

Design and Responsive Technologies for Human Well-being

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Abstract

The field of research involving design and well-being, finds in the development of responsive technologies and Artificial Intelligence the latest tools for mutual influence and transformation.

Research on this topic, shared at the *Disrupting Geographies in the Design World* forum, testified to the multiple and contemporary fields of investigation related both to technological development and the human sphere.

The paper proposes a clustering of research on this topic into two sets: the first group gathers research and design approaches that increase human knowledge toward digital data, the second brings together insights on behavioral changes generated by design using emerging technologies.

The results of the debate and the categorizations open new focus points aimed at improving, through the discipline of design, individual and collective well-being.

Keywords

Well-being
Health
Self-tracking
Human Body Design
Data

Introduction

Well-being and responsive technologies are an important contemporary design field combining the latest advancements in technology with wellness practices. In the continuous aspiration of humans to improve their personal well-being, a design field emerges that has grown along several dimensions: linked to the relationship between body and product –more and more dematerialized, losing the gestural nature and the physicality– related to medical sciences, food, fitness activities, self-tracking system, and linked to behavior change. In this transformative scenario, the individual becomes the center of a knowledge process that changes and transforms his/her body towards a renewed balance between design and technology. The debate we wish to open in this contribution is related to the research of models in which the human being is part of a system of well-being between interpretation and prediction and how the human body is involved and changes his behaviors.

Designers could play a critical role in the development of these innovative artifacts, and they are responsible for designing the tangible forms, the interfaces, and the user experience of this new class of products, ensuring that they are helpful, respond to the real needs, and intuitive for the user. They work in multidisciplinary teams with developers, researchers, and other team members to create a useful and engaging experience for the people.

These design approaches to technologies can help to create products and services that provide people with new tools to monitor and improve their physical and mental health that can be customized to fit the unique needs of each person. Some examples of responsive technologies include wearables that track fitness and sleep patterns, virtual reality therapy, and AI-powered mental health apps. As the field of wellness and responsive technologies continues to grow, it has the potential to revolutionize the way we approach healthcare and well-being.

The development of emotion analysis technologies such as computer vision, and natural language processing, has facilitated the adoption of these techniques beyond monitoring or diagnostic, moving towards interventions to facilitate well-being. AI-augmented applications such as avatars, and bots are indeed used for digital therapeutics by accessing peoples' emotions, to cure and prevent medical disorders (Hamada & Kanai, 2022). Recent advancements in machine learning have enabled hyper-realistic animation of faces and the cloning of voices from fictional to non-fictional characters. Beyond the malicious use like for example Deepfakes, researchers highlight how these technologies offer new opportunities for creating interactions with digital characters that can deeply engage us: AI agents may be able to provide support through voice-based conversations and facial expressions with the potential to enable deeper personalization and increased trust on the interaction (Pataranutaporn et al., 2021). Another important step is constituted by the set of *embodied AI*, or artificial agents able to learn through interactions with their surrounding environments (Duan et al., 2022). This is about giving for example social robots another dimension for unscripted interactions perceiving them as independent agents with their own motivations and desires. For example, Robin, the social robot for

diabetic children, behaves in a way where sometimes it disengages from interaction with the children to look for other things or initiate other activities. This characteristic, including *having* diabetes, and its capacity to provide personalized experiences, makes it a *life-like* character meaningful to diabetic children (Cañamero & Lewis, 2016). The embedded capability of these systems to make decisions fueled by data and independently from human assistance, makes them face ethical challenges related to data governance, consent, ownership, and privacy. AIs are in a way influencing forces that can shape our choices and actions, but they could also foster positive social interaction and cooperation, key elements to human well-being. This opens a broad challenge for engineers, designers, and policymakers in shaping our socio-technical system. Human existence is embedded in a network of physical, biological, and social relationships. AI tools are becoming an important part of this ecosystem and they have the potential to reconnect us on an individual and community level, considering all the multidimensional values involved.

Knowledge and behavior as a cluster of trends for human well-being

In the field of research on responsive technologies, a technological level of digital systems is emerging that increasingly enables the reading of human complexity and offers possibilities for providing dynamic responses to the singularity of people.

The studies shared during the Forum bear significant witness to the multiple and contemporary exploration fields investigated by design. These can be clustered into two sets: the first groups research and design approaches that augment human knowledge toward digital data; the second brings together insights into the behavior generated by designs using emerging technologies.

Knowledge

The focus of this group of research is the dialogue between the human body and digital data related to a place or to an entity. These data contribute to characterizing the spaces from which they come (Zannoni, 2018) or the objects that are expressing them. The translocation of these data into elements that can be experienced in the human perceptual field is an area of research and design characterized by high complexity. Tools capable of augmenting the reach of sensory channels have been described by Tomás Maldonado (Maldonado, 1997) as sensory-perceptual prostheses, and their presence in research and the market is evidenced by numerous case studies. The application areas of these projects are mainly health, professional and amateur sports, and wellness related to lifestyles.

The body aimed at self-knowledge

Projects and research that use human physiological and behavioral data with the goal of acting on the person from whom they are derived, are inscribed in the research field of *quantified self* (Swan, 2013). This topic is widely established in the marketplace as evidenced by the widespread tracking systems of physiological parameters in the field of sports and health (Zannoni et al., 2022). Despite the stable presence of the research strand, there are many innovative directions in which researchers are working in recent years.

An interesting reflection on this issue is proposed by Antonella Valeria Penati and Carlo Emilio Standoli. The research highlights how difficult it is to measure the results of design interventions. This is especially so when a prolonged temporality enters the experiences with the consequent effects on perception and human dynamics. With respect to these analyses, the discipline of design is identified as an inclusive and collaborative tool for generating an ethical breakthrough.

This turn seems to be glimpsed within the research presented by Giuseppe Mincoelli, Gian Andrea Giacobone, and Michele Marchi. The paper shows the results achieved by the PLEINAIR project in which the data collected were used in order to raise awareness of behaviors aimed at improving well-being and mitigating the impact of aging on the quality of life.

The body aimed at the knowledge of others

Physiological and behavioral data used to give answers outside the individual from which they were extracted is a frontier area for both design and other scientific disciplines. Here technology aims to recognize behavioral categories from the data itself; an example is the research field of *affective computing* (Karyotis et al., 2017) in which face-tracking software recognizes emotions.

These data can also be translated into object behaviors that become mediators between people. The importance of such research is growing as robots become more ubiquitous in everyday life. Within this field is the research presented by Lorenza Abbate and Claudio Germak. The two authors investigate how design can express itself within the empathic implementation processes of telepresence robots through communication processes –bodily, gestural, and vocal– in relation to social contexts.

Designing in this field requires multidisciplinary skills and many different stakeholders. Design has a duty to enter these processes and understand the mechanisms through which to dialogue with other disciplines. With this goal, researchers Christian Mendoza, Roberto Íñiguez Flores, and Ruth León Morán measured themselves against the role of design and specifically the creative process in synergy with engineering disciplines.

The area of research aimed at transforming environmental data into elements related to the field of perception is broad (Gellersen et al., 1999). Significant representations of this field are embodied both by designs that intervene in close connection with the perception of individuals and by those that translate data into characterizations of collective spaces. In the first category belong, for example, the experiments by cyborg artists Neil Harbisson and Moon Ribas¹, both of whom are engaged in transforming a datum of the environment into a sensation experienced by their own bodies. In the second category, we find projects pertaining to the fields of digital placemaking, digital wayfinding, or digital sensemaking (Dall'Osso et al., 2022). Here, sensors diffused in space through citizen action (De Greve et al., 2022) collect information that can be translated into sensations that can be experienced through space.

The analysis presented by Elena Cavallin compares data-driven designs that act close to the human body with those more distant from it. It emerges from the literature and case studies review that the impact on well-being is more measurable when acting in proximity to the user than in designs more distant in time and space.

The complexity that emerges in these processes calls designers and researchers to question about ways of designing. With such a need, Margherita Ascari, Andrea Cattabriga, Simona Colitti, and Ami Liçaj focus the attention of their research on ways of representing design processes highlighting the need to imagine new nonlinear models.

Closely associated with the evolution of design practices is the need to develop tools for accountability to complex systems. Around this need is the analytical work proposed by Jane Vita, Tiina Mäkelä, and Teemu Leinonen. The researchers show how technological innovations, when managed with systemic and participatory action, can support an understanding of human rights, regulations, the environment, and biodiversity.

A significant contribution to the project is the expressive possibilities derived from materials research. Innovations in this field have great potential as Noemi Emidi's work demonstrates. Innovative configurations derived from interactive, dynamic, and bio-inspired materials design open up renewed experiences of comfort and meaning related to environments.

Behaviour

The field of designing objects, systems, and services to affect the body, mind, and more specifically human behavior, has grown exponentially since the 1980s, following the spread and subsequent increase in the use of technological tools. Starting from Donald Norman's early thought on the psychology of everyday objects (Norman, 1988), through *captology* (Computers as persuasive technology) (Fogg, 2002), to the more recent teachings on *Nudges* (Thaler & Sunstein, 2021), the theories and techniques used to design changes in behavior through technological tools are numerous and frequently adopted in a variety of fields, for example, the medical one or those related to mental and physical well-being.

This research converge fields of knowledge related to embodiment theories, the phenomenology of perception (Merleau-Ponty, 1945), and neuroscience.

The spaces in which the human body moves and interacts are tangible, virtual, or mixed. The research collected in this cluster, highlights multiple ways in which digital technology intervenes by demanding behavioral responses.

The triggered body

The body reacts continuously to external stimuli, and its reactions are determined in most cases by psycho-physical triggers (Safer, 2013) which affect the individual's sphere of interest. In this case, the body is temporarily activated, and attention is captured *here and now* by triggering cognitive, perceptual, and emotional channels.

Activate is a verb that is often used in the field of design for the enhancement of cultural heritage, and it is meant to emphasize the design activity aimed at making Heritage more usable and accessible (Lupo, 2021). Also called *activating objects* in this context are those artifacts that, upon the user's gesture, trigger audio-visual content.

The contributions offered in the Forum confirm that one of the application areas of research in which digital technologies are used to activate body reactions is precisely the museum field. Alessandra Miano's work clearly expresses how much this kind of design can strengthen visitor experiences of fruition and engagement. Museum spaces, densified with multisensory actions, activate reciprocal relationships between users and artifacts, strengthening narrative and cognitive action.

Enhancing cultural heritage through augmented digital experiences is also the focus of Letizia Bollini and Marco Borsotti's reflections. The researchers explore the evolution of exhibition languages and practices and, through a Design-Driven Innovation perspective, investigate multiple design directions in which the human is at the center of a communicative ecosystem. In this perspective, the multiple nature of space can respond to the narrative components of exhibits while preserving a balance between body and technology.

Another area in which the body is activated by external agents and stimuli is food. Lígia Afreixo and Francisco Providência propose research with an ethnographic point of view that examines how different ingredients and cooking methods give rise to multiple constructive, organoleptic, and functional characteristics. The reasoning considers different cultures and extends to new technologies through which results comparable to industrial processes can be achieved.

The conditioned body

Conditioning is often conveyed by physical stimuli related to the perceptual, emotional, and psychological spheres, but only when the action is repeated does the behavior change take on the characteristics of habit.

Examples of objects that condition the body include smart water bottles-such as the Hidrate Spark², which reminds the user to drink through visual and haptic feedback, the smart object Doppel³, designed and developed by Fotini Markopoulou, Jack Hooper, Andreas Bilicki, and Nell Bennett, a wearable device worn on the wrist that through vibration reduces stress and increases the user's attention or Ellie⁴ the pills organizer that reminds the user of pills to take in a relatively long time frame.

2
hidratespark.com

3
feeldoppel.com

4
elliegrid.com

Also fitting within the area of psychophysical well-being and medical prevention is PASSO Project by Silvia Imbesi and Giuseppe Mincolelli. The project aims to develop an innovative biofeedback system specifically designed to monitor and rehabilitate gait and postural impairments in people affected by Parkinson's Disease, during specific training sessions in domestic and ambulatory environments.

Also Pathos by Elisa L'Angiocola and Angela Giambattista is a project aimed at the well-being of patients in the hospital setting and proposes a service to enhance a good hospitalization experience aimed particularly at women treated in the gynaecological-obstetric department. The system involves monitoring patients' emotions through a device, thereby changing, in this way, the behaviors and type of communication of nursing and medical staff in relation to changing moods.

Finally, Francesca Bonetti and Giorgio Casoni propose an interesting research project that aims to enhance the cognitive abilities and performance of people in the workplace through the neurotechnology used in the Brain Wellness program. In the latter case wearable biofeedback sensors as well as different training sessions, lead users to modify their behavior by reducing stress and anxiety, and increasing determining components such as focused and sustained attention, awareness, resilience, and mental presence.

The communicative body

Awareness, consciousness-raising, and consequent behavior modification also pass through the communicative sphere. The representation of data or the immediate visualization of complex information can be one of the vectors that enable the processing of thoughts and opinions. This system, acting not just at the sensory level, but also at the cognitive one, leads to greater awareness of the body in relation to the surrounding world.

There are numerous examples of such an approach, among them are the representative infographics of the daily movement of wearable devices, or the data visualizations of numerous newspapers related to the Covid-19 pandemic period.

The research of Elisabetta Cianfanelli, Margherita Tufarelli, and Elena Pucci, leak the relationship between the human body, clothing, and the surrounding world. Through a framework built by examining case studies, the researchers propose an interpretation of the most recent transformations in the fashion industry. They thus make it clear that clothing can be an important tool for making the wearer, but also those around him, aware of certain external or internal stimuli. These wrappings, for example, auto-actively transform, register feedback, or augment certain human functions.

Daniela Anna Calabi and Alice Maturo consider the apo-mediation approach as fundamental to communication and awareness processes in the field of health. In particular, responsive technologies in the health communication field stimulates solutions for accessible prevention information, thus increasing awareness, by interpreting the needs of different stakeholders-physicians, patients, and citizens. Such a communication system translates the complexity of information and makes it understandable and communicable. In this case, body awareness and consciousness-raising passes through the lens of design, which acts as a mediator and translator of data and content.

Conclusions

Within the field of well-being and responsive technologies, promising scenarios and trends emerged for future developments in body-related design.

The contributions shared during the Forum brought out two main clusters that respectively gather three research trends. The first cluster groups research investigating the relationship between specific categories of data and knowledge. The second brings together research that investigates the ways through which to provoke behavior change in individuals. In particular, the following specifics are highlighted:

CLUSTER 1 – KNOWLEDGE

The body aimed at self-knowledge, an established field developed in the scientific literature, uses physiological and behavioral data of the individual by processing and translating them for self-understanding.

The body aimed at the knowledge of others uses physiological and behavioral data of individuals' bodies that are processed and translated to inform other people. This recent field is at the center of a phase of technological consolidation and is being debated and deepened with regard to its applications.

The body aimed at knowledge of its environment contemplates heterogeneous data afferent to space that are processed and translated to become part of the experience of one or more people. It turns out to be an emerging trend that is still under-researched. The many stakeholders involved make it complex and difficult to manage; despite this, this area could potentially be accessible and implementable in the future with the development of technologies, such as AI.

The triggered body which reacts in a specific time and space to a distinctly perceptible action, is within a contemporary research area that follows the evolution of technologies.

The conditioned body which reacts to a periodic or continuous action by changing the behavioral pattern of the individual is well represented by research and commercial products and appears to be one of the most promising trends for the coming years.

The communicative body among the most established trends in the design research landscape, increases people's awareness as a result of understanding information and works on the multiple forms of communication and simplification of complexity.

The result of this debate opens horizons for new meanings and focus points on design studies and practices which include research focused on products and services in which the well-being of the individuals and the collectivities are essential elements of a human-center approach to the innovative use of the technologies.

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