

Visceral Design: Sites of Intra-action at the Interstices of Waves and Particles

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Abstract. Quantum physics has undermined our traditional view of the world. Waves and particles that were once considered fundamentally opposed now can be both, depending how we look at them. This raises questions: How do we conceive the world beyond human-centric perception? How do we enrich experience and feel empathy for other entities human and non-human?

As we deconstruct the Cartesian logic of modernity, other borders fall under scrutiny. There is a fundamental change occurring in the theory and practice of art and design where the line between product and user, wearable and wearer, artwork and audience is blurring. This article explores visceral design approaches to human computer interaction and wearable technology drawing on theories of critical/speculative design, visceral thinking, humanistic computing and intra-action. Case studies are introduced to demonstrate approaches that are open to the perspectives presented and represent ways the sensibility described can be distributed through practice.

Keywords: Visceral design · Visceral theory · Wearables · Actants · Intra-action · Vibrant matter · Interface · Interaction · Material · Object oriented ontology · BODYecology · BIOdress · Human-centric perception · Speculative design · Critical design

1 Introduction

Excess of sorrow laughs. Excess of joy weeps... Exuberance is Beauty.

William Blake [1]

Blake's poetry captures a visceral sensibility. This paper explores the visceral from a trans-disciplinary perspective that converges arts praxis, computer and cognitive science, and philosophy that lead us to question: How can we reconfigure art and design practices to realign with the extraordinary changes in our understanding of the world? How do we conceive the world beyond human-centric perception? How do we enrich experience and feel empathy for other entities human and non-human? How do we undermine our subjective segregation of time and our commodification of labour? How can we leverage the affordances of wearables, implantables, digestibles, to augment our sensibilities and emotions to immerse the body in sustainable post-anthropocentric ways of living in the world?

Quantum physics has undermined our traditional view of the world and demands a radical shift in our current design practices. At the heart of visceral design is a consideration of matter, so that is where this article begins. Rather than interpret the world through language, linguistic and semiotic analysis, we shall explore interaction at a more primary level – prior to cognition. The author extends Donald Norman’s ideas about Visceral Design with Steve Mann’s notion of Humanistic Intelligence. They both engage pre-cognitive communication channels. The dominance of language over material within Western culture is under scrutiny as a natural progression of deconstructivist modernist theories of feminism, postcolonialism, queer theory and post-humanism. Gender politics strived for inclusivity of female activity, then gay and other gendered, displaced, disporic, animal, plant and ultimately all forms of matter.

The work of Donna Haraway on multispecies cosmopolitics for example, offer concepts to overcome this hierarchy of mind over matter [2]. A contemporary understanding of materials acknowledges that they are actants – they have agency. Resisting this notion, our traditions and culture prioritise language in the way we interpret the world where materials are viewed as dormant, passive and mute. Representationalism situates us as outsider reflecting on the world. Karen Barad posits a post-humanist performative approach which “insists on understanding, thinking, observing and theorising as practices of engagement with, and as part the world in which we have our being”.

The author draws on Barat’s notion of intra-action and material practices of agency such as vibrant matter (Bennett) [3] and Sunaptic sculpture (Flanagan) [4]. Rather than intellectual theory alone, Visceral Theory, along with Affect Theory and Actor Network Theory offer notions of direct entanglement and active engagement with the stuff of the world. The site of creativity can be found in the flow, in the in-between spaces that are always in motion. Art and design practices generated in the interstices, at the site of intra-action, give us a glimpse of post-anthropocentric ways of experiencing and understanding the world. The first section of this paper will describe theoretical perspectives followed by case studies of wearables and digestibles that exemplify arts praxis that are explore this shift in world view. Acknowledging entanglement with the environment promotes accountability and fosters a world where the quality and experience of design, rather than the acquisition of goods, is what determines value and quality of life.

2 HCI and DUXU

There is a growing awareness of visual and soma aesthetics in interactive systems design. In the domain of Human Computer Interaction (HCI), the *modus operandi* of screen and keyboard is in demise, for example, voice recognition will quickly supersede the need to type and other haptic modes of communication will follow. Contemporary HCI now operates with an expanded frame of reference that encompasses experimental new digital technologies. Methodologies within HCI and design user experience and usability are evolving to acknowledge interdisciplinary approaches and have been greatly influenced by areas of the humanities such as social science, anthropology and art. The authors focus, and that of this paper is wearable computing or wearable technologies

(for expediency we will use the generic term ‘wearables’) that are emerging at the intersection of innovation and tradition, where scientific research, artisan knowledge and material histories mix.

Materiality is a vital notion to consider to understand the relationship between humans and digital technologies. Visceral experience is a bodily response, Jens Hauser uses the notion ‘reverse othering’ [5] to put forward the case that materials elicit reactions as a demonstration of their agency. Both humans, objects and materials are performative, but our social histories have enculturated us to believe we hold the seat of power in this relationship. Effectively blinkering us into ignorance regarding the dynamism and reciprocity of these networks of interactions, numbing our sense of accountability for the repercussion and consequence of what we put-out into the world.

For too long the process of design has been considered a matter of imposing our will onto materials, whereas good design is often born from traditional wisdom where the tolerances of materials and forms are tried and tested – where artisans understand that objects result from a meeting of the will of the material and the will of the maker. It is in this fuzzy zone (in a Bhabhaian sense) where effervescent peripheries intermingle that new forms generate. In other words, evolution is enabled through the intra-active reciprocity of the maker’s hand and material.

Wearable technology is both physical and ephemeral, increasingly smaller or invisible, so it is disappearing into the substrates of the built and organic world around (and within) us. The next generation of wearables will not only be created from electronic components – metal, wire and silicon – but include a wide range of materials such as organic wetware, graphene, Biomedical gel and data. Good design reaches into the future to explore new material technologies and into the past where traditional wisdom has pushed the boundaries and tolerances of materials and techniques, tried and tested to create a harmonious balance between material form and function. Wearables combine digital and traditional crafting of atoms and bits, and as data is fungible can flow into different physical or visual forms. Hence, our capacity to inhabit an expanded sense of being in the world is extended beyond perceptual borders of time and space.

3 Visceral Theory

The two main approaches to aesthetic interaction can be classified as analytical or pragmatic [6]. An analytical approach typically looks at an objects appearance, attractiveness, formal physical qualities of design and the concept of the design without broader reference to the conditions of its environment. A pragmatic approach, (endorsed by the author) is experiential involving intra-action [7] between artefact and observer, subject and object, user and tool, and emerges through their entanglement with context, history and culture. “Aesthetic interaction promotes bodily experiences as well as complex symbolic representations when interacting with systems” [8].

The dictionary defines ‘visceral’ as: 1. relating to the viscera: *the visceral nervous system*; 2. relating to deep inward feelings rather than to the intellect. Progenitors of visceral thinking are evident in the literature of design theorists such as Zdislaw Lewalski 1988, Ray Crozier 1994 and Mike Baxter 1995, each developing different terminology

to express similar ideas. Lewalski describes what he refers to as “X-values,” which express “the order of visual forms” [9]; Ray Crozier’s research into psychological responses to design identifies the visceral as a “response to form” [10]; Mike Baxter uses the term “intrinsic attractiveness” to describe something similar [11]. Donald Norman adopted the term “visceral” when he categorized design interaction into three levels – visceral, behavioral and reflective [12].

The visceral level describes the body’s immediate gut feeling eliciting subconscious reactions. The body gauges a situation and responds automatically, sending biological signals directly to the muscles to react and to the brain to be on alert. It can automatically decide whether something is dangerous or safe, bad or good, attractive or unattractive. The visceral level is intuitive but it is influenced by the surrounding environment and the other cognitive levels of perception (behavioural or reflective).

Since Norman, others have attempted to describe the visceral using different language such as Gerry Cupchik’s “sensory/aesthetic response” [13]. More recently Cara Wrigley proffered a synthesis of the whole canon of literature as “visceral hedonic rhetoric framework” [14].

4 Affect and Embodiment

Anthropologist Thomas Csordas posits ‘affect’ as one of ten components of corporeality to methodologically describe embodiment. According to Csordas the other components are sensory experience, movement or mobility, bodily form, copresence, metabolism/physiology, capacity, orientation, gender and temporality [15].

Rather than limit our interpretation of the world through the semiotic paradigm of culture as text, a phenomenological paradigm of embodiment offers a complimentary interpretation. The phenomenon of intentionality and existence can be analysed in terms of affect. Our participation in a cultural world is an embodied experience, so in order to think about the future of human computer interaction it is important that designers consider embodiment as part of their methodology. Emotion and cognition are equally influential to thought and behaviour and should not be considered as separate entities. Further, design must go beyond the limitation of human centric perception and recognise the potential of materials and bodies (not only human bodies) as actants. How can wearables draw our attention to the limitations of our current perception and expand our awareness to one that leverages our entanglement with the world around us toward sustainable ways of being? How did we come to have a liminal rather than holistic perception of the world in the first place?

5 Vibrant Materiality

Life is not life, but rock rearranging itself under the sun.

Dorian Sagan [16]

Matter can be observed to change state from a solid body, to liquid and finally gaseous and invisible as in ice, water, steam. In accordance with this observation it was believed

prior to the enlightenment that the breath (Greek *pneuma*, Latin *spiritus*) seen in cold weather was evidence of the solid human body turning into gas – from body to spirit.

The etymology of ‘material’ follows a path that leads to our current interpretation of ‘immaterial’ to mean it’s opposite, in other words matter as substance and immaterial as emptiness or nothingness. According to Vilém Flusser immaterial should be understood as full of stuff, meaning something more like amorphous, lacking in form but brimming with matter. The Greek term for wood ‘Hylé’ was used by philosophers not to refer to wood in general but the type of wood stored in carpenter’s workshops. Greek philosophy came up with this term seeking a way to define what is opposite to ‘morphé’ (Greek for ‘form’). Flusser concludes that ‘Hylés’ use was analogous to our use of amorphous. Greek philosophy’s explanation of the world was that of an amorphous stew of phenomena (the material world) that was only revealed to us through theory. Reality consists of forms concealed behind an illusion that is the ‘formal world’. “... amorphous phenomena flow into forms, occupy them in order to flow out into the amorphous once again” [17]. Hylé and morphé are opposing concepts, like the English matter/form. So material/immaterial are always the same stuff they are just in different amorphous states. Flusser suggests we think of ‘matter’ as ‘stuff’ - which gets stuffed into forms - as a more appropriate contemporary metaphor than that of the carpenter’s wood blocks being cut into forms. A parallel idea within a scientific world view is to acknowledge that materials are in a constant state of entropy, where “matter is substance in its intra-active becoming—not a thing, but a doing, a congealing of agency. Matter is a stabilizing and destabilizing process of iterative intra-activity” [18].

6 Scientific Epistemology

In modern science under the influence of Cartesian thought, we took a path that led us in one direction to divide matter into infinitely smaller pieces; and in the other to the speed of light (gas viewed as high energy). Matter and energy, body and spirit, material and time, viewed as opposite to one another. An order of hierarchy fell into place in Western societies under the enlightenment modernity paradigm that placed the human mind at the top and the body below followed by animals, plants, less complex organisms, down to inanimate objects like stone. Human relations to the non-human world continue to be governed by this hierarchal order. We legitimise its structure by valorising one human-centric perspective where all else is viewed as other. Where “rational subjects remake the world as ‘objects’ – scientific objects, material objects, economic objects, objects of conquest, objects of desire, and so on. These objects are constructed through a gaze that is necessarily reductive since it isolates things from the complexity of systems in which they are immersed” [19].

Contemporary information technology, particularly virtual reality is enabling us to visualise concepts of matter that are closer to the original notion in Flusser’s explanation – viewed as temporary filling of forms. At Ars Electronica in 1993 Peter Weibel noted this shift from “defining life as substance, material hardware or mechanism to conceiving life as code, language, immaterial software, dynamical system” [20]. But this faith in the virtual as descriptor of the real has now been unplugged, rather than flipping reality,

quantum physics shows us the vibrancy of matter at an atomic level where substance, material and mechanism are viewed as temporary constellations of stuff that are always moving toward a natural state of entropy. Louise Poissant's description seems to grasp this, "the raw material, one must say is algorithmic and abstract and at the same time composed of communicational flux made of sensations, emotions, ideas and exchanges" [21].

7 Moist Media

Life began in the ocean, where water is ambient and life is an immersive experience. With the evolution to life on land, organisms emerged that found ways to mobilise the environmental functions that the ocean had once performed and marine life had taken for granted. Rather than being immersed in the life giving fluid that supports half of the living mass of the world, life on the land evolved portable irrigation systems that connected organisms [22].

"Biota has had to find ways to carry the sea within it, and moreover, to construct watery conduits from 'node' to 'node'" [23]. Over time water enacts the rising of sea level as "the land biota literally carries the sea and its distinctive solutes over the surface of the land" [24].

Following Dianna and Mark McMenamin's notion of life on land as a 'Hypersea', Sadie Plant presented the narrative above in her 1998 publication *Digital Women + the New Technoculture*. Plant's interest lay in the fuzzy border between land and water. This is the littoral zone, an edge that is never stable but always in a state of flux, where the intra-action of water and land fuse into beaches of silicon.

"Ninety-five percent of the volume of the earth's crust is composed of silicates" they are within our bodies as well as the earth. It is this mutual materiality that makes silicon an ideal conduit for our fluid technogenesis. The mechanical limitations of computing are becoming evident, but technological and biological mutation continue the evolutionary process of wearable technology in wetware and new materials science. The tide continues to rise to quantum levels of computing in digital oceans. "What were once discreet media and separable senses have become promiscuous and entwined" [25].

The growth of wetware complements software and hardware. Roy Ascott points out that moist media describes a more coherent network at a biological level [26]. Moist media implies that technological tools and media are not viewed in opposition to humans but form a moist living ecosystem.

8 Object Oriented Ontology

If the world is made of particles and waves, parts or effects, then an object is something in between. Quantum theory posits that objects are only cognitive constructions. This sideways glance has more to do with framing experience, which then appears as a kind of shape shifting. In this light, art and design can provide ways to indirectly gain access to the object. The intense interest, growth and viability of wearables is in part due to their ability to inhabit the in-between, the intra-active space brought to life in the littoral

zones of the body and world, private and public, physical and digital. Once we accept that objects are inherently unstable, we need not think of them as being pushed around by processes, particles or perception, rather the instability of objects in a state of quantum coherence is intrinsic. In defence of an object oriented ontology Timothy Morton says that objects are not static but metaphorically they seem to ‘breathe’, “occupying two positions, vibrating and not vibrating simultaneously” [27].

Wearables bring brain, body and environment back together in an integrated expression where both bodily and intellectual aspects of experience are equally valid. In this sense art and design take an exploratory role and act as conduit to disseminate new ideas. Following Merleau-Ponty’s phenomenological approach to perception, wearable design takes as its starting point ‘embodied interaction’ which entails a consideration of “physical, bodily, and social aspects of our interaction with digital technology” [28]. Speculative and critical wearable design practices search for new possibilities, they then test, project and distribute these new definitions.

9 Organic Intra-action

The definition of human-computer interaction traditionally refers to information exchange between human and computer but that definition is too narrow to define the future that will include more corporeal experiences and information exchange between physical world and computers. Jun Rekimoto describes future intra-active systems that aim to mimic the complexity of natural ecosystems “wall systems that will react to human gesture, be aware of the air in the room, and be able to stabilize conditions (such as temperature and humidity) in the same way a cell membrane maintains the stability of a cell environment” [29]. In a similar approach Natalie Jeremijenko’s projects demonstrate interface ecologies, practices that interconnect multiple systems to form a whole. “Interfaces are the catalytic border zones where systems of representation meet, mix, and recombine. Through this recombination, interface ecosystems generate fundamental innovations of form, experience, knowledge, and technology” [30].

The title of this article proposes design creativity as sites of intra-action at the interstices of waves and particles. The term intra-action makes a direct reference to Karen Barad’s theory of agential realism. The word ‘interaction’ is based on the assumption that two entities are separate to begin with, ‘intra-action’ alternatively describes the same space but with full awareness of the agential nature of each entity. In fact, the conception of the object is in some sense inverted or turned inside out. “It is through specific agential intra-actions that the boundaries and properties of the components of phenomena become determinate and that particular concepts (that is, particular material articulations of the world) become meaningful” [31]. Barad offers a theory that hinges on causal relationships between materials and practices which can be viewed as an alternative to representationalism and in this sense intra-action is a profound conceptual shift. Hers is an agential realist ontology, both posthumanist and performative. Wearables represent a media capable of inhabiting and engaging these intra-active interfaces.

“Phenomenon is a dynamic relationality that is locally determinate in its matter and meaning as mutually determined (within a particular phenomenon) through specific

causal intra-actions” [32]. In this reframing sustainability becomes an inherent condition of materiality. “Responsibility is not an obligation that the subject chooses but rather an incarnate relation that precedes the intentionality of consciousness. Responsibility is not a calculation to be performed. It is a relation always already integral to the world’s ongoing intra-active becoming and not-becoming” [33].

10 Case Studies

Having described a general theoretical approach, in this section three case studies are described that demonstrate speculative design approaches that are open to the perspectives presented. They represent ways that the aforementioned visceral sensibilities can be played out and tested in art and design practice.

10.1 Cross Species Adventure Club

Natalie Jeremijenko’s arts practice can be described as experimental design to promote non-violent social change. The Cross Species Adventure Club leverages the visceral aesthetic experience of eating. It consists of an iPhone app, a cookbook and a series of events that explore “food webs, community structure, chemistry, nutrient cycles and the behavior of organisms within complex ecological systems” [34]. In Boston she hosted ‘Lures and other Edibles – Adventures in Aquatic Ecosystems’ where guests attended a banquet and the molecular gastronomy menu consisted of environmentally conscientious meals. For example, edible fishing lures containing a chelating agent, that when digested by humans or fish, binds the heavy metals in the body so that they can be passed through in a less reactive harmless form as salts. “With the lures, humans and fish share a diet engineered for environmental remediation. Sharing these particular foods promotes an active, interventionist companionship anchored in bodily processes” [35]. One can imagine Jeremijenko’s approach combined with naturally occurring nano actuators such as those used by Tangible Media Group at MIT Media Lab in BioLogic. BioLogic is a breathable fabric with vents that open when *bacillus subtilis natto*, a substance found in fermented soya beans, expands through hygromorphic transformation induced by heat or humidity [36].

10.2 BODYecology

The author’s arts practice is developed with an awareness of interconnected systems and visceral sensibility. BODYecology operates in the liminal space between unconscious sleep and material artifact illuminating our contemporary society in a critical sleep crisis. Our culture has a problematic relationship to sleep leading to chronic social jetlag and affiliated illnesses [37]. The industrialization of time, governed by productive work hours leaves sleep as something negative that our body gives-in-to when we can no longer stay awake. Sleep is eroded at each end of the day. Diurnal time is ignored, as we stimulate our bodies to stay awake way past sunset late into the night fueled by electric lights and screens, then in the morning the industrial time of the alarm clock

wakes us long before our bodies are fully rested. This repeats all week resulting in social jetlag and then we binge sleep on weekends.

Flanagan's installation consists of a system of connected objects: a bed, a portable dyeing machine and a weaving loom. Merino lamb's wool is spun into thread and placed into one end of the dyeing machine, threaded through the system and connected to an empty bobbin at the other end. When set in motion, the wool is drawn through an indigo dye bath and drying box. The bobbin is connected to a pressure sensor on a pillow on the bed adjacent to the box. When Flanagan sleeps the weight of her head on the pillow engages the sensor and the bobbin starts turning. Flanagan's body is connected to the dye machine via a Fitbit. Specifically, the Fitbit communicates to an auger above the dye bath. Three phases of sleep are translated into three positions of the auger. Deep sleep = low in the indigo dye bath, restless = shallow, awake = above the dye level. By the morning the wool has been transferred from one end of the dye machine to the other resulting in a bobbin full of variegated blue thread, the visceral memory of sleep the night before. The thread is then transferred to a shuttle and to the third phase of the system, the weaving loom which sits adjacent to the dyeing machine. A double weave configuration on a portable loom enables the weaving to be contained in a narrow area. After approximately one month sleeping and weaving, the warps are cut and the blanket unfolded from the loom. The blanket can then be used on the bed, completing the cycle. The performance installation and resulting blanket act as catalyst for discussion and self reflection on sleep. Visitors to the installation spend time in dialogue with the artist sharing their experience of sleep. Through this dialogical methodology future research questions solidify, for example an awareness of changes in sleep patterns can be used as a diagnostic tool to warn mental health sufferers of pending relapses, in bipolar disorder [38]. A future research study proposition is to investigate woolen textiles and their effect on sleep quality in menopausal women (Fig. 1).

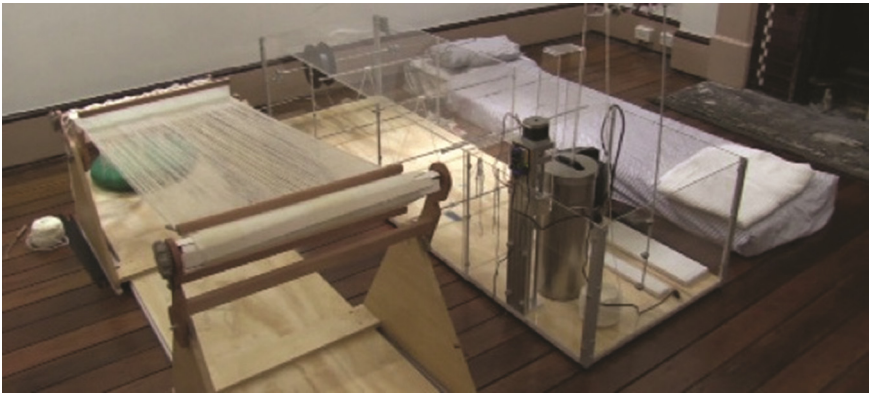


Fig. 1. BODYecology 2015 Tricia Flanagan (video still)

10.3 BIODress

BIODress is a body-worn interface designed to enhance empathy between human and non-human entities “facilitating interspecies communication with a goal to create an expanded network of embodiment. The overall objective is to encourage human empathy beyond the anthropocentric towards more sustainable development” [39]. BIODress connects the body to plant and environmental data through visceral and visual communication to evoke awareness and responsibility by human agents for their role in the ecosystem. The BIODress augments the body’s awareness and sensitivity to the life of plants by responding to three parameters (Fig. 2).



Fig. 2. BIODress 2014, Sara Adhitya, Beck Davis, Tricia Flanagan, Raune Frankjaer, Zoe Mahony, (alphabetically listed).

EMG readings and particulate sensors on a plant induce movement, temperature and color changes on the BIODress so wearers develop an emotional response to conditions affecting their companion plant. Thermochromatic dyes change the color of the leafy structure of the dress according to particulate levels in the air. Clean air gives a green-brown reading and red-magenta is the response to pollutants. The color change is produced by heating conductive thread embroidered onto the dresses surface, so the color change is felt through the wearers skin as well as witnessed externally by others. The shoulders of the dress are made from thermally pleated organza that expand and contract, metaphorically breathing. Actuators set into the shoulders respond to the

particulate sensor reading on the plant. Heavier breathing, i.e. faster motion indicates poorer air quality. Movement of fabric leaves are engineered using shape memory alloy embedded in vein like structures on the dress. The movement reflects the plants activity as gauged by the EMG sensor attached to the surface of one of it's leaves.

"The impact works on a number of levels. As a wearer, one is able to embody the state of the plant and its surrounding environment. As an observer, this information is broadcast to the public domain" [40].

11 Conclusions

Wearables exist in intra-active zones. The living body provides mobility and the frame of reference changes as they enter new environments – cultural, social, climatic, environmental etc. They are open to transformation by media and discourse and are developed with critical interaction in mind – in terms of user/wearer experience. As digital media becomes increasingly intuitive and hidden away within the structures of our clothing and built environments, wearables speak out as a reassertion of the body's haptic, visceral sensibilities in the digital world, an extension of the body's organic and dynamic interface aesthetics [41].

Two perspectives emerge as profound, from one the sensory deterritorialization is conceived as an ontological shift in the materiality of our culture "a necessary consequence of the historically unprecedented interpenetration of the body and media" [42]. The other imagines an unprecedented fluidity between the human body and computer. Steve Mann's humanistic computing for example draws on this formulation where there exists a mutual embedding of both 'body and space' in the primary 'medium' of sensation. Mark Hansen acknowledges these shifts and hypothesises 'the affective body' – "the role of the body as, at once, a *source* for and *activator* of a rich affective constitution of space" [42]. In this way space itself is an attribute of wearables. "Whilst media make space flexible and invisible, it is the body that allows mediated space to be experienced sensorily, precisely as space made wearable" [43].

A visceral approach to design could be viewed as an extra parameter to extend standard approaches to human computer interaction and design user experience and usability, but rather its full potential could be the reinvigoration of current design practices to address anthropocentrism and promulgate sustainable design approaches.

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