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# Human Body Interaction

edited by Michele Zannoni, Roberto Montanari

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# Summary

**HUMAN BODIES, SYSTEM AND MACHINE INTERACTION**



**HUMAN BODIES, DIGITAL DATA AND SOCIAL IMPACTS**

# THE INTERNATIONAL SYMPOSIUM OF FUTURE DESIGN FOR HUMAN BODY INTERACTION

*Michele Zannoni*, Roberto Montanari**, Laura Succini**

## Where we are and where we started

The idea on which the International Symposium of Future Design for Human Body Interaction[1] is based – and so is this book, whose main aim is to describe the project – was born in 2020, during a historical period that the current circumstances nowadays authorize to define as pre-Covid time. Nonetheless, the pandemic situation itself can be considered as the most explicit demonstration of how the intrinsic bond between humans and their body, while too often neglected, needs to be re-conducted at the center of a discourse that aims to discuss the individual in its complexity. The Symposium was born to build a network of professional researchers who deeply investigate the state of the art and the possible future evolutions of human-machine interfaces. It was held in Bologna on June 22, 2021 (fig. 1).

The topic had already been raised and explored in Flaviano Celaschi's recent work on Human Body Design, where the professor stresses how the contemporary development of design economies progressively focuses on the individuals who, in a now globalized social context, increasingly seeks a product built and customized for their identity, including their body (Casoni & Celaschi, 2020; Celaschi, 2016). It is precisely for this reason that, nowadays, there cannot be a discourse on the design that is detached from of a user-centric perspective, capable of putting an in-depth study of the individuals and all their needs in the first place. However, in many cases, although properly conceived as a pivotal factor in design thinking, the user is actually configured as an abstract archetype, a centralizer of mostly behavioral functions that leave corporeality at the margins of the discussion. In the wake, therefore, of Celaschi's solicitations, and with the will to concentrate the research on the person as a whole, we decided to undertake a

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On the left:
1. Michele Zannoni and Roberto Montanari during the Symposium keynote. Photo by Key Scampa.

path that had the aim of placing the human body exactly at the center of the design process.

The result of this operation is the project of the Symposium, that is a network of researchers, designers, and companies united in the name of the final objective of building an observatory[2] for the activation of research processes capable of investigating the concrete implications of the newfound centrality of the human body. Moving from a design perspective, the impacts that such specific attention on the human body could have in the design of physical and virtual interaction processes have been particularly privileged subjects of this observation (Zannoni et al., 2021a).

## The growing network of the Symposium

44 individuals from 7 different countries belonging to the academic and professional world responded to our call to take part in the project. They proposed about 70 case studies relevant to the Symposium. Further work carried out by our ADU research team has therefore integrated their reports by collecting a database that now counts about 300 projects and involves 460 people and 260 companies.

Three main areas of interest have emerged in this multitude and variety of subject and themes, which we defined as follows:

- *Homo faber*, an area mainly related to the tools that humans can build and use to achieve their goals;
- *Homo saluber*, an area mainly focused on the health of the human body as an organism;
- *Homo cogitans*, an area mainly related to the properly human characteristic of thought and prediction.

As can be seen from the definitions assigned to each of the three areas, which try to return a clustering of the activities of the Symposium by the different areas of afference, what remains at the center of our discourse is precisely the human being, in the various possible declinations of his way of relating to and interacting with the world (Zannoni et al., 2021b).

## The methodology of the Symposium

The Advanced Design Unit of the Department of Architecture at the University of Bologna has consolidated the Future Design framework as a methodological basis to develop, through a network of international observers, a process of research and anticipation in the field of design science studies. This approach to scientific research first appeared in 2017 and was refined in subsequent years. It aims to integrate knowledge, models, and networks from the micro to the macro and collect use cases and best practices: projects that start from the micro but speak to the macro.

The aforementioned definitions represent the final result of a process of research and analysis that has constituted the methodology at the basis of the Symposium (Celaschi et al., 2021, p. 16). Particularly, the project has been articulated in five different phases, namely:

- Phase 1: the basic research;
- Phase 2: the constitution of a network of expert observers;
- Phase 3: conduction of a census, cataloging, mapping, and interpretation of the significant cases in this context;
- Phase 4: the construction of a shared repository;
- Phase 5: the organization and presentation of the Symposium event;
- Phase 6: the construction of the permanent observatory.

The basis of our research is therefore constituted by real-world use cases, which have provided the possibility, on one hand, to raise attention on issues and themes that are in progress in the contemporary design field and in the market; and, on the other hand, to start from a solid basis for our observation, linked since its origins to a process driven and shaped by real data. It is precisely for this reason that the observers of our Symposium play a central role, constituting a direct approach to the field collection of the data gathered and organized within the shared repository. The organization of the Symposium event has undoubtedly played a key role in the project, by creating a moment of sharing and dialogue between all the participants. Finally, the results achieved allow and invite further evolution of the whole project, which, by transforming the miscellaneous group of observers into a network of contin-

uous connections, allows the creation of a permanent observatory in direct contact with the trends and turning points of design and the contemporary market.

The following paragraphs will therefore account for the methodology applied and the results achieved by the project up to the organization of the Symposium.

*Basic research and construction of a network of observers*

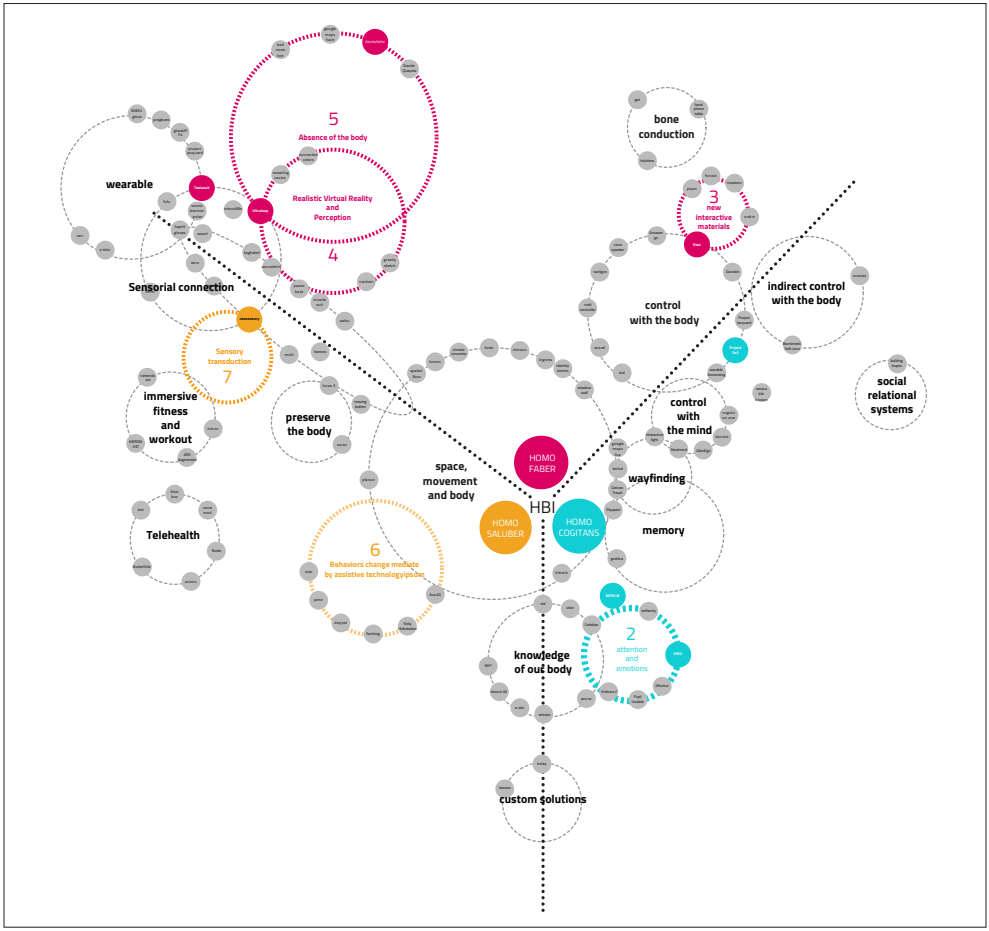
Conceiving the case studies found and analyzed during *Phase 1* of our methodological process as a constellation of themes articulated around the three main axes of our areas of interest, it is possible to create a diagram as shown in figure 2.

By analyzing the configuration that has thus formed, it is also possible to find some specific trends in each area. In particular, if in the left area, at the intersection between *Homo saluber* and *Homo faber,* it is possible to map case studies and products already available on the market. In the right area, centered around *Homo cogitans*, there are case studies still in a mainly prototypical and experimental research phase, which nevertheless prefigure a possible and hoped-for growth of new products and services.

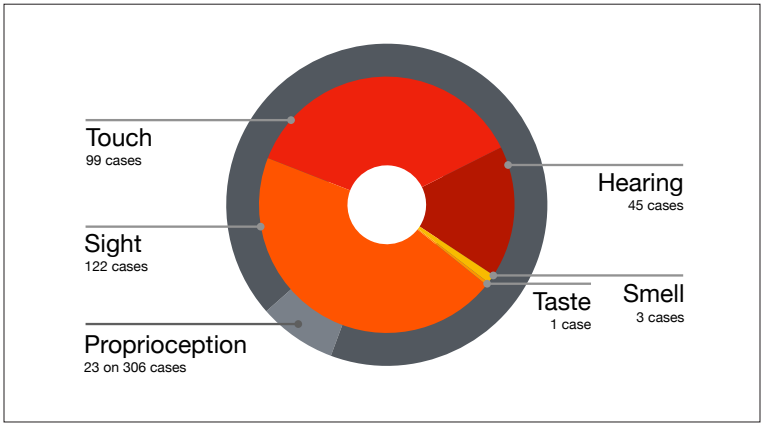
*Cataloguing the case studies*

In research based on scenarios focused on the user's corporeality, a cataloging tool for the analyzed case studies is naturally based on the sensory and perceptive aspects of the body itself. The five senses, in fact, constitute the five communication channels through which the interaction between the individual, the machine, and the world takes place. The various case studies mapped in the research have developed an approach to interaction that varies from time to time based on the chosen communication channel, that is on the sense (or senses) that have been mostly considered in the design and implementation of the interaction between the individual and the machine (fig. 3). By shifting the attention from the single case to the whole system, a perspective emerges that, through a photograph of the contemporary situation, allows us to catch a glimpse of certain trends that, though sometimes confirming what has already been ascertained in the past, sometimes shed light on new aspects and detectors.

The first assumption that can be made refers to the confirmation of the centrality of sight and the visual channel in the




2. Maps of the case studies and the field of application on the design themes.




3. Analysis of the senses involved and technologies enabling interaction.

interaction of the individual with the world, as most of the projects of the Symposium rely on this sensory dimension to connote the interaction process. However, promising explorations can be seen that focus on the use of other channels and sensory dimensions. As we will see, contemporary research on the adequate exploitation of the active haptic channel, which is a type of interaction that starts from touch and its sensory possibilities, has particular relevance. The aspects relating to vocal interaction and acoustic exploration, on the other hand, remain in the background, although their importance proves to be very relevant, especially in multitasking contexts. Finally, research on an interaction that involves or supports the olfactory and taste channels remains rather unfathomable ground. In this sense, one might wonder if the importance that these senses have assumed during the pandemic situation, due to the impact of the COVID-19 virus, could bring more attention to a field that is, for now, on the fringes of research.

*Mapping the themes that emerged*

Starting from the cataloging activity executed in the previous phase, in order to activate anticipation processes to understand the complexity of the contemporary situation in the design field and market, we have highlighted seven research themes corresponding to the speeches given by the guests of our event reported in the paragraph *The Symposium event*:

- The first is related to the relationship between the machine and the body and how artificial intelligence is used to improve the processes of interaction of digital systems with humans. (Refer to *Theme 1. AI to help machines understand human movements*);
- The second is related to the same concept but in the complex sphere of emotion recognition. (Refer to *Theme 2. Emotion tracking*);
- The third and fourth themes are linked to interaction with physical and virtual artifacts. New tools and materials can open up a new comprehensive interaction between the physical artifact and the digital dimension. (Refer to *Theme 3. New capacitive touch materials* and *Theme 4. Virtualization needs feedback*);

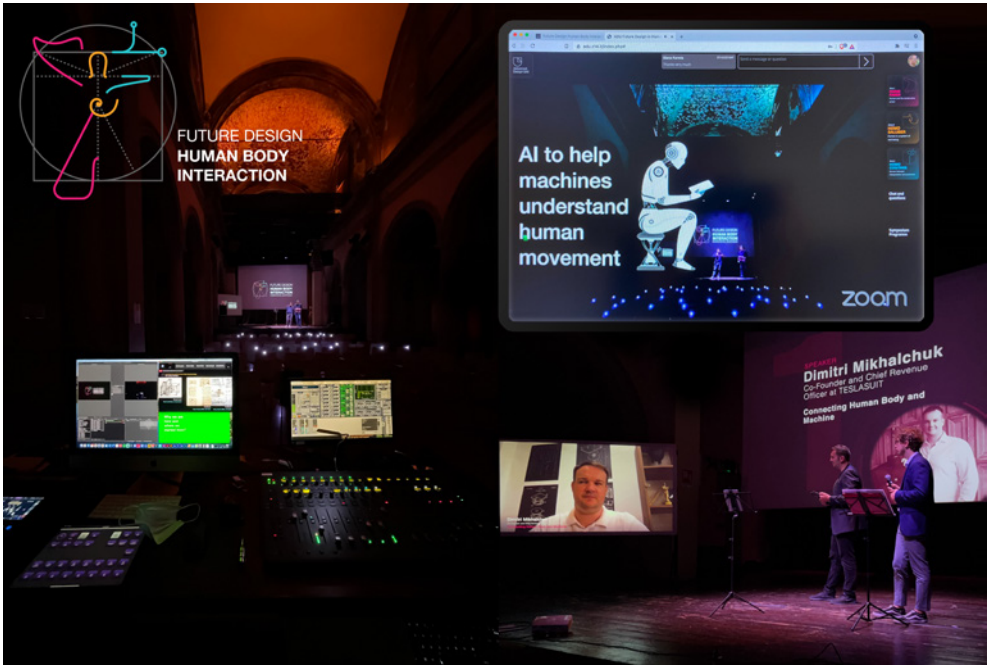
- The fifth theme is related to the absence of the body in social and learning relations, a topic that has seen exponential growth due to the COVID-19 limitations. (Refer to *Theme 5. The absence of the body*);
- The sixth field of research is mainly linked to the well-being area and the behavioral change processes triggered by assistive technology. (Refer to *Theme 6. Behavioral changes mediated by assistive technology*);
- The last theme is focused on the so-called *sensory transduction*, where the lack of one sense is shifted via technology to the other ones: a topic that is now moving from the prototype level to a productive dimension. (Refer to *Theme 7. Sensory transduction. A new perception of reality*).

In summary, these seven fields of research tell us about a complex scenario where the experiments that were prototypes at the beginning of this century are now becoming concrete B2B and B2C products.

## The Symposium event

The Symposium was an opportunity to confront in a digital and multidirectional way certain questions concerning the evolutions of the human-machine relationship. The event was held in a virtual mode in the San Leonardo theater in Bologna and it was organized by the main implementers of the project to create a moment of comparison and sharing between the various observers involved. The main goal was to gather scholars and active witnesses who are conducting experiments all around the world, to exchange insights. During the event, all the data involved in the projects and case studies collected during the research were available to view as a database integrated into the streaming platform (fig. 4). This was a preview of the observatory that would be opened to the public in the following months. To reduce the distance between the online attendees and the people in the theater, there was a lighting installation on the empty theater stall that indicated the online presence of the participants.

Based on the seven themes identified in the research, it has thus been possible to organize seven presentations in the morning




4. The San Leonardo theater in Bologna and the streaming platform. Photo by Key Scampa.

part of the Symposium concerning the main phenomena affecting the world of contemporary design in relation to a specific interest in the human body, conducted by experts and protagonists of these same changes.

*Theme 1. AI to help machines understand human movements*

The historical period in which this Symposium takes place is not irrelevant to the themes that have been brought to light. We are, in fact, in a moment of transition between two different models of human-machine interaction, which therefore needs to remodel traditional paradigms in an innovative and original perspective. In the current scenario in which we are moving from a model where it was the individual who controlled the machine through an interaction based on direct commands to a model where it is the machine itself to learn from people and their behaviors, it becomes necessary to acquire a new mindset able to overcome the traditional idea of the interface to create a new, more effective, and innovative model. The latter is naturally supported by artificial intelligence (AI), which is expected to be able to think, interact, and behave in ways that support humans by providing personalized, adaptive, responsive, and proactive services in a variety of settings (Pollini & Giusti, 2021).

In this perspective, an example of the implementation of AI-based technology for the understanding of human behavior has been provided at the Symposium by Leonardo Giusti, head of design at Google Atap[3] (fig. 5), the Google Device and services research and development lab. "As humans, we have this sort of implicit understanding of other humans' behavior and this feeling of being understood by other people without saying a word. But it never happens with technology. So, what if we could experience a similar feeling when we interact with a technological product? This is, in the end, the problem that we're trying to solve through the Soli project", he has explained to the public. Soli, a miniature radar sensor created by Google Atap, is a technological device able to understand human motion at different scales, from finger motion to full body motion. Thanks to radar and advanced machine learning algorithms (Hayashi et al., 2021), Soli allows the interpretation of small and large gestures as well as body language expressions, spatial relations, and even more complex activity patterns like social context, giving life to a new interaction language based on the continuous understanding of nonverbal communication cues. "If


5. Leonardo Giusti, head of design at Google Atap. The Symposium speech: https://youtu.be/h9u2eBGFKyk.

you think about that, this is very similar to the way we interact with each other", continues Giusti, stressing a fact that also constitutes one of the cardinal assignments of our project: the accent on human-machine interaction must be shifted towards humans and their natural way of behaving and communicating through verbal and non-verbal languages. The setup of neural networks, capable of interpreting human movement in an increasingly precise manner, is gradually becoming a stable reality that can be implemented in design processes. With some products already available on the market, a mature scenario is now opening, in which the designers and developers are becoming able to teach the machine to interpret human gestures and exploit that knowledge to realize deeply human-centered products.

*Theme 2. Tracking emotions*

Emotions constitute a spectrum of investigation for the recognition of the status of users whose importance has largely grown in recent years. Furthermore, they are beginning to be conceived no longer as separate factors but as concurrent and interdependent in the regulation of human behavior in its complexity. For example, the scientific literature in neuroscience leads us to consider the emotional state or its arousal as connected to phenomena such as cognitive load, attention distribution, or operational choices.

After the pioneering perspectives indicated in a famous book entitled *Affective Computer* (Picard, 1997), emotion recognition technologies have grown considerably in terms of flexibility and


6. Maura Mengoni, associate professor at the Polytechnic University of Mark and president of Emoj. The Symposium speech: https://youtu.be/yK7_2qEC6s0.

availability, to the point of being deeply rooted in the interface design process. In other words, it is now possible to state that interfaces no longer adapt only to the user's cognitive state or psychological-behavioral profile, but also to their emotional state.

As part of the Symposium, we wanted to give space – in addition to a wide range of technologies – to an Italian technological project dedicated to the theme of emotional recognition: Emoj.[4] Presented by Maura Mengoni, associate professor at the Polytechnic University of Marche and president of Emoj (fig. 6), the project gives life to software enabling the recognition of human emotion. It is based on a coding system including deep convolutional neural networks, enabling the recognition of age, gender, the six primary common emotions, violence, engagement, gaze, direction, and other indicators from pictures and videos captured by every type of camera. "We, as designers or researchers, have to measure objectively and quantitatively the reaction that people have when interacting with other products. Hence, we must know who the customers are, what makes them different from the others, how they feel, and what they want" stated Mengoni during her intervention at the Symposium. Thus, Emoj contributes to providing this kind of measurement by defining a holistic approach and an implemented technological framework oriented to the analysis of human system interaction at every touchpoint and to the adaptation of the user experience based on user state. Applicable in a large variety of fields, from museums to automotive, it highlights the importance and the innovative power of this kind of measurement based on


7. Jakub Kamecki, partnerships & alliances at TG0. The Symposium speech: https://youtu.be/S9gGvtJvMP8.

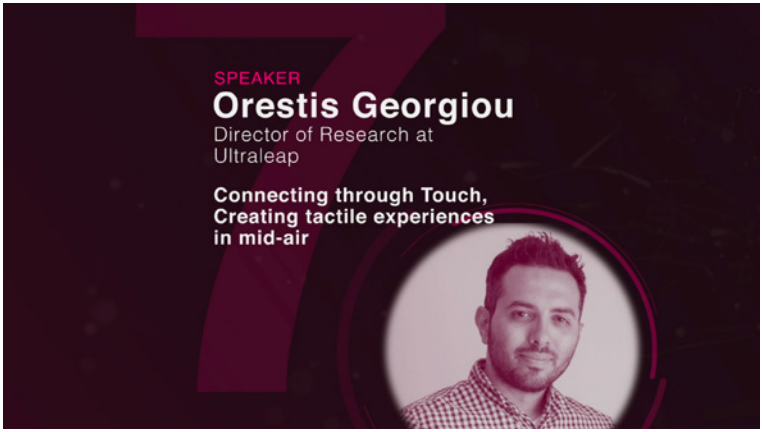
emotions to realize a sensitive, responsive, and personalized environment (Mengoni et al., 2021).

*Theme 3. New capacitive materials*

The last twenty years of interface development have been characterized by continuous research on screens for our devices to obtain increasingly defined and precise tools to trace the touch of our hands on their surface. However, the rigid and planar configuration of the screens is and keeps being a limitation in the interaction with human tactile capabilities. Some attempts to overcome this limitation have been produced, such as the OLED technologies, which have introduced the flexible screen, but the morphological limit of the shape has remained a crisis point, and the designers have had to integrate part of no-screen surfaces with capacitive sensors. The digital transition to a real tactile experience is still an unsolved goal.

Precisely for this reason, some recent projects, including the case study presented in this Symposium by the company TG0 (Tangi0 Ltd), are working on a new frontier of tactile interaction, moving toward the design and implementation of new interactive systems to connect human and machine through a profound link between the body and artifacts (Kong, 2020).

The main objective of TG0, as presented in the Symposium by Jakub Kamecki (fig. 7), is to "bring back the sense of touch as a way to interact with machines, through the creation of memorable controls". The intimate and private aspect of interaction is recreated by TG0 through the realization of 3D shapes and patterns that, with




8. Orestis Georgiou, director of research at Ultraleap. The Symposium speech: https://youtu.be/E2tPFFYBdeM.

the ability to detect every touch, gesture, pressure, movement, and deformation through a smart polymer approach, can offer the user an exciting way to interact with technology. The idea behind the project is that such kind of interfaces inviting the user to play with them can reduce the time and fatigue of the interaction while providing a more pleasant and fulfilling experience for the customer.

*Theme 4. Virtualization needs feedback*

As previously mentioned, touch is a sense that plays a tactical role for an interface designer. In fact, it does not have the same semantic foundation as the visual channel – that is, it does not allow exchanges of fine and detailed information. However, it is a strategic element to enable effective multimodal interactions, especially under multi-task conditions. Touch, if used carefully within an adequate interface, reveals all its tactical potential in constituting an almost immediate feedback element for the user, who can continue to devote all his visual or acoustic attention to something else. The active action of the tactile channel – namely, its ability to actively transmit a signal – is called haptics. The challenge of making the haptic channel an active, reconfigurable, and new language of interaction is at the center of two innovative projects that have chosen to present their research at the Symposium: Ultraleap[5] and Teslasuit.[6]

The first was proposed at the Symposium by Orestis Georgiou, director of research at Ultraleap (fig. 8). "While in immersive reality the visuals and the audio that we see are incredibly compelling, we're completely missing feedback for our vital sense, a sense


9. Dimitri Mikhalchuk, Co-Founder and Chief Revenue, Officer at TESLASUIT. The Symposium speech: https://youtu.be/n1-XhgMGyE8.

of touch. […] Touch is both discriminative and functional, but it's also social and effective. It's a key aspect of how we connect and how we experience the physical and digital world. And more than that, we've got to move away from these handheld controllers if we are ever going to have a feedback mechanism for touch that is widely adopted for virtual and augmented reality", stated Georgiou. Focusing his research on the implementation of virtual tactile feedback and stressing the need of providing interaction even without specific devices – which sometimes are a limitation rather than a support – he has shown how haptic technology, by using sound waves to project tactile sensations and vibrations through the air and directly onto the user's hands and fingertips, represents a great resource for immersivity and accessibility in the virtual reality (Romanus et al., 2019).

The second project focuses on a discrepancy that is emerging in the interaction processes between two different scenarios of Human-machine relationships. "We are currently moving from the age of hands and touch, in which we operated buttons and knobs, to an age of mind and body, in which we use our body as a user interface. Human-machine interfaces are [becoming] gateways to ever more natural forms of communication between humans and machines. Hence, we find ourselves on the journey […] towards full immersion, a world in which our reality is overlaid, mixed, and even extended with the digital sphere." So states Dimitri Mikhalchuk (fig. 9), co-founder and chief revenue officer at Teslasuit. The

compelling need and the challenge for the contemporary development of technological devices is thus the necessity to realize simple, easy-to-use, plug & play product interfaces that are familiar to the users and let them express themselves in the most natural way possible. Teslasuit, as a real technological exoskeleton able to collect and interpret biometric data obtained from the natural action of the human body, as well as its implementations in projects concerning real use cases, are perfect examples of how the new interfaces are propagated as more and more adaptive, almost symbiotic with the human body. The latter is thus enabled to spontaneously express itself in its naturalness, free from the forcing of traditional machine-oriented interactions.

*Theme 5. The absence of the body*

While in the previous themes, concerning virtualization, the aim was to materialize the feedback to support the illusion of interaction, in this theme the opposite problem is raised, which is how to deal with an interaction in which the body is, in fact, absent. This new condition of *being without a body* is not only a probable requisite of a future that is increasingly moving towards virtuality but has also been forcefully brought to light in the real world from the COVID-19 pandemic. In the emergency period, indeed, everyone has been called to confront the absence of the body in interaction – with others and with things – as a form of new normality. The restrictions on movements and gatherings have in fact led to the shift of interactive experiences to the frame of a video: from the three-dimensionality of the physical space to the two-dimensionality of the screen. If, on one hand, it is a condition to which we are now accustomed and which may seem acceptable to many of us, a critical reflection emerges, on the other hand, on the limitation of the perceptive process of the totality of the body. In this new mode of interaction, which excludes the physical coexistence of the two interacting subjects in the same place, the most invisible, yet fundamental, part of the communication, devoid of fundamental parts of body language, is missing. The very scope, intrinsic to the very nature of the interaction – the transmission of an emotional and empathetic message – is thus erased from the digital tools we use to connect.

The absence of the body as an interacting subject greatly limits the transfer of emotions between humans, impacting, among


10. Fabio Ferretti, project manager at Alterballetto. The Symposium speech: https://youtu.be/l6RQ2jteGm0.

others, even an area in which this aspect plays a fundamental role: that of performing arts. Feeling art through digital mediation is a critical issue of our times. Just imagine the different sensations experienced in a real or virtual visit to a museum or between a streamed or live performance of an artist's concert. However, in a reality in which the absence of bodies is destined to form – if not a new normality, at least a possible option – it becomes necessary to experiment with the interaction within and through new forms of conveyance of the emotional process. One of the most notable experiments in this area was conducted by one of the participants in the Symposium, the Aterballetto foundation.[7] Indeed, their recent project investigates new languages and interaction methods to not lose the emotions of dance in a totally virtual environment. It is based on a double change of perspective: on one hand, an approach to new and innovative media and technologies for this type of art form; on the other, a new concept of the user experience from its very foundations. In fact, using the Oculus, which allows a virtual and immersive user experience, the viewer is brought directly to the stage, at close range with the dancers who can interact with him through a direct and deep channel. Thanks to choreographies specifically designed for this type of virtual fruition, and recorded through the cinematic viewer, it was, therefore, possible to find a new communication channel to realize, in the words of the speaker Fabio Ferretti, "a virtual dance for real people, to create a new experience that is no longer a live show but could also exist after the live show" (fig. 10).

*Theme 6. Behavioral change mediated by assistive technology*

Our behavior is naturally presented in the face of change with a suspicious attitude and a leathery spirit. In other words, changing behavior is complex and often futile. As Kurt Lewin (1947) points out, change pathways must find facilitation, that is *channels* of transition from one behavior to another or from one habit to another. In other words, behavior may change more easily if guided through a facilitated and rapid path, from which it is difficult to exit and not complex to enter, which leads us – forcing us, so to speak – towards change. Interfaces and many media and devices are designed to promote virtuous behavioral changes. However, not all people act by seeking out the channels we referred to earlier. Instead, some of them reinterpret the channeling and enabling factors that act through effective physical and perceptive solicitations.

One of the fields in which the innovation of human skills and behaviors can undergo the most changes is that of aviation, whose new areas of investigation were illustrated at the Symposium by Simone Pozzi, CEO of Deep Blue[8] (fig. 11). In apparent contradiction with the idea of innovation advocated by contemporary media, but following what was previously stated on resistance to changes in human behavior, Pozzi wants to remind us how "the world is a slowly-changing domain" in which innovation represents a "long-term process". Also, in a field perceived as technological and advanced as aviation, the key question is whether innovative changes in the current systems, through the introduction of new technologies now available or developable in the market, are truly advantageous for humans and their performances. On one hand, it is true, for example, that automation supports humans in both regular and critical operations, allocating functions between humans and machines. However, automation can be very problematic because it makes the system harder to control in the processing phase. The goal here is thus to overcome the basic status in which automation works well in normal conditions to exploit all its potential in order to maximize situational awareness, support decision-making, and enhance performance execution in critical and non-anticipated situations. At the same time, it is necessary to find and develop the technologies necessary to monitor different human

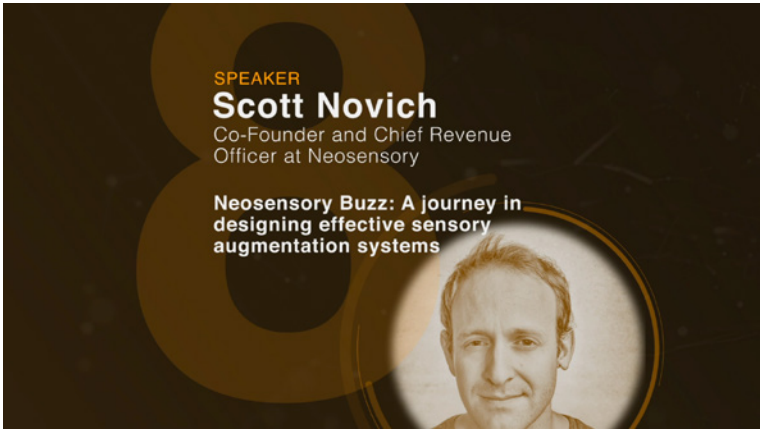

11. Simone Pozzi, CEO of Deep Blue. The Symposium speech: https://youtu.be/k7-ONHbSqQs.

statuses and answer properly to them and the situation. From this perspective, two helpful means are undoubtedly the AI and human monitoring systems, which are fields of interest and research for the company.

In any case, speaking of these issues, one cannot avoid a question that, even in the case of Pozzi, remains open and which, in our opinion, constitutes a fundamental starting point for future reflection of the Symposium and its research, namely: how much, how, and to what degree of possibility will it be possible to change the behaviors and skills to be possessed by men in correspondence with the changes applied to the machine system?

*Theme 7. Sensory transduction. A new perception of reality*

When speaking of technology and the human body, different devices have proven to help us in transformative processes and are now consolidated factors in the replacement of missing or deficient parts of our bodies. As addressed several times, prosthetics have acquired maturity and an increasingly faithful rendering of the human body and the elements of nature. Functional fruition and replacement are giving way to paths centered on processes of *sensory transduction* in which the lack of one sense is transferred to another through the use of technology that commutates the signals in different representations, from Neil Harbisson's first experiments on the cyborg at the beginning of this century – in which he tried to compensate the lack of part of the electromagnetic spectrum




12. Scott D. Novich, co-founder, and chief technology officer at Neosensory. The Symposium speech: https://youtu.be/pOk4yg_xo_8.

vision – to the research that Neosensory[9] has presented at the Symposium (Eagleman et al., 2019). The scenario reported by Scott D. Novich (fig. 12), co-founder and chief technology officer of the company, shows a potential that leads us to imagine a design mutation of perceptive possibilities toward an increasingly hybrid sensorial communication.

"Sensory augmentation is the idea that there's some information out there that can be perceived kind of natively in the way we think of sound, vision, or touch. And we can do this non-invasively by encoding this information to reach some target set of sensory receptors in our body. The challenge is to do [this] in a smart enough way such that we guarantee that as much of the information that we care about makes it to the brain", Novich explained. The challenge and the aim of sensory augmentation are thus to bridge the gap between the information present in the world and the possibility to receive it by our senses.

The devices developed by Neosensory are, in fact, able to take information from the environment and find the proper mathematical representation to realize the appropriate encoding to let the information reach the target sensory receptors in the human body (Novich & Eagleman, 2015). Thanks to a re-interpretation of the sensory information available in reality based on the receptive possibilities of the individual, Neosensory is configured as a good example of how technology and innovation can be the right means to not only amplify but even allow the interaction of Human with the surrounding world.

## The discussion panels

The Symposium was organized in two parts. The morning was dedicated to the guests' presentations and the afternoon to discussion panels on three specific topics that participants could sign up for. The first panel with the title: New Ergonomics, Challenges, Applications, and New Perspectives was moderated by Roberto Montanari and Andreas Sicklinger with the guests Mirko Daneluzzo (DIDI Dubai Institute of Design and Innovation), Andrew Morris (Loughborough University), and Fabio Mattioli (The University of Melbourne). The second panel, called Designing for wellbeing: data and behavior changes, was moderated by Giorgio Casoni and Giorgio Dall'Osso with the guests Mario Fedriga (Technogym), Carlo Tacconi (mHealth Technologies). The last panel, titled Human-Machine Interaction design: interfaces, services, and processes was moderated by Alessandro Pollini and Michele Zannoni and presented the researches of Margherita Peruzzini (University of Modena and Reggio Emilia), Francesco Tesauri, and Leandro Guidotti (RE:Lab), Andrea Peraboni (SDI Automazione), Angela di Massa (BSD design), and Francesco Grippo (EMAG SU).

## Conclusion and lessons learned

The presentations heard so far, as well as the research, cataloging, and sharing activities that have been carried out during the project, demonstrate how we are at the beginning of a process of understanding the new relationship between design and the body, which has been approached according to the product and market logic, but which is now changing towards a dimension of design for the well-being of the individual as well as the community.

The seven design directions that we have highlighted, and which we had set out to investigate, represent only a few of the many possible paths between the three defined macro-areas of the *Homo faber*, *saluber*, and *cogitans*. The evidence of the cases analyzed in the Symposium shows us that it is now necessary to open a structured multidisciplinary debate on these themes, which to this day have only been analyzed as emerging tech-

nologies and their potential to construct artifacts and services, but could now open a new age of transformative artifacts for humans and their bodies to achieve a new level of well-being for people in respect of the physiological and cultural differences.

## Notes

[1] International Symposium Future Design Human Body Interaction, Bologna, June 22, 2021, https://adu.unibo.it/humanbodyinteraction. The symposium proponents were: Flaviano Celaschi, Elena Formia, Roberto Montanari, Andreas Sicklinger, and Michele Zannoni with the scientific collaboration of Giorgio Dall'Osso and Marco Pezzi. The workgroup consisted of: Luca Barbieri, Andrea Cattabriga, Alberto Calleo, Arianna Fantesini, Lucrezia Rivieccio, and Ludovica Rosato. A special thanks to Annalisa Mombelli and Elisa Silva for their important contribution to the systematic collection of the material in this project.
[2] Human Body Interaction Observatory, https://adu.unibo.it/hbi/.
[3] Google Atap, https://atap.google.com.
[4] Emoj S.r.l, https://www.emojlab.com.
[5] Ultraleap Ltd, https://www.ultraleap.com.
[6] Teslasuit, VR Electronics Ltd, https://teslasuit.io.
[7] Aterballetto Fondazione Nazionale della Danza, https://www.aterballetto.it.
[8] Deep Blue S.r.l, https://dblue.it.
[9] Neosensory Inc., https://neosensory.com.

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