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Smart Experience in Fashion Design: A Speculative Analysis of Smart Material Systems Applications

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Abstract: During the last decade, smart materials and systems have increasingly impacted several niches, including 'one-off/limited edition experimental fashion'. As the traditional boundaries between what is art and what was not supposed to be art are now turning into osmotic membranes, we will speculatively focus on how 'smart material systems' are highly contributing to outline a new creative landscape full of interesting and compelling issues. Introducing three different sub-niches of experimental fashion—multi-sensory dresses, empathic dresses, and bio-smart dresses—this article outlines the emergence of a new smart design scenario. Then, we critically discuss some of the implications of the developing research in terms of design thinking and design aesthetics. This paper aims to contribute to the topic of next design scenario, demonstrating how design research is increasingly affecting the extension of human perception, emotions, and the concept of 'almost-living' entities, projecting towards the redefinition of relationships with materials and objects.

Keywords: smart material systems; fashion design experimentations; next design scenario; design thinking; design aesthetics; multi-sensory dresses; empathic dresses; bio-smart dresses; smart experience

1. Introduction

During the last decade, new smart materials jointly with digital technologies have increasingly impacted several niches, including 'one-off/limited edition experimental fashion'.

The advanced materials that we are going to refer to in this article are generally named smart materials. Defined as "highly engineered materials that respond intelligently to their environment" (Addington and Schodek 2005, p. 9), as well as 'sensible and interactive' (Cardillo and Ferrara 2008), smart materials are often embedded in more conventional materials and applied in a system with microelectronic components and miniaturized technologies. So, today, smart materials and the smart material system (Ferrara 2017, p. 176) is an expression that includes many different kinds of material systems, with different degrees of complexity, and smart behaviors, able to mediate between analogic and digital dimensions, embedding the intelligence in the physical matter. They are also named *ICS_Materials*, i.e., Interactive, Connected and Smart Materials (Ferrara et al. 2018), in a material vision where the integration of inactive material characteristics and new active behaviors is able to expand the sensory dimensions of the experience with a material.

Last but not least, with the expression of 'smart material systems', we also refer to 'bio-smart materials' (Lucibello et al. 2018)—material systems in which the artificial intelligence and 'intelligence in nature' are interconnected to complement each other. This means that bio-smart materials have an intelligent behavior in a biological sense, or they yield the intelligence of nature, integrating it with artificial intelligence systems.

Designers can apply 'smart material systems' in order to offer a 'smart user experience' (Bengisu and Ferrara 2018, p. 84). So, for example, a material surface, such as a common fabric

that embeds a nitinol wire (a smart material), can become sensitive and responsive (with visual or kinetic response) according to an external stimulus, like a rise in temperature. This may happen when you wear it, and the increase in body temperature causes the expansion of the fabric. The surface can acquire an active and autonomous behavior with no need for human intervention (Ferrara and Bengisu 2013, p. 24). Adding sensors and an Arduino, the textile can monitor complex behavior in daily life. Combing other microelectronics, it acquires the ability to transfer and receive information. New smart surfaces are able to transform the artifacts from static and inactive to dynamic, proactive, and almost-living entities (Russo and Ferrara 2017).

Today, the emerging 'smart materiality' is hybridizing the digital and the analogic dimension to improve the material performance and it is, without doubt, a powerful stimulus for creative practices. If, as already stated in the mid-1980s, advanced materials are characterized more by their performance than their functionality (Manzini 1986), smart materiality is promising much more in relation to current paradigms based on communication, sustainability, and human experience (Bengisu and Ferrara 2018).

Smart materiality, together with new technologies such as 3D printing, and new design approaches such as interaction, and biomimetic design, have started to be used in creative practice both as catalysts of the design process, allowing artists and designers to interact directly with the technological reality, and as an active agent of an extraordinary field of experimentation on expressive languages, sophisticated functionality, and perceptive and emotional involvement of the users. Thanks to their performance, the application of 'smart material systems' has been the focus of much research and fashion innovation experiments, where they pave the way to the enhancement of programmable and interactive dresses, accessories, and shoes, contributing to their implementation as wearable technologies. So, they have reached catwalks as well as museums and galleries. The number of art and fashion design public presentations of 'experiential prototyping' (Buchenau and Suri 2000) that capture a big audience proposing a highly experiential involvement is a clear indication of the increasing interest and the appropriation of smart materiality performance. In some cases, the experimental prototypes are just about to reach the market.

2. Method

In the contemporary creative practices environment, designers have adopted a role of 'designer-as-artist', shaping a phenomenon with many symptoms in different creative activity niches, such as the one related with 'science-design' (Duggan 2001). We will contextualize our analysis on this latter niche, deeply involved in active cross-discipline research practices, and discuss experimental one-off fashion projects related with science-design. In this hybrid field of creative investigations, the use of scientific advances and technologies contributes in breaking the boundaries of traditional art-making, recognizing the experimental process for its actual artwork value (Rush 1999, p. 48). Science-designers emphasize the material performance and prototype construction. This is evident in the documentation of their work, as well as in its communication. They leverage videos and special events as a means of revealing the experimentation behind the work. Science-fashion-designers utilize their fashion shows as art performance, extending potential customers' involvement in their creative process.

As boundaries between what is art and what traditionally art was not supposed to be are now turning into osmotic membranes, we will focus on how 'smart material systems' are highly contributing to outline next design scenario. All 'smart material systems' are worthy of further analysis, not just

in terms of art theory, but rather through the lens of design thinking[1], considering different focus approaches, and design aesthetics[2].

In order to highlight how 'smart material systems' are implementing experimental fashion design, now articulated in several niches and sub-niches, we will introduce three different promising sub-niches, with a case study each. These three case studies are intentionally chosen for their speculative approach, useful to enable us to think about the future (Auger 2013). We specify that the choice of case studies is based on previous design phenomenology research studies covering the worldwide in-lab experiments with smart materials and systems (Ferrara and Bengisu 2013; Bengisu and Ferrara 2018; Ferrara et al. 2018; Parisi et al. 2018). These research studies we refer to let us to recognize some trends with a strong potential to deeply influence the next design scenario, including fashion, with interesting outcomes in terms of social and cultural factors.

We will question the impact caused by 'smart material systems' on experimental fashion design, in terms of user experience, and highlight some of the communicational and relational issues potentially generated, referring also to design aesthetics. Today, more than ever, questioning performances and involvements discloses the core of a contemporary creative approach, where unedited inspirational and pursued completions are encouraging new implementations, generating useful and extremely engaging outcomes. Indeed, with all the material potential currently available, envisioning what could be next in terms of smart behavior and yet unedited performances is what also pushes further creativity and contemporary design thinking.

3. Multi-Sensory Dresses

What is stated above in relation to the increasing opportunities, pursued by a new generation of artists, technologists, and designers aiming to establish profitable collaborations with digital technology and science, is perfectly mirrored by what occurs when design thinking focuses on the 'multi-sensory design approach'. This approach has its origins in the *Design Primario* (Centro Design Montefibre 1975; Trini Castelli 2017) and focuses on sensory perception and qualities of surfaces able to build the user experience of comfort. In the digital era, this approach has been evolving in different ways with the challenge to design products that provide users with rich, satisfying, and also virtual experiences.

Since the early 1990s, a special type of wearable devices has been developing a way of multi-sensory design approach in the virtual reality (VR) frame, based on interactive computational technology able to generate smart visual experience similar and connected to the real word. Whereas before VR products remained in a very little niche market of entertainment industries, most recently implementations have been promoting new areas of applications, touching also experimental fashion, thanks to the miniaturization and democratization of technology, and most of all the increasing number of senses (tactile, olfactory, gustatory, and nociceptive, i.e., painful) that can be stimulated with a VR simulator

Before presenting a case study on this point, some implementations of haptic technologies will be shown through a haptic suit developed by the industry giant Tesla. Designed for virtual reality games, *Teslasuit* embeds under the fabric a neuromuscular electrical stimulation system, inspired by rehabilitation and athletic training techniques in physical therapy. This provides an electro-tactile haptic feedback distributed throughout the body. The system consists of 46 thermo-controlled haptic sensors located on the front and back of the body, stimulating the nerves directly with electricity.

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[1] According to Tim Brown's definition, *design thinking* is a set of skills that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business can convert into consumer value and market opportunity.

[2] *Design aesthetics* focuses on design, product appearance, and the way people perceive products, i.e., meaning of the appearance mainly in terms of social and cultural factors and the construction of meaning according to sensory modalities and emotional engagement, including also values and ethical concerns.

The stimulations are very similar to the body's own native language and provide a smart sensory experience giving the wearer the ability to touch and feel objects inside the VR. The range of electrical stimulations can vary from a gentle breeze to the simulation of the sensorial experience of an impact, now giving the wearer a full-body experience. Motion capture sensors and a library full of programmed animations allow the system to simulate a wide range of haptic impacts, like the subtle pattern of raindrops against the skin, the cold gust of wind, the warmth of a dragon's flame, or the hit of a sword across the body.

Coming back to experimental fashion, at the Royal College of Art in London students are experimenting with 'smart material systems' for useful applications of haptic technology. *WIM* (Figure 1) is the prototype of a highly innovative dress delivering haptic sensations across the body, conceived by Jun Kamei, Kate McCambridge, and Jacob Boast, in collaboration with Duncan Carter (Kamei 2017). Built on the fields of neuroplasticity and research studies used to promote motor learning and rehabilitation, *WIM* investigates the communication of movements. The prototype was developed in partnership with algorithm designers, sound designers, and technologists. The dress embeds electric-driven artificial muscles made of electro-active polymers (EAPs). EAPs are smart materials with the peculiarity of *Materials that Move* (Bengisu and Ferrara 2018). Connected with digital technologies, they are able to deliver sensory stimulation to the joints and skin of a user's body, communicating information about the sequence and nature of movements. *WIM* can accordingly receive data and instructions about the body's implicit movement in order to activate the expansion, contraction, and vibration of the artificial muscles.

Figure 1. *WIM* haptic dress by J. Kamei, K. McCambridge and J. Boast. Courtesy J. Kamei.

Working with dancers and performers to inform the placing and integration of this technology, the performing result of *WIM* research was a live choreography system performed at Victoria and Albert Museum, London, during the Reveal Festival. In that particular case, of fundamental importance was the collaboration with Abnormal, a studio specialized in bringing digital craft to technology-enabled contemporary art. The studio collaborated with the designers to implement the performance of *WIM* with a new haptic-based language developed to assist with directing and choreographing movement. In order to better support the functionality of *WIM* during the communication from the stage to the audience, Abnormal developed a generative and immersive soundscape showing the interplay between dancer and choreographer. The soundscape takes the form of an electronic, ambient, surround-sound piece that is contorted and distorted by messages sent by a choreographer to the dancer's garment. The algorithmic approach to sound design enables the soundscape to respond to the performance in real time and to both adapt to input from the choreographer and actively affect the dancers' movement. It enables *WIM* to not only facilitate a real-time conversation between the dancer and the choreographer but also complete that feedback loop by adding the soundscape as an actor.

WIM is only one of the many promising useful applications of 'smart material systems' able to create new multi-sensory experiences. Many research studies are related to sensory substitution, implementations in athletic training, physical rehabilitation, and sharing movements with others.

The up-to-date research in cognitive neurosciences shows that increasing the number of stimulated senses can dramatically enhance a user's 'sense of presence', as well as enjoyment, and even the memory for the encounter/experience (Gallace et al. 2012); this niche of experimentation is becoming very stimulating. This kind of research studies have already opened a cross-disciplinary landscape, where useful applications go beyond human sensory limitations[3].

4. Empathic Dresses

Another promising niche of experimental fashion is related to the 'empathic design' approach (McDonagh-Philp and Lebbon 2000; Crossley 2015). This user-centered design approach focuses on the user's emotional experience and reactions toward a product on multiple cognitive levels, including users' behavior and affective response. Also, this approach has been evolving with digital transformation, shifting from knowing consumer' physiological, social, and psychological demands for fashion applications to embodied emotional communication. Today, new ways of experiencing emotions come from embedding 'smart material systems' in dresses, increasing multimodal channels for emotion experiencing.

Between the most speculative research studies, we propose taking a close look into the research of the architect, designer and researcher Behnaz Farahi, working in the intersection of fashion and interaction design. Already in 2015, she explored through her project *Caress of the Gaze* the potential of interactive technologies and their relationship to the human body (Farahi 2016, 2016). Indeed, she created a garment as a sort of primary interface, enabling the person wearing it to experience one of the main aspects of human interaction: people's gaze. The project was essentially based on eye-gaze tracking technology and facial tracking cameras detecting the orientation of the gaze, connected to a system made of a microcontroller, eight wires of Smart Memory Alloy (SMA) as the actuators embedded in a 3D printed mesh of Polylactide (PLA) that give shape to the garment (Bengisu and Ferrara 2018). This smart material system allows the garment to move in response to the gaze of other people.

In 2017, Behnaz Farahi released another wearable concept called *Opale*, a custom-made fashion item integrating 'smart material systems' including a facial tracking technology, a camera able to detect a certain range of facial expressions, and an interactive pneumatic system responding and accordingly changing the configuration. As an animal fur, the outfit is composed of a forest of optic fibers (52,000) embedded in a silicon layer that dynamically reacts (Farahi 2017). It was launched as a new step forward, relying on the same technology already tested and implemented on *Caress of the Gaze* to respond to unconscious facial expressions and bodily movements of onlookers. The garment can respond to the manifestation of feelings like anger, by compulsive or agitated movements, but it can also react to surprise by bristling, hence influencing social interaction (Figure 2).

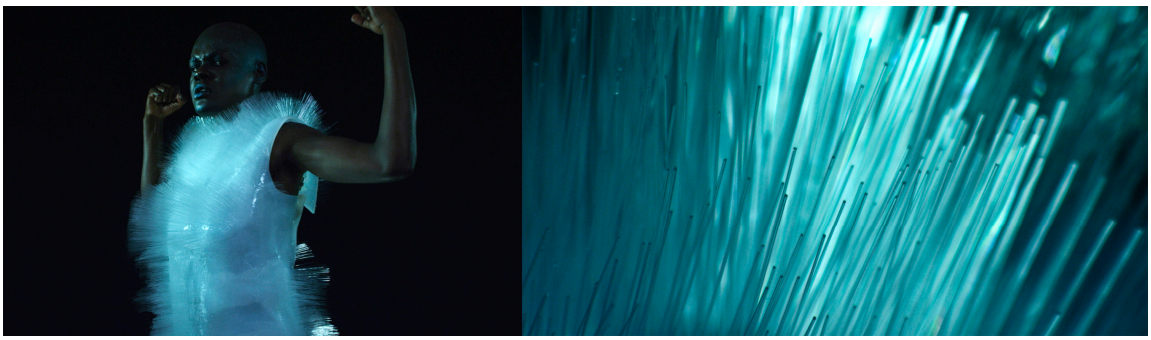

Figure 2. *Opale*, emphatic dress by B. Farahi. Courtesy B. Farahi

[3] In fact, the study on synesthesia has clarified that human sensory perceptions are not an objective reproduction of reality, but instead an inference that the brain draws from the signals it receives.

Analyzing Benhaz Farahi's research, we can highlight how the behavior by a living being (human, animal, or even vegetables), based on various internal/external stimuli (like involuntary skin responses such as chills or defense mechanisms), can act as an element of inspiration. Her research goes beyond a simple interest in the movement of human or animal skin, and draws inspiration from experimental psychology research about empathy. She wants to address and explore psychosocial questions of emotion, intimacy, privacy, gender, and identity. Then, *Caress of the Gaze* and *Opale* are a kind of design investigation into mechanisms involving the social understanding of emotions. In particular, *Opale* reproduces the 'mirror mechanism for emotions', according to the hypothesis that suggests that 'mirror neurons' are involved in mimicry and thereby emotional contagion and empathy (Iacoboni 2009). Thus, by observing the expression of the emotions of others, we connect directly with their meaning, reflecting the emotional behavior of others with our bodily expressions. In the same way, the dress responds to the facial expressions of nearby people. The research, funded by the USC Bridge Art + Science Alliance Research Grant program, is a collaboration with Paolo Salvagione, an artist who works in the intersection of engineering and participation, who developed the compact mechanical and electrical systems deployed in this dress, Julian Ceipek, who wrote the algorithm to control the smart system, and Nicolas Cambier, a writer and director who directed the video of *Opale*'s performance, which has been shared on the Internet.

5. Bio-Smart Dresses

Another emergent creative niche, growing thanks to the emergence of the sustainability paradigm, bio-mimicry, and design-biology collaboration, came fully to light in 2015 with *bioLogic*, the research team leading by prof. Hiroshi Ishii in MIT's Tangible Media Group Lab, born from the collaboration among MIT Media Lab, MIT Chemical Engineering Department, and the Royal College of Art (MIT 2015, 2018). This interdisciplinary team composed of designers, scientists, and engineers created a completely new form of performance textile embedding bacteria as living actuators and sensors. The humidity-sensitive bacteria *Bacillus subtilis* natto was studied for its ability to expand and contract in an environment with atmospheric moisture. This natural phenomenon observed in a bio-lab was analyzed for its potential for functional use in a dynamic fabric. Then, the team explored how bacterial properties can be applied to fabric and formed into living interfaces between body and environment. The animate natto cells were assembled with a micron-resolution custom bio-printing system and cell-infused onto a fabric in order to create a responsive material able to ventilate the skin of an athlete or a dancer, reacting to body heat and sweat. As fabric in a suit reacts to perspiration, tiny vents over bodily heat zones open and close, allowing for rapid cooling.

In the fall of 2015, thanks to a collaboration with New Balance, a company that is interested in creating sportswear that regulates athletes' body temperatures, thereby enhancing performance, the *bioLogic* suits were featured in a live ballet performance, and a video was shared on the Internet and social networks (Figure 3).

Figure 3. *BioLogic*. Courtesy MIT Tangible Media Group Lab.

More recently, MIT Media Lab has used the same approach while developing a highly innovative shoe concept in partnership with athletic sportswear company Puma. Outwear designers applied a brand new technology to give shape to one of the next performance sports shoes endowed with

'Deep Learning Insoles', powered by the Biorealize studio. Briefly describing the technology itself, it seems of interest to remind that Deep Learning Insoles are silicone-based disposable inlays containing microbial cultures that are able to monitor biochemical vitals that typically change during running or workouts. Since the very early stage of dissemination, and also in terms of marketing, just as reported by the launching campaign, the role of bacteria was made quite loud and clear by stating that the "microbial layer consists of mini cavities that are filled with bacteria and media specialized in sensing different compounds present in sweat". Bacteria then respond to what they sense with specific chemicals causing a pH and a conductivity change in the sole itself, which gets recorded by a network of electrical circuits, connected to microcontrollers positioned in the third layer. Invisible living organisms are then about to dramatically change the very essence of workout and endurance routine. Such a new step in bridging science and design is being broadly communicated also to potential mass consumers. Biology has always played a big role in all the various aspect of our life, but in such a specific case it is also contributing to extending the quality of living organisms to something that, instead of being 'animated' by software, or being programmed in advance, contains a form of primitive life just within its own structure.

Looking at other experimental design activities, like the synthetic biology by Carol Collet (Biolace) in fashion design, and growing creations, like the textile-like material made with plant roots by Diana Scherer (InterWoven), and bio-smart bandages in the sector or medical design, a new bio-smart trend emerges. This provides a new approach to 'hacking' nature's components (Collet 2013). Natural organisms, like micro-organisms and plants that live and reproduce, are manipulated at the micro- or nano-scale in a way that preserves their autonomy and applies it to make something different.

The bio-smart scenario seems to be able to reconcile manufacturing processes with the principles of nature, and its models of sustainability, by the use of bacteria to substitute irreversible chemical processes and create innovative materials and products.

6. Discussion between Design Thinking and Design Aesthetics

Looking at the three different areas of experimental research presented in the previous paragraphs allows us to add considerations regarding the evolution of next design scenario and potential implications of the current research in terms of design thinking and design aesthetics.

It seems relevant to drive the attention at first to the expansions and new peculiarities of a creative practices environment associated with experimental fashion, where design operates as a bridge between different disciplines. The selected case studies show a strong convergence of various disciplines, design approaches, and synergies that involve disciplines such as neuroscience or biology that, in a not so distant past, were considered not to be associated with fashion at all. Artists and designers work together with technologists, neuroscientists, biologists, and multimedia and software engineers to create a new set of high skills. The cross-disciplinarily promises innovation that shifts focus beyond the traditional use of dresses to embrace uncertainty, interpretation, and new meanings. In some cases, the research aims to stimulate a critical discourse on the use of technology, in connection with social and cultural issues. It contributes to founding a critical view on how the techno-scientific development is shared and accepted by the public. Then, the sophisticated performance of 'smart material systems' is a source of questioning the contents and meanings of the newly available media. Experimental fashion prototypes communication and diffusion via the Web, exhibitions, and performances and takes the role of exploring the way(s) in which users and objects interact, the system(s) in which they exist, and the manner(s) in which realities are shaped and constructed by technologies reality.

Shifting our discourse onto the communicational and aesthetics side of the case studies, we can question some issues related to such a new or even next generation concepts of smart wearable devices.

If in the past it was well-established that "clothes are semiotic devices, machines for communication" (Eco 1986, p. 195) and their functions as mediators are essential as social tools, like interfaces between our bodies and society (Barnard 2014), today's explorations through application

of 'smart material systems' in experimental fashion question this certainty. A dress surface that interacts with the gazes of people, or with their conscious or even unconscious facial expressions, would change from being a tool required to cover intimate body parts, and not to externalize more than what is already codified, to a tool for showing feeling and the emotional state of another subject. It would become a sort of 'emotions unveiling machine', or even an obstacle for social communication, rather than a mediator (Russo 2018). Communicational issues and dynamics get even more complicated if a dress becomes an 'almost-living object', i.e., it embeds living organisms, or aspects of organic systems, like motion, proactivity, reactivity, and autonomy. This sort of characteristic of new materiality marks a highly dangerous territory standing beyond the socially and culturally visibility allowed.

Another consideration about user perceptions comes from the characteristics of 'smart performance'. The 'magic' of smart objects and dresses is able to make people fall in love with them, in terms of the "wow effect" as well as the "super power" they seem to transmit to users, as in the case of *Opale*, *WIM*, and *BioLogic*. We can appreciate the aesthetic value of these dresses in terms of formal language, because of their clean and elegant design, with no implication of hi-tech connotations. Technology thus dissolves in use and the interaction enhances human interaction, but we penetrate the essence of their smartness only once we start experiencing it, in a sensory and functional way. We can then appreciate the expansion of the palette of senses and the experiences they generate. With multi-sensory dresses, our experience can move, just as it is happening, over a visually emphasized culture towards an increasingly multi-sensory environment that can drastically change our interaction with reality. Design research could go beyond human limitations and offer new implications in terms of interactions between people's social experiences and perception of the real world.

However, how would our experience be if the garment responds automatically although we do not want it to do so? How about its performance when we do not appreciate it, or if it becomes dangerous, without us being able to turn it off? The problem of whether or not to trust a smart object is one of the most difficult challenges to overcome while dealing with designing smart objects (Russo 2018). It depends on its degree of trustfulness, sense of security, and possibilities of managing the behavior of smart objects.

In developing smart performance, designers are now exploring new ways of relating to senses, feelings, and emotions in social contexts, challenging cultures, aesthetic languages, and even ethical judgments. On this point, it is relevant to offer the reminder that, despite any stereotype or assumption, technology indeed participates in the human condition. Just like human–human communication, technology and humans act and react (Cho and Park 2013). Such a point is likely to exponentially grow further if we consider the increasing ability of programmed smart objects that respond autonomously.

While technology expands possibilities for human experience, design experimentations have to resolve the critical points of the new experiences surrounding user exposure, like concerns for the potential psychological costs associated with the users' overexposure to simultaneous multiple sensory stimuli.

We cannot know whether these cases of experimental fashion will be able to break established standards, unlocking new parameters and barriers, as occurred in the past. In any case, these experiments are a great help to evaluate and establish what we want or do not wish for our future, in terms of envisioning how 'next design scenario' may look like.

7. Conclusions

With the awareness that the impact of 'smart material systems' is not yet a massive phenomenon, but rather an experimental and sometimes still conceptual platform, we critically develop our argumentations on experimental fashion considering three specific emerging areas, each representing a different sub-niche trend of experimentation, featured by a different focus of design thinking. These are *multi-sensory*, *empathic*, and *bio-smart dresses*. Each one has been analyzed through a promising speculation, which is particularly interesting for our study because of its theoretical/critical approach.

The study, based on a preliminary analysis of the three areas of investigation, including their approach characteristics, allows us to point out how they are likely to generate a new complex panorama of interdisciplinary collaboration that characterizes the incremental line between art, fashion design, and science. Designers are now expanding their roles from shaping existing reality to creating and growing a new one. Thereafter, we critically discuss some of the implications of the actual research in term of design thinking and design aesthetics.

Fashion systems, with their media power, may act as forerunners for disruptive innovations, trying to be a source of reflection and questions not only about the elements that make up the medium of 'smart material systems', but also their performance, and social meaning.

We think it is now time to start questioning the significant changes taking place concerning diffuse materiality and smartness, and thinking in terms of 'almost-living objects', requiring therefore a different categorization, since they appear as also manifesting themselves as a new source of interaction and behavioral reference for the user. For instance, since the very early stages of their implementation, several articles have already opened up a discourse on the impact of A.I. and robotics, with the aim of building up a sort of baseline for further research (Dirican 2015). 'Smart material systems' and their increasing applications deserve the same kind of attention.

The implementation of 'smart material systems' has indeed created a new and unedited category of reactive objects, able to read our facial expression mimics, once exclusive prerogative of human beings and animals, and to mimic our feelings, or increase our sensory experience toward components of reality not perceptible by the human sensory system. In terms of perception, displacement and, of course, language association and dynamics, such a shift in perception discloses a challenging frontier to be analyzed further. Indeed, all the references linked to the sphere of what is visceral, behavioral, and/or reflective (Norman 2004) has so far been listed on the user rather than on the object side. At least a slight shift in perspectives is now needed, because a society in which humans and robots will have to coexist is no longer an episode of fiction, but mere reality and it is then necessary to investigate all aspects that regulate their relationship in order to ensure an ethical dimension and an effective benefit for people (Germak et al. 2015). Objects themselves do take a big part in world transformation (Floch 1995), and so, now more than ever, the fact of becoming deeply aware of how such a new generation of 'things' is progressively redesigning the space we live in, and consequentially the language we speak and the gestures we daily use, appears as a central issue to deal with. Several unedited aspects emerge while starting to analyze intelligent systems and human interaction. Quite an interesting point, arising as a relevant one, is undoubtedly that of the dimensional scale of the almost-living objects human beings have to interact with. Dimensions emerge as the main parameter in terms of empathy, affection, emotional reaction/involvement, trustfulness, or rejection (Cardoso 2013; Beyaert-Geslin 2015), but what also appears extremely decisive, specifically in relation to consistency, is consequentially the specific function assigned.

Art and design are increasingly taking the stage in the philosophy of technology (Vial 2018) and the analysis of all the influence produced by innovation and technological know-how on our moral and societal values, especially concerning 'smart experience' (Ferrara and Russo 2018) and 'smart aesthetics' (Russo and Ferrara 2017) is still a field requiring further investigations.

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