DA – DIPARTIMENTO DI ARCHITETTURA
ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Collana del Dipartimento di Architettura – DA
Alma Mater Studiorum – Università di Bologna
Direttore: Fabrizio Ivan Apollonio.
Comitato Scientifico:
Matteo Agnoletto, Ernesto Antonini, Fabrizio Apollonio, Cristiana Bartolomei, Andrea Borsari, Francesco Ceccarelli, Flaviano Celaschi, Federico Fallavollita, Filippo Fantini, Annarita Ferrante, Elena Maria Formia, Francisco Gallego Roca, Valentina Gianfrate, Riccardo Gulli, Carola Hein, Stefen Holzer, Piotr Kuroczynski, Giovanni Leoni, Thomas Leslie, Danila Longo, Gino Malacarne, Giovanni Mochi, Dijon Moraes jr, Marco Pretelli, Rasmus Henrik Reeh, Uwe Schroeder, Gianni Sinni, Simona Tondelli, Corrado Topi, Annalisa Trentin, Andrea Ugolini.
Coordinamento editoriale della Collana: Micaela Antonucci.

Il Comitato assicura attraverso un processo di double-blind peer review la validità scientifica dei volumi pubblicati.

Ricerca svolta nell'ambito del progetto Dipartimenti Eccellenti del MIUR 2018-2022.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI ARCHITETTURA
DIPARTIMENTO DI ECCELLENZA MIUR
(L. 232 DEL 1/12/2016)

Fondazione Bologna University Press
Via Saragozza 10, 40123 Bologna
tel. (+39) 051 232 882 – fax (+39) 051 221 019

ISSN 2385-0515
ISBN: 979-12-5477-165-5
ISBN online: 979-12-5477-166-2

www.buponline.com
info@buponline.com

In copertina: Image generated by the sentence "head with VR headset, wallpaper"
with Midjourney AI by Michele Zannoni.

Progetto grafico: Gianluca Bollina-DoppioClickArt (Bologna)
Impaginazione: Design People (Bologna)

Stampa: Global Print (Gorgonzola, Milano)

Prima edizione: novembre 2022

Human Body Interaction

edited by Michele Zannoni, Roberto Montanari

Bologna
University Press

Summary

HUMAN BODIES, SYSTEM AND MACHINE INTERACTION

HUMAN BODIES, DIGITAL DATA AND SOCIAL IMPACTS

HUMAN-CENTERED TECHNOLOGIES FOR A MORE SENIOR-FRIENDLY SOCIETY

Giuseppe Mincolelli, Gian Andrea Giacobone*, Silvia Imbesi**

Introduction

The increase in life expectancy has globally shown a significant acceleration in recent decades. In developing countries, this is mainly due to a reduction in infant mortality, but a global trend is that of a reduction in mortality in the elderly population, a phenomenon that is particularly noticeable in high-income countries. The global aging of humanity, the change in the quantitative relationship between young and old, is a novelty in the history of mankind which has, and will have more and more in the near future, consequences on the structure and quality of our living environment at the social, economic and cultural level. This evolution in the composition of the population, like any radical change, can have positive or negative consequences depending on the strategy with which we will face it.

The older generations have a wealth of wisdom and experience that represents immense value for the new generations, as long as communication is encouraged. On the other hand, an older population can constitute a burden on the health system which risks becoming unsustainable if current strategies and tools are maintained (Beard et al., 2012). Especially in richer countries, the healthcare system for the elderly is focused on the costly treatment of acute and severe syndromes, rather than on maintaining a healthy lifestyle. It is clear that an increase in the number of patients requiring expensive care in the last few years of their lives can pose a financial risk that is difficult to deal with.

In its 2015 "World report on aging and health", WHO clearly stated that "most of the health problems of older age are the result of chronic diseases. Many of these can be prevented or delayed by engaging in healthy behaviors" (Who, 2015). In other words, if we all led a healthy lifestyle and prevented the conse-

** Dipartimento di Architettura, Università degli Studi di Ferrara, Italy*

On the left:
1. Some of the smart objects developed within the HABITAT project.

quences of syndromes, diseases, or risky health states through monitoring and preventive care, not only could we prolong an active and satisfying life even in old age, but we could reduce the impact of the high costs of severe geriatric syndromes on the health system significantly. In the same report, the WHO underlines how the consequences of lifestyle and behavior on the health of the elderly depend only in part on personal choices and are significantly due to the characteristics of the environment and the social system. There is also a cultural obstacle to overcome in order to encourage a change in the behavior and mindset of both the elderly and the people who are candidates to be so: age-related stereotypes.

What are elderly persons, what goals and ambitions can they have, what lifestyle can they lead, and what is, more generally, their potential, are concepts that are affected by an inadequate cultural heritage, matured in very different times from today. In particular, one of the greatest risks is discrimination and generational segregation which greatly limits the possibilities for cooperation, dialogue and social understanding. In this extremely complex and rapidly evolving scenario, in addition to the risk factors listed above, we can fortunately also identify opportunities that can help find both short and long-term strategies and solutions. The digital revolution, together with the expansion of the internet from people to things, continuously proposes new tools or technologies that are suitable or adaptable to the issue of behavioral change. Advanced sensors, wearable devices, pervasive computing, and smart objects allow us to offer different types of monitoring, tutoring, and empowerment services in any place and in a personalized way. It is possible, for a designer or, better, for a team of innovators, to propose personal and environmental systems and services with which to promote autonomy and independence, improve awareness of the health and well-being of one's body, monitor its status as a function of time at different scales, disseminate knowledge on the most advanced systems of preventive health and on the lifestyles recommended for each (Mincolelli et al., 2018).

In this paper we present some projects developed by Quid, the design research unit of the Department of Architecture of the University of Ferrara and of the TekneHub, laboratory of the High Technology Network of the Emilia Romagna Region,

in the last five years, which have as their theme the conception of strategies and tools for the empowerment of elderly people through the improvement of the performance of the lived environments and the increase of awareness on lifestyles for behavioral change.

Methodology

Our design research unit deals with innovating systems of products, services, and environments capable of improving the quality of life by increasing environmental, economic, and social sustainability and inclusiveness (Mincolelli et al., 2020). With this in mind, we have defined a set of constantly evolving methodological tools that can be summarized in the following categories/principles:

1. Human-centered design (HCD) and not only human. At the heart of the project are human society and the improvement of the quality of life. In addition to the traditional HCD approach, which involves the analysis of users and stakeholders of the studied systems, the needs of the stakeholders belonging to the environmental ecosystem and biosphere and those of the artificial intelligence or digital stakeholders that can influence the results are also taken into account.
2. Multidisciplinary approach. In dealing with complex problems, the contribution of very diversified skills and knowledge is necessary. We have developed tools, such as an advanced version of the Quality Function Deployment and specific canvas for collaboration between experts who follow both quantitative and qualitative approaches to research and allow effective collaboration, from the sharing of objectives to the awareness of the development of the project in the different areas, and co-evaluation of the results achieved.
3. Codesign-make it tangible-fail fast. Users and stakeholders are involved from the early stages of the project, even during the analysis of the problem. Interaction is not limited to discussion, designers act as facilitators to allow users and

stakeholders to develop design proposals. The proposals are made understandable to everyone through the continuous creation of prototypes of increasing realisticity, in order to make them fail as soon as possible, without impacting too much on the costs and timing of the project.
4. Technological acceptance-usability. Prototypes are continuously tested in real and simulated environments. The results of the tests determine the survival of the project proposals.
5. Natural interfaces and behavioral change. We are looking for ways of interaction that are easily understandable and do not require an upset of life habits but are capable of suggesting and promoting behaviors and attitudes that improve the quality of life without constraints and without distracting from life itself.

HABITAT: Home Assistance Basata su Internet of Things per l'Autonomia di Tutti

An innovative application of the previously described methodology was developed by the QUID design research unit in the project HABITAT (Home Assistance Basata su Internet of things per l'Autonomia di Tutti). HABITAT was funded by the Emilia-Romagna Region within the POR 2014-2020 funding campaign, promoting innovative research projects faced by multidisciplinary teams.

The project team was led by CIRI ICT (Interdepartmental Center for Industrial Research specialized in radiofrequency systems) and composed of the following partners: CIRI SDV (Interdepartmental Center for Industrial Research, Health Sciences and Technologies of the University of Bologna, expert in technical validation of inertial sensors), TekneHub (Technopole of the University of Ferrara belonging to the Construction Thematic Platform of the Emilia-Romagna Region high-tech network, working in the field of User Centered Design and Inclusive Design), ASC Insieme (Azienda Servizi per la Cittadinanza of Bologna province) and Romagna Tech (innovation agency of Romagna, competent on dis- semination of results). These institutions were assisted in the smart solutions' prototyping by

several companies with significant knowledge in their industrial fields.

HABITAT aimed to develop and test innovative solutions to encourage older people's autonomy, postpone the necessity of personal assistance and improve the quality of life of self-sufficient and non-self-sufficient elderly and people taking care of them. Specifically, common daily products and furniture were enriched with Artificial Intelligence becoming smart objects able to interoperate in a smart open system. These devices can monitor the person's behaviors and habits and autonomously adapt themselves, in real-time, following the user's needs during daily activities in their own environment (Borelli et al., 2019; Mincolelli et al., 2020).

The project followed a HCD approach involving from the beginning different categories of users as elder people, their relatives and caregivers, social and medical operators of community contexts and stakeholders of the healthcare and industrial fields.

During HABITAT were prototype several smart solutions interconnected in a smart platform thanks to IoT:

- A smart armchair integrating sensors in its structure, able to detect incorrect posture, sedentary time and some user's parameters.
- A smart wall lamp working as an indoor localization system thanks to a reader and a wearable tag. This object is able to detect dangerous situations monitoring the user's gait and movements in the house.
- A smart belt integrating inertial sensors and the previously cited wearable tag. This device detects the person's position and postures, reporting any falls or dangerous events.
- A smart wall frame with an integrated touchscreen acting as the user interface of the whole system. This device sends personalized graphical and vocal messages, reminders and alarms to the person suggesting a safe and healthy daily lifestyle.

The design of each device was developed in collaboration with the multidisciplinary research team and with the participation of different typologies of users in specific meetings, participatory activities and co-design workshops. Prototypes were itera-

tively tested with users for the selection of solutions presenting a high level of accessibility and usability. The final prototypes were tested out of the laboratory context in an apartment specially set up for the implementation of the testing protocol, simulating users' daily routines. The results of the project were officially presented at the international fair Exposanità in Bologna in 2020.

The HABITAT project is characterized by a discrete but innovative use of technology used for the satisfaction of the person's needs. The possibility of personalization, in every context allowing it, significantly implements users' acceptance and the possibility of satisfying peculiar requirements given by a condition of frailty.

PLEINAIR: Parchi Liberi E Inclusivi in Network per l'Attività Intergenerazionale Ricreativa e fisica

PLEINAIR is the acronym of Free and Inclusive Parks in Networks for Recreational and Physical Intergenerational Activities and is the second interdisciplinary project developed by QUID within the Emilia Romagna's regional grant agreement POR FESR 2014-2020. The project was coordinated by DataRiver and involved the following academic and industrial partners: CIRI SDV, Future Technology Lab, TekneHub, A.I.A.S., Ergotek srl, Sarba spa, and mHealth Technologies srl.

PLEINAIR embraces the concept of the active city (Dorato, 2020) to discourage sedentary lifestyles – caused by different contextual factors such as high urbanization, aging population and misuse of technology (Park et al., 2020) – and reduce its negative health impact on society by developing an enabling built environment that encourages citizens of all ages and capabilities to be physically active in everyday life through equitable access to urban public spaces.

The project proposes the development of an IoMT-based system (Internet of Medical Things) that stimulates citizens to perform physical activity and, hence, to mitigate the impact of aging on their quality of life, by interacting directly with a series of recreative and outdoor fitness furnishings, named Outdoor Smart Objects (Osos), which provide adaptable and personal-

ized experiences according to physical and cognitive characteristics and capabilities of each user.

PLEINAIR aims to foster conviviality and socialization by designing inclusive urban spaces that reduce social berries by fostering an intergenerational environment in which seniors, adults, teenagers and children can share experiences, and activities, build social relationships and enhance communication with each other without any restriction.

Due to Covid-19, PLEINAIR adopted a HCD methodology (Mincolelli et al., 2020) but also speculative design and hybrid co-design techniques to envision and develop the final prototypes engaging with the users both in physical and remote environments (Mincolelli et al., 2021; Mincolelli et al., 2022). The activities involved stakeholders from municipalities, educational institutions and daycare centers.

The final result consists of four OSOs connected to each other through a cloud-based IoT platform and a mobile application, which enable the users to engage with the smart products:

- An interactive floor made up of several smart tiles equipped with sensors and visual feedback that provide interactive games or fitness activities configurable from the mobile application. The smart tiles are the core of the project because they can record the users' performance and elaborate tailored experiences and personalized motivational strategies based on their capabilities and preferences recorded during a specific physical activity.
- An integrated furnishing made up of three smart elements, which are a green unit for monitoring plants, a smart table for playing inclusive cognitive games and a fitness smart bench for physical exercises. The smart tiles embedded in the table and bench provide interactive activities.
- A comfortable swivel chair equipped with a sunshade and a rotating base that guarantees intergenerational socialization, weather protection or privacy depending on its configuration in the environment.
- An ergonomic smart chair made up of a stand assist lift (based under the seat), which is able to recognize fragile citizens and enables them to sit or stand up autonomously.

2. Some of the outdoor smart objects developed during the research activities of the PLEINAIR project.

In the last research phase, the final prototypes were officially installed inside the Museo della Civiltà Contadina, in Bentivoglio (BO), Italy, in which were tested and validated through an iterative and interactive process with the final users. The testing phase lasted two months – from the 23rd of October to the 17th of December 2021 – and involved about 114 users, including children, teenagers, adults, seniors and fragile people. The tests gathered positive feedback from the audience but also many considerations to improve the usability and inclusiveness of the interactive activities, especially those addressed to the elderly.

PASSO project: Smart sensory cues for older users affected by Parkinson's disease

The PASSO project (PArkinson's Smart Sensory cues for Olders), started as a doctoral research project exploring Human Centered methodologies applied to the field of Inclusive Design addressed to niche users with special requirements. Specifically, this project is addressed to elder users facing the first stages of Parkinson's disease (PD), affecting primarily motor abilities related to maintaining a correct posture and practicing an efficient gait (Meara & Koller, 2000).

The project was developed by Silvia Imbesi, attending the IDAUP Doctoral Program (International Doctorate Architecture and Urban Planning) at the Department of Architecture of the University of Ferrara in Italy, supervised by Professor Giuseppe Mincolelli, in collaboration with engineers of CIRI SDV (Scienze della Vita e Tecnologie per la Salute) of the Department of Electrical, Electronic, and Information Engineering "Guglielmo Marconi" and medical researchers of IRCCS Istituto Scienze Neurologiche, both located in Bologna, Italy.

The design research project regards an innovative mHealth system using biofeedback for the rehabilitation of gait and postural disturbances in persons with PD. Results obtained in the PASSO project are supposed to be used in ambulatory contexts and outside specialized centers to rehabilitate postural and transient gait disturbances and to provide training sessions at home (Imbesi et al., 2021; Imbesi & Mincolelli, 2020).

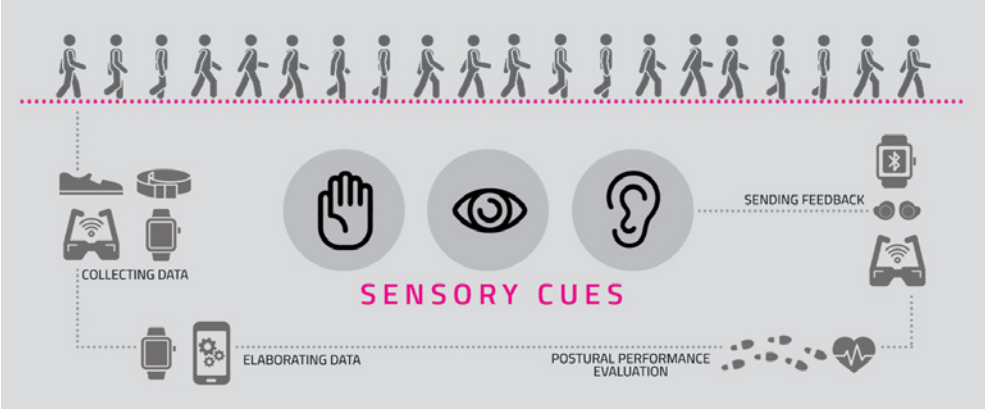
The PASSO project followed an iterative HCD approach: the design process was divided into three main iterative cycles, each one engaging all researchers of the multidisciplinary team. Even different categories of users were involved in the design process to improve the system's usability, accessibility and level of needs satisfaction. The used methodology proved to be effective for multidisciplinary design processes balancing both human and technological factors for the development of smart systems targeted to niche users.

The first design cycle of the PASSO project investigated how visual, auditory, and haptic cues can positively impact on the users' gait. Several sensory cues were tested to understand which typology of stimulation mainly influences users' gait and on which gait spatio-temporal parameters the designed sensory signals mostly impact.

During the second design cycle, a mHealth system based on a wireless body sensor network was developed. This smart wearable system allows the monitoring of trunk postural features and the real-time submission of haptic cues to correct unbalanced postures. Thanks to smartwatches positioned in the shoulders area, haptic cues encourage users to correct their trunk postural behavior, depending on the specific clinical needs.

The third and last design cycle was dedicated to the system interface. The graphic image of the web application managing the system was developed in several versions following the requirements of the different typologies of users involved in the design process. The whole system was tested with users with PD to assess its functionality, usability, ease of use and wearability.

The whole project investigated the relationship between users and wearable objects transmitting biofeedback as prosthesis for the human body, able to improve posture and walking performances. The smart Health system is able to help the person in managing daily tasks properly and autonomously. The methodological approach led to satisfactory results, the project outputs can be considered as relevant in the field of design methodologies for the design of smart devices aiming to improve older users' health and wellbeing.



3. Scheme representing elements of the system.

Conclusion

The analysis of the three research projects shows that the adoption of HCD methodologies determines the chance of obtaining inclusive and qualitative solutions capable of enhancing older people's quality of life through a multidimensional approach. Indeed, the three projects investigated well-being as a multifaceted phenomenon at different scales and environments, including both the primary purpose of the individuals' care and the social-normative criteria of the subject's person-environment system, which generally refers to happiness, self-contentment, satisfying social relationships and autonomy (Kunzmann et al., 2000).

From that perspective, the research team developed inclusive enabling technologies building resilience among older people by empowering their cognition, functioning, and physical conditions through scalable assistive environments. The final developed solutions aim to foster an active and meaningful life by optimizing participation opportunities in paths of health, safety and socialization, which together are responsible for increasing the quality of physical and mental well-being.

The adopted methods merged the elderly's functional and objective conditions with their intimate and subjective experiences, since their ability to act in the world is equally important to trust and self-esteem, acceptance and wish of sharing personal needs, limits, and abilities (Pollini et al., 2022).

Involving older people in the early stages of the activities helped the projects to raise awareness and acceptance of self-management technologies, building experiences that offer personal care able to maintain independence in daily activities. The HCD methodology involved not only the elderly but also their families and other complementary stakeholders, such as local communities, educational institutions, daycare centers, caregivers, doctors or policymakers, who contributed to face up new social challenges at a systemic scale, building collective solutions and successful projects that embrace the perspectives of a multitude of people.

Lastly, the development of interconnected technologies, such as Artificial Intelligence and Internet of Things, enabled the projects to focus on exploring new values, including, on one side, adaptability and empowerment by developing personalized digital aids, on the other side, autonomy and perceived self-efficacy through lifestyle monitoring. These multidimensional factors were identified through the adoption of a HCD and data-driven approach moving the research activities close to the resourceful aging framework (Giaccardi et al., 2016), aiming at empowering older people to age resourcefully by enhancing health prevention while stimulating and motivating people themselves in improving their everyday lives.

Notes

The paper was conceived by Giuseppe Mincolelli and written and reviewed jointly by the authors. Giuseppe Mincolelli produced "Introduction" and "Methodology"; Gian Andrea Giacobone produced "PLEINAIR: Parchi Liberi E Inclusivi in Network per l'Attività Intergenerazionale Ricreativa e fisica" and "Conclusion" and Silvia Imbesi produced "HABITAT: Home AssistanceAssistence Basata su Interner of Things per l'Autonomia di Tutti" and "PASSO project: Smart sensory cues for older users affected by Parkinson's disease".

References

Beard et al., 2012
Beard J., Biggs S., Bloom D.E., Fried L.P., Hogan P.R., Kalache A., & Olshansky S.J. (2012). *Global Population Ageing: Peril or Promise?*. PGDA Working Papers No. 8912. Program on the Global Demography of Aging. https://ideas.repec.org/p/gdm/wpaper/8912.html.

Borelli et al., 2019
Borelli E., Paolini G., Antoniazzi F., Barbiroli M., Benassi F., Chesani F., Chiari L., Fantini M., Fuschini F., Galassi A., Giacobone G.A., Imbesi S., Licciardello M., Loreti D., Marchi M., Masotti D., Mello P., Mellone S., Mincolelli G., Raffaelli C., Roffia L., Cinotti T.S., Tacconi C., Tamburini P., Zoli M., & Costanzo A. (2019). HABITAT: An IoT Solution for Independent Elderly. *Sensors*, 19(5), 1258. https://doi.org/10.3390/s19051258.

Dorato, 2020
Dorato E. (2020). *Preventive Urbanism: the Role of Health in Designing Active Cities*. Quodlibet Studio.

Giaccardi et al., 2016
Giaccardi E., Kuijerb L., & Nevenc L. (2016). Design for Resourceful Ageing: Intervening in the Ethics of Gerontechnology. In Lloyd P., & Bohemia E. (eds.), *The Future Focused Thinking - DRS International Conference 2016* (pp. 3552-3566). 27-30 June, Brighton, United Kingdom. https://doi.org/10.21606/drs.2016.258.

Imbesi & Mincolelli, 2020
Imbesi S., & Mincolelli G. (2020). Design of Smart Devices for Older People: A User Centered Approach for the Collection of Users' Needs. In Ahram T., Karwowski W., Vergnano A., Leali F., & Taiar R. (eds.), *Intelligent Human Systems Integration 2020* (Vol. 1131, pp. 860-864). Springer. https://doi.org/10.1007/978-3-030-39512-4_131.

Imbesi et al., 2021
Imbesi S., Corzani M., Petrocchi F., Lopane G., Chiari L., & Mincolelli G. (2021). User-Centered Design of Cues with Smart Glasses for Gait Rehabilitation in People with Parkinson's Disease: A Methodology for the Analysis of Human Requirements and Cues Effectiveness. In Wright J.L., Barber D., Scataglini S., & Rajulu S.L. (eds.), *Advances in Simulation and Digital Human Modeling* (Vol. 264, pp. 348-358). Springer. https://doi.org/10.1007/978-3-030-79763-8_42.

Kunzmann et al., 2000
Kunzmann U., Little T.D., & Smith J. (2000). Is age-related stability of subjective well-being a paradox? Cross-sectional and longitudinal evidence from the Berlin Aging Study. *Psychology and Aging*, 15, 511-526. https://doi.org/10.1037/0882-7974.15.3.511.

Meara & Koller, 2000
Meara J., & Koller W.C. (eds.) (2000). *Parkinson's Disease and Parkinsonism in the Elderly*. Cambridge University Press. https://doi.org/10.1017/CBO9780511585012.

Mincolelli et al., 2018
Mincolelli G., Marchi M., & Imbesi S. (2018). Inclusive Design for Ageing People and the Internet of Things: Understanding Needs. In Di Bucchianico G., & Kercher P.F. (eds.), *Advances in Design for Inclusion* (pp. 98-108). Springer. https://doi.org/10.1007/978-3-319-60597-5_9.

Mincolelli et al., 2020
Mincolelli G., Imbesi S., Giacobone G.A., & Marchi M. (2020). Human Centered Methodologies for the Development of Multidisciplinary Design Research in

the Field of IOT Systems: Project Habitat and Pleinair. In Ahram T., Karwowski W., Vergnano A., Leali F., & Taiar R. (eds.), *Intelligent Human Systems Integration 2020* (Vol. 1131, pp. 829-834). Springer. https://doi.org/10.1007/978-3-030-39512-4_126.

Mincolelli et al., 2021
Mincolelli G., Giacobone G.A., & Marchi, M. (2021). Project PLEINAIR: Discovering User Needs Exploring a Non-conventional Human-Centered Approach. In Shin C.S., Di Bucchianico G., Fukuda S., Ghim Y.G., Montagna G., & Carvalho C. (eds.), *Advances in Industrial Design*. (Vol. 206, pp. 363-370). Springer. https://doi.org/10.1007/978-3-030-80829-7_45.

Mincolelli et al., 2022
Mincolelli G., Giacobone G.A., & Marchi M. (2022). PLEINAIR project: participatory methodologies to validate and integrate product concepts with young users. In Di Bucchianico G. (ed.), *Design for Inclusion*. (Vol. 45, pp. 45-53). AHFE Open Access. https://doi.org/10.54941/ahfe1001868.

Park et al., 2020
Park J.H., Moon J.H., Kim H.J., Kong M.H., & Oh Y.H. (2020). Sedentary Lifestyle: Overview of Updated Evidence of Potential Health Risks. *Korean Journal of Family Medicine*, 41(6), 365-373. https://doi.org/10.4082/kjfm.20.0165.

Pollini et al., 2022
Pollini A., Giacobone G.A., & Zannoni M. (2022). Aging and Interaction: Designing for Active Living Experiences. In Scataglini S., Imbesi S., & Marques G. (eds.), *Internet of Things for Human-Centered Design. Studies in Computational Intelligence* (Vol. 1011, pp. 39-61). Springer. https://doi.org/10.1007/978-981-16-8488-3_3.

Who, 2015
WHO - World Health Organization (2015). *World report on ageing and health*. World Health Organization. https://apps.who.int/iris/handle/10665/186463.