 5 billion networked objects and, according to forecasts, there will be about 28 billion by 2025. This market, which was worth about $655 billion is set to be worth about $11 trillion by 2025, or 11% of the entire world economy [23].
Wearable computers and smart clothing represent today the new frontier of electronic devices; compact and miniaturized these are directly worn by humans, creating a constant interaction between computer and user. The potential for interaction, created by these devices with humans and ubiquitous computing systems, can be directed in many directions: to help and assist people, to push them towards new patterns of behavior, to change social dynamics, up to the possibility of transforming these wearable systems, massively distributed, in a "collective wearable", a super-organism of interactive personal digital assistants, globally extended [24].

2.2 Social and Assistive Robotics for older people: potentialities and research areas

In recent years, robotics is making significant advances in a variety of fields, including medicine and social and health care. It represents one of the potential solutions for improving the quality of life of the elderly and services to them, enhancing their mobility, communication possibilities, increasing their sense of security and independence and promoting social inclusion [25].
Specifically, *advanced robotics* is among the five revolutionary technologies that have the potential to transform private life, work, and the global economy [26]: in the not too distant future, robots will actively cooperate with humans during the performance of daily activities, healthy activities, and for the promotion of social inclusion [27, 28]. The integration of new technologies in interconnected systems can facilitate the activities of healthcare professionals (e.g., health monitoring, medication intake control, environmental safety) and can prevent loneliness and isolation of elderly people, supporting them in performing ADLs and promoting socialization and active emotional and cognitive stimulation.
Referring to the home robotics market alone, the number of adoptions of robotic systems in the home has increased by 31 million between 2016 and 2019 [29]. The market value of robots for performing difficult or dangerous household tasks (lawn mowing, pool cleaning, floor cleaning, etc.) grew by 13 billion during this time frame. Furthermore, the assistive robotics market is expected to grow from $ 4.1 billion in 2019 to $ 11.2 billion in 2024 with a CAGR (Compound Annual Growth Rate) of 22.3% [30].
The scientific community has provided several taxonomies and classifications of assistive robotics, categorizing platforms based on the type of assistance provided (physical or non-physical), the ability to socialize or establish effective psycho-emotional interaction [31] and formal and morphological features (mechanical, zoomorphic, humanoid) [32]. The need to systematize this wide area is due to the countless fields of application of assistive robots which also implies differences from a morphological and functional point of view. *Medical robots* can support doctors and surgeons during specialist visits or operations and support patients during rehabilitation; *prosthetic robots* can replace limbs, muscles and perform similar functions; *socially interactive robots* can support social communication and people's psycho-emotional well-being; *companion robots* integrate artificial intelligence and learning skills to fight

stress and loneliness; *therapeutic robots*, often zoomorphic, show benefits in interacting with people suffering from dementia, Alzheimer's or cognitive problems; *service robots*, oriented towards efficiency and functionality, provide support to the performance of ADLs.
At international level, research and experimentation involved robotic platforms belonging to the above categories and more: among mechanical robots, Giraffplus [33], Care-O-Bot [9] and the Robot-ERA system [34] guarantee telepresence activities, monitoring of activities and falls, support to the performance of ADLs; desk robots such as Jibo [35] or ElliQ [36], integrate artificial intelligence with the aim of reducing the digital divide between generations and counteract isolation and depression, promoting communication and socialization; among zoomorphic robots, Paro [37] and Aibo [38] are widely experimented for therapeutic purposes and as companion robots for entertainment and emotion management; among humanoids, NAO [39] and Pepper [40] find many applications as walking assistants, social facilitators, motivators for physical activity, help in increasing cognitive activities.
In the perspective of *ageing in place*, research is investigating how robotic systems, connected in the cloud with wearable devices and sensors integrated in the domestic environment can help the elderly to be independent and maintain a good state of health, but also support caregivers in carrying out their tasks.

3. Issues and challenges of Assistive Technologies: acceptability and ethical considerations

Although the revolutionary scope of new technologies is a known fact and their benefits have been demonstrated globally through research and testing programs, it is important to keep in mind that they will need to be integrated within people's domestic environments and daily routines and not be invasive or distort environments and habits. In order to avoid the risk of creating an incompatibility between technology and human activities, it is essential to ensure the effective use and management of these digital products, so that the interaction between people, social and domestic space and technology can be satisfying and comfortable [41], but also reliable and acceptable.
The type of interaction users engage in with new technologies can define the experience of aging itself [42]. However, many traceable products in the area of assistive technology and robotics have been designed with little regard for the social, aesthetic, and emotional relationships that older adults will establish with the product [13]. In addition, societal values and ethical beliefs are reflected within technologies that, in turn, convey them to people [43, 12]. Therefore, the distinctive elements of future assistive products should not be only based on functionality and efficiency: they must also produce an interaction based on attractiveness, convenience, and absence of stigma. For all users, but specifically for elderly, elements such as accessibility, ease of use, and reliability are essential [42].
Several studies highlight the issues of new technologies developed for the elderly. Indeed, sometimes there is a lack of matching between the daily life of elderly people, their needs and the available technologies [44]. In other cases, the low adoption rate of new technologies by older people may depend on inefficient interface design, privacy or security concerns, or economic or socio-cultural barriers [45]. As many solutions to these issues are identified in the greater inclusion of older adults and formal and/or informal caregivers in the design processes, e.g. by co-design sessions and also by an evaluation of such systems based on the age and real needs of the end users [46].
According to Michel et. al [13], assistive technology is limited in its application due to four main issues: acceptance (the use of technology changes among older people and is influenced by factors such as convenience, ease of use, functionality, and personal preferences); overall efficiency and proven results (not all monitoring and care models are able to demonstrate significant improvements, there are still implementations to be made in terms of electronic health records, technological capabilities of telemedicine environments, etc.); standardization (regulation of robotics, wearables, and even data sensing and transmission systems requires and will involve a significant effort by the relevant agencies and strong collaboration between them); financing (technologies have different costs at national and regional level and not always the health system provides full or partial reimbursement, although it would be desirable a free supply for the most fragile people).
Acceptability of technologies is defined as "the demonstrable willingness within a user group to employ information technology for the task it is designed to support" [47]. Safety and usability requirements are closely interrelated and, although both have roots in the field of Human-Computer Interaction [48], they continue to be key factors in the successful implementation of such products and in ensuring a positive overall experience for all users involved.
The urgency of these issues, especially those related to standardization, is increasingly evident: designers and engineers work to create intelligent robots that are adaptive, respectful, and flexible according to the users' needs, but the regulation of these devices is up to politicians and administrations. Their decisions are important in defining, for example, the needs of caregivers in relation to physical or cognitive efforts to care for the elderly, or the best compromise between a sense of dignity and independence and fighting isolation and loneliness.

The increasing use of robotic and wearable technologies also brings with it an increase in ethical issues related to them, both in scientific and humanistic fields. This topic is so debated that it has generated a vast area of research, the *Roboethics* [49], which aims to develop scientific and cultural tools for the analysis of the ethical implications of assistive robotics in order to prevent any abuse against humankind. Ethical issues, in relation to the topic of design for health and technologies addressed to older users, are extremely delicate and need detailed guidelines related to all legal, moral and social aspects [1]. They are elaborated from the socio-ethical implications already addressed in the field of Human-Computer Interaction, following the massive diffusion of computer systems both in professional settings and in everyday private life. Starting from HCI, Friedman & Kahn [50] identify the fundamental human values involved in the design of new technologies and, therefore, also of assistive technologies. They are: human well-being, ownership, privacy, freedom from bias, universal usability, autonomy, trust, informed consent, responsibility, identity, calm, environmental sustainability.

According to Casey et al. [51], the most urgent issues, specifically in the case of technologies for older people, include: changing or modifying the nature of care; replacing human care; human autonomy in the context of any restrictions placed by the robot for safety; negative impact on dignity; emotional attachment of the user and/or over-dependence on the robot; and safety and privacy concerns.

Feil-Seifer & Mataric [31] apply a well-established medical ethical model to identify some key ethical principles in the field of assistive robotics: they should act in the best interest of the patient; they meet the "first, do no harm" principle, whereby robots should not harm a patient; they should empower the patient to make a decision based on informed and not forced care; equitable distribution of scarce healthcare resources.

Sharkey & Sharkey [52] identify six ethical issues, relating them to the potential benefits of using technology for the care and safety of older adults: potential reduction in the amount of human contact; objectification and loss of control; privacy; personal freedom; deception and infantilization; and circumstances in which older adults should be allowed to control robots.

On this basis, it is clear the key role of designers and the effectiveness of their design approaches and methodologies, for the development of truly human-centred technologies, which are built first with respect for fundamental human rights and then adapt flexibly, according to different situations to the values, beliefs, expectations and desires of individual users, supporting their independence and assisting them in improving their well-being and quality of life.

4. The contribution of Design: research and operational strategies for *Human-Centred Assistive Technologies*

With regard to the above considerations, Design for Health and the scientific and methodological approaches of Human-Centred Design (HCD) and Ergonomics for Design can provide a fundamental contribution. These disciplines place people at the center of the design process and involve users in the creative process. For these purposes they differ from many design practices: they focus on the people for whom the product is intended, rather than on the creative process of the designer or on the material and technological properties of the product itself. Through the theoretical and methodological tools of HCD, designers can offer an important contribution in order to identify and evaluate users' real needs and to translate them into tangible design solutions. From this point of view, Interaction Design (ID) and User Experience (UX), intended as the global experience of the user before, during and after the use of a product, can also contribute to the development of products and interactive systems truly based on people's desires and expectations. “Design is an activity of practical intervention and creative expression; it is both a connecting factor between different skills and a tool for innovation. The role of the designer consists in his ability to proactively intervene on what exists, to interpret the complex set of factors that surround us and then to develop design solutions in order to meet people's needs, expectations and desires and also to propose new behaviors and suggest new lifestyles" [53].

Older people need technologies that are respectful, flexible and adapted to their specific needs. The role of design is to focus on the specific features of this target of users, together with ethical and psycho-social issues related to the use of assistive technologies, in order to ensure that they are actually tools to support the performance of daily activities or to help caregivers in the administration of care and assistance. Like commonly used technology products (e.g. smartphones, computers, tablets) new technologies (robots for telepresence, sensors for monitoring physiological parameters, etc.) can help humans to communicate, to be independent, to perform complex or dangerous activities without ever replacing the empathic and interpersonal bond that exists between individuals. These technologies should be conceived as an enhancement of interpersonal relationships and as an extension of human possibilities and abilities. However, this is only possible if they are designed according to a Human-Centred approach.

Research on elderly users has an additional focus: they often perceive new technologies as "constrictive," as mere tools of control, detached from users' needs, and as products that can or may in the future replace human care and assistance. This idea in the collective imagination is amplified by the fact that technologies often make a task slower, more dangerous, and more frustrating, although the

ideal technologies should make a task easier, more efficient, safer, and more enjoyable [54]. Therefore, even in Inclusive Design, researchers and designers work to understand and analyze all the needs of these potential users, so as to develop flexible and adaptive products and services that can be used without any limitations.
The role of the designer takes on multiple meanings: the designer has problem solving skills; he/she optimizes production processes and implements products from every point of view; the designer is a catalyst for the multidisciplinary skills of the professionals within a team; he/she creates and imagines possible and future scenarios, through the formulation of questions about what people want or don't want, desire or need. In this regard, Czaja et al. [55] offer an overview of design principles in relation to older users, with the aim of systematizing all the psychological and human factors to be considered when designing for these users. The researchers provide real specific guidelines regarding input/output devices, design of interfaces, products, environments and services, analyzing the role of assistive technologies and related ethical, social and psychological issues.
The success and benefits of new technologies depend on design from a morphological and aesthetic point of view but also in terms of interaction, user experience, safety and reliability. The complexity of the interaction with new technologies requires a multidisciplinary collaboration and their effectiveness depends on the analysis of the users' needs. However, very often the HCD approach is not embedded within the development processes of these technologies. Only a few studies attempted to integrate the scientific view of Ergonomics/Human Factors and HCD within the intervention area of human-robot-assistive technology interaction.
Some of the design principles for applying the HCD approach to the domain of new technologies are summarized by [56]: priority of human needs and requirements; clear communication to users of the potential of technologies; integration of quantitative (weight, size, etc.) and qualitative (sensory qualities, cultural context of reference users, etc.) design criteria; adequacy of solutions called to operate in different environments and with various types of users; possibility of reconfiguration; resilience and long-term sustainability, in order to reduce complexity as much as possible.
Pollmann & Fronemann, [57] transferred a need-based design approach to the HRI domain, resulting in the *UXellence® Framework*. Their aim is to define interaction strategies for the acceptability of social robots by integrating user research methods in order to identify relevant needs early in the design process. The framework consists of ten psychological users' needs: safety; priorities; self-expression; feeling close to those who are important; being popular and appreciated by others; being in positive competition with others; maintaining one's own well-being; feeling able to master challenges, which includes autonomy; accomplishing something in one's environment and with others; stimulation, curiosity, and exploration of new things.
The contribution of design and its approaches and methodologies is aimed at the development of truly human-centered technologies, which are built with respect for fundamental human rights and which can be adaptive according to different beliefs, expectations and desires of individual users, supporting their independence and assisting them in improving their well-being and quality of life.
A *good design* also involves another meaning of the word *good*: that is, *fair*, *ethical*. This implies a deep reflection by designers that have to develop new technologies: they should reflect on the consequences of the development and of the use by people of a product/system/environment. Moreover, the relationship between users and designers is based on extreme *trust*: every time people use a product, they trust that the designer has carried out his work in an ethical manner. Therefore, it is up to the designer to become aware of this tacit agreement and to respect it [58]. The HCD approach can provide for a design that takes into account the values and human rights common to all people, as well as general and specific psycho-social contexts, to use them as reference points throughout the iterative process of development and validation.
The Ergonomics for Design and the HCD approach has been successfully applied within the CloudIA research program (Fig. 1) aimed at developing and testing innovative Cloud solutions, including a robot, two wearable devices and a sensor system into a smart environment, in order to improve the quality of life of older people and support the caregivers' activities [59]. The CloudIA research program includes a partnership made of five social cooperatives of the Tuscan territory and two Research Organizations: the Laboratory of Ergonomics and Design (LED) of the Department of Architecture of the University of Florence and the Department of Biorobotics of the Scuola Universitaria Superiore S. Anna of Pisa.

5. Discussion and conclusion

This paper shows the contribution of design in relation to new technologies for *ageing in place*, in order to support the development of technologies based on effective and intuitive interaction, absence of stigma, reliability and safety and able to ensure a positive user experience from both a hedonic and functional point of view. In fact, in addition to factors related only to use, aesthetics and functionality, there is also a strong emotional component in the way people interact with products [43], especially in the case of those with a strong social and interactive component such as assistive and social robots and new technologies in general. The emotional factor of interaction with social and assistive

Fig. 1: The robot, wearable devices and the sensor system developed within the CloudIA research project.

technologies, together with the pleasure of use, is the intrinsic motivation that drives people to use systems, products or services.
Research in these areas includes studies covering a variety of contexts of use, activities, different kinds of wearables, robotic systems and smart environments which can offer different types of interaction for a wide range of users. However, the scientific literature points to the need not to replace but to integrate existing systems of care and assistance with new digital technologies [60].
The challenges for designers of new technologies concern both technical and psychological, ethical and social aspects, since the ultimate goal of these technological products/systems is to make human care more efficient, enriching the interaction between people.
In this perspective, the Human-Centred Design (HCD), Ergonomics for Design and Design for Health can offer its contribution in terms of: identification and analysis of users' needs and expectations in order to create people-centered products; development of assistive technologies in relation to shared human values, since the ethical beliefs of society are reflected within the technologies that, in turn, transmit them to people [12, 43]. In addition, there is a natural extension of the skills needed to design assistive technologies which makes it necessary for various professionals, such as psychologists, sociologists, designers, etc., to collaborate. On this basis, the designer becomes a catalyst for the different professional skills involved in the project, providing the contribution to innovation and competitiveness that has been recognized by the European Union in the Commission Staff Working Document, which looks at "Design as a driver of user-centred innovation" [61].
Finally, the contribution of design concerns both the project strategies and the *research through design*: designers are professionals able to identify people's needs and translate them into tangible solutions but they are also responsible, from an ethical and social point of view, for the use and dissemination of technologies designed to support and not replace human work.

Paper contributions

Francesca Tosi, Claudia Becchimanzi and Mattia Pistolesi have equally contributed to the drafting of this paper.

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