Technology toward more-than-human symbiosis

RESEARCH-ARTICLE

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Technology toward more-than-human symbiosis

Critical reflections from the design perspective

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ABSTRACT

The research aims at analyzing the theme of human-nature interactions mediated by technologies from different perspectives and applying three lenses: the first one is more pragmatic and oriented by technological applications, and, thus, with relapses on design practices, while the other two are theoretical – decolonization and post-human feminism – and they provide a critical vision of the topics of interest from an ontological and epistemological point of view, with relapses on design theories. Therefore, the goal of the research is to provide a first draft of a framework, designed through a process of literature review and case studies analysis, that can stimulate more-than-human connections as collaborative and symbiotic processes between human and non-human agents, oriented by new perspectives upon technology.

CCS CONCEPTS

• **Applied computing**; • **Arts and humanities**; • **Media arts**;

KEYWORDS

decolonization, post-human feminism, technology, more-than-human, design, pragmatism

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1 INTRODUCTION

What happens when humankind, having irreparably altered the balance of planet Earth, stops being the center of the world? And amid the ecological crisis, what relationships can be restored not only between human individuals but between all the species inhabiting the planet? [1].

To contrast the paradigm of Anthropocene, many scholars and practitioners from different fields are producing theories and actions that are constituting a pluriversal body of knowledge that opposes the universal and Western perspective [2]. What is therefore desirable is a change in the current and dominant paradigm, based on the concept of anthropocentrism, and, thus, strongly human-centered, towards non-centric visions, which see an outline or a perimeter (one world), within which multiple and plural worlds, perspectives, experiences, and points of view coexist, belonging to human beings and all natural actors. Drawing from the Zapatista movement, what should be achieved is "un Mundo donde quepan muchos mundos" (a World where many worlds fit).

From an ontological and epistemological perspective, it means embracing and fostering critical and pragmatic paradigms, such as post-human feminism [3] and decolonization [4], that try to diverge from the positivistic and the constructivist worldviews that contributed to produce the dichotomies between nature and human, Global South and Global North, genders, and so on, responsible for the current environmental, social, and values crisis [5]: one of the criticisms toward constructivism is that it assumes that two different social formations are completely different and incommensurate. Therefore, it is impossible to compare different worldviews, and thus, communicating between them about what is true and false becomes impracticable. It also means researching, approaching, producing, and exploiting technology by applying these non-centric paradigms. In this way, it can become an effective and efficient tool to regenerate the relationship with nature, build new relationships, and, thus, enable all actors, human and non-human, and collaborate in the constitution of new senses and meanings that should contribute to building a more-than-human ontology and epistemology. Through the analysis of the case studies those concepts are going to be further explained. Extending these concepts, technology itself could assume the role of an agent within the pluriverse: technology is understood as a non-living entity that serves to build and mediate relationships between nature, the more-than-human, and the human being [6]. Thus, it becomes a tool for multispecies interaction, a sort of catalyst and facilitator for these new or rediscovered relationships. In mediating these interactions, technology may also add its own contribute to the connections themselves, adapting them according to the peculiarities of the involved living entities, i.e., different levels or kinds of perceptions, communications, and willingness [5, 7, 8]. Therefore, technology is also meant as an active participator in rediscovering relationships and enlarging the range of possible connections between living entities or, at least, the hypotheses to get in contact with a broader variety of natural agencies.

Within the design field, a pragmatic perspective [9] helps in stimulating reflection on practical actions and real projects; to decolonize design research and practice means having a transcultural

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approach toward the multifaceted complexity we are living in, relying on critical and speculative approaches. Having a post-human feminist perspective on design means showing how everything is connected within a complex system and demonstrating the need to converge different viewpoints and movements with similar aims at their base [3].

Thus, the research aims at analyzing the theme of human-nature interactions mediated by technologies from different perspectives and applying the lenses of pragmatism, decolonization, and post-human feminism. Therefore, the goal of the research is to provide a first draft of a framework, designed through a process of literature review and case studies analysis, that can stimulate more-than-human connections as collaborative and symbiotic processes between human and non-human agents, oriented by new perspectives upon technology, and mediated by design.

In the first section of the paper, the pragmatic perspective is presented with a focus on what it means for design research and practice, how it may influence the relationship and the interactions between nature and humans, and what it means to have a pragmatic perspective on technology. In the second section, the decolonial perspective is described, focusing on what it means to have this stance toward human-nature interaction and technology and how it may influence design research and practice; the third section is dedicated to presenting the post-human feminism and the concept of alienation, identifying technology as a non-human agent. Within the fourth section, three case studies are presented and described, one that shows a posthuman feminist approach to a technological project and one to further explains the concept of decolonization within the design field, highlighting how an indigenous perspective may exploit technology in different ways to achieve a deeper relationship with nature, and two to further analyze the application of pragmatism to design in the context of human-nature interactions. Finally, in the conclusion, a first draft of guidelines to co-design with more-than-human actors [8] is highlighted, drawing on the principles, values, and body of knowledge of pragmatism, decolonization, and posthuman feminism. Further issues and questions are also described, such as the modalities to involve more-than-human actors as real stakeholders within co-design processes, trying to understand which role the technology may assume in this context and scenario.

2 A PRAGMATIC PERSPECTIVE

Dealing with the topic of more-than-human interactions means inquiry and investigating some existing interconnections within the real world, trying to understand complex issues through theorization. A strong link with the practical aspects is inherently underpinned during this process, moving away from the dichotomy theory-practice towards an embodied inquiry [10].

To this end, the concept of pragmatism offers some interesting suggestions to intend post-human interactions. As stated by Frega, pragmatism represents an epistemology and inquiry approach oriented toward practice and empirical activities as crucial to investigate human, social, and natural phenomena [11]. The individual is therefore invited to a constant process of reactions and reflections on "the consequences of its interactions with the environment" [10], highlighting some common aspects with the methodological tools of design research and practice. According to their transformative nature, new knowledge, tools, and/or methods may be directly developed through practical experimentations and projects within real contexts. Therefore, "designerly ways of knowing, thinking, and acting" [9] may contribute to a more pragmatic way of inquiry, fostering a perspective-shifting through design practitioners' activity and using practical inquiry tools to reflect on theoretical aspects [12].

Reflection-in-action is a way to connect theoretical aspects of design research to their implementation and transformation into the real world by reflecting on them through concrete actions and design projects [13]. Recently, this pragmatic approach has been intertwined with the topics of multispecies justice and sustainability [14], human-non-human interaction [8], and post-human design [15], resulting in a growing number of design projects focused on human-nature interaction. As a matter of fact, reflecting on more-than-human relations let assume the world we live in as the environment where these interactions occur. Artifacts, products, exhibitions, or similar projects can be seen as practical experiences for reflecting and reacting on these topics, encouraging to assume post-human perspectives. In this section, a more pragmatic lens is going to be used to investigate the human-nature interaction as well as the role of technology in the perspective-shifting toward a post-human approach to design practice. To this end, some design experimentations will be critically analyzed to understand the key points to foster more-than-human contributions of technology within the current changing context for design [16].

2.1 What Pragmatic Epistemology Means for Design

Within the design research and practice context, pragmatism offers a new epistemological lens that stimulates ongoing reflection on practical actions and real projects. Pragmatism is often assumed as a research epistemology in contrast with the duality given by positivism and constructivism [10].

Thanks to its situational and interventionist nature, pragmatic perspectives in design research focus on building new knowledge through reflective practice in real contexts, recognizing the crucial role of interventions that include exploration and experimentation [10, 12]. Practical inquiry tools may be used to reflect on complex issues by means of embodied and interactive experiences from the design practice [17]. Artifacts and experiences are, therefore, the media not only to build new knowledge but also to share it and foster new critical reflections. Moreover, a pragmatic perspective allows design research to tackle complex issues and problems as a starting point for inquiry and, consequently, design [18]. Therefore, concrete actions, such as artifacts, exhibitions, or performative experiences, are the focus of this approach and represent a way to connect theoretical frameworks developed through research with practice by solving real-life issues [19]. These aspects of pragmatism may be implemented within the design research by selecting the methodologies that emphasize practical interventions as inquiry tools, such as Research through Design or Critical and Reflective Design. Hence, these methodologies represent the actual translation of the pragmatic epistemology into research-oriented approaches and processes.

As new environmental and socio-technical issues have arisen in the last years, design discipline should change accordingly [16], as well as the epistemological perspectives to deal with them. Pragmatism may help in framing new research inquiries on these emerging aspects, linking their practical interventions to continuous reactions and reflections and contributing to their progressive definition and transformation. An increasing number of design projects are currently focusing on the topics of multispecies justice and sustainability, human-non-human interaction, more-than-human entities, and post-human design, building new knowledge within the design research domain through experimentations and experiences [20, 21]. Hence, pragmatism appears as a proper lens to reflect on human-nature interactions by following critical approaches from design research.

2.2 A Pragmatic Approach to Human-Nature Interactions

Pragmatic concepts represent a well-suited approach to connecting design theory and practice [10]. Similarly, multispecies justice and post-human design are increasingly investigated by designing new interactions and experiences to raise the awareness of a wide audience, ranging from researchers and practitioners to professionals and entire communities [22]. Therefore, pragmatism offers an alternative way to explore theoretical aspects within the real world and foster critical reflections on emerging environmental and socio-technical aspects. In particular, human-nature interactions may be translated into design projects and experiences, often following the principles of speculative design and participatory design [7, 23]. For instance, the audience can be involved in reflecting on possible and plausible futures through fictional events, using some artifacts that clearly show the consequences of their actions on different agencies, or participating in provocative exhibitions that represent transformative scenarios linked to concrete actions or real events.

A pragmatic approach may, therefore, foster the perspective-shifting of a variegated audience through real experiences, highlighting the different ecologies within our pluriversal world. According to different works, human-nature interaction may generate new collaborative patterns between humans and non-humans, such as new participative materialities, artifacts, and relationships [7, 24, 25]. However, dealing with human-nature interactions also means critically considering the role of non-human agents within the designed experience. As a matter of fact, the collaborative path should represent a real non-hierarchical interaction between humans and non-humans, trying to overcome the intrinsic anthropocentric bias that we could experience as humans [8, 26]. In this way, design practice may foster the debate on multispecies sustainability and collaboration through pragmatic, situated, and more-than-human interventions.

Pragmatism can help in considering the world we live in as the environment where these interactions occur, encouraging to reflect on the human-nature relation by means of practical experiences. At the beginning, these interactions may be replicated to better understand their working principles and the roles of the different actors, i.e., through prototypes or artifacts. New interactions may be designed at a later stage, envisioning the possible consequences for the involved agencies, which means shifting towards non-human ways of interpreting the environment. In this case, more provocative tools and less defined may be used, including a degree of uncertainty to be progressively investigated by the researcher and the audience.

2.3 A Pragmatic Approach to Technology

From a practical point of view, technology has a central role in connecting different ecologies and may act by following several paths. On the one hand, its role is to mediate human-non-human relationships, translating the needs and feedback according to the different ways of communication [8]. On the other hand, technology can actively participate in the multispecies debate by representing a third element that disrupts the human-nature dichotomy [5]. Similarly, technological innovations may represent a different perspective on the pluriversal dialogue between humans and non-humans as part of independent and new ecologies.

Therefore, new technological methods and innovations have the potential to bring theoretical considerations related to human-non-human interaction and post-human design into more pragmatic and real contexts [14, 22], moving from abstractness to concreteness. For instance, computational, generative, and parametric design may be sought as pragmatic actors in concrete projects and experiences. Thanks to their adaptive and transformative interventions, the design outcome is not only meant to simply translate the multispecies perspectives but also to let the technology add further elements to design projects and experiences, i.e., multiple alternatives through generative design [27, 28]. However, the role of technology should be critically considered, paying attention to its way of mediating different multispecies agencies and/or participating in the designed experience, avoiding human-biased actions of technology or anthropocentric outcomes [24, 29].

3 A DECOLONIAL PERSPECTIVE

Decolonizing discourses seek to move away from the universal ontology of the Western World and focus on situating many experiences, epistemologies, and narratives [4], within one world [2]. They refer to the work and actions to restore land and life by ending a continuous period of colonialism [30], whose effects still endure in present, resulting in what Quijano [31] defines as coloniality: the continuous reiteration of dichotomies between subject and object, between humans and nature, between Global North and Global South. Coloniality also represents the establishment of traditional models of power, and how they influence our worldviews [32]. Therefore, decolonial studies use hindsight [32] to dismantle these assets of power, entangling their theories with environmental studies, critical theories of race, feminism, and science and technology studies [32]. It can be assumed that decolonization works on two different layers: on one side, to dissemble colonial relations; on the other, to tackle the colonial mechanisms that undertake our life, our relationships with other human beings, and with other beings [32].

In the next paragraphs, the lens of decolonization is going to be applied to human-nature interactions and to the potential roles that new technologies may have in shaping and mediating these relationships. Through this perspective, we are also going to highlight traits and characteristics that the disciplines of design should adopt to become a means for more sustainable and pluriversal ontologies

[2], epistemologies, politics [33], and actions, recognizing design both as influenced by capitalism and neocolonialism and as a tool to maintain the traditional models of power.

3.1 A Decolonized Approach to Human-Nature Interactions

Environmental justice is often defined through Western ways of thinking, which lead to failure in accounting for cases involving mutually undermining modes of life, in rendering visible that participation may contribute to the reproduction of environmental injustices. Also, in tackling the idea that the Global South has no valid ontologies to draw from [34].

Colonial discourses underlie and interact with materiality. Coloniality is a global phenomenon and a wicked issue. Therefore, decolonization must target all the domains in which coloniality acts to subvert the traditional and current paradigms and provide insights into the nature of reality at large [35].

Rights of Nature [36, 37] is an interesting and fundamental concept [38] that arises from Global South and that demonstrates how to go beyond the dichotomy of humans-nature, typical of Western ontology. It is based on the notion that the natural realm has its own independence, agency, and legitimacy, and it argues that indigenous narratives about human and nature rights should be included as fundamental within the discourses regarding more-than-human ecologies [39], sustainable transformations [40], and social and environmental justice [34]. Therefore, the concept of Rights of Nature appears fundamental as a critical element of reflection on the issues addressed. It is evident that it is a first and young step to reach the objectives of independence (of the single natural entities) and of interdependence (between the single natural entities).

Thus, a decolonizing perspective can make sense of the current crisis of values that contributes to both environmental and social crises [36]: since these require actions to be solved, and the nature of these actions depends upon how the crises are conceived [41], decolonized and pluriversal worldviews would enrich the discourses about those crises and the paths to reach just and sustainable futures.

3.2 A Decolonized Approach to Technology

While technology and technological innovations and development are often depicted as means for positive change, they can also represent significant risks, especially to already vulnerable people [32], and to natural environments. In a world where inequalities in the distribution of power and agency still represent the predominant conditions, technology can't be considered neutral. In the current paradigm, it is a means to exercise power and to continue to validate social and environmental injustices and global and local imbalances. Furthermore, different decolonization scholars have argued the potential ethical and social implications of technology if developed in a universal context [4].

Applying a decolonial lens to technology may mean reconstructing the Western histories and philosophies of technology to decolonize the reasonings of scholars and practitioners as a pre-condition for decolonial technological innovation or application to take place. This approach can be considered top-down [6]. It can also be intended as practices that, being developed together with marginalized people, intend to co-design solutions through a pluriversal dialogue of knowledge. As opposed to the previous one, this approach has to be intended bottom-up [6].

Decolonial studies admit a transformative power of technology, but they highlight the need for ways to resist the ongoing effects of colonial ontology; therefore, they construct their epistemology as a continuous process of resistance, appropriation, and theorization of the relationship between colonialism, technology, and the human [32].

3.3 What Decolonization Means for Design

Although the theme of decolonization is discussed in several disciplines, it appears underdeveloped in the discourse on design, where there seem to be theoretical and methodological gaps regarding it [4], visible in all the domains where design is involved [4]. Yet, a growing number of scholars [2, 35, 38, 41], particularly situated within the Global South, are addressing and deepening these themes and subjects, trying to propose new, pluriversal, and more inclusive approaches: since design does have politics, it can therefore be colonial or decolonial.

Understanding a general twofold stance of design, as a problem-solver and a sense-maker [16], the first lever to be exercised consists in the inclusion of indigenous senses and meanings of ontologies and epistemologies belonging to the Global South, which are able to conceive many worlds within one world. Applying decolonizing theories to design means, on a theoretical level, having a non-centric, peripheral, and non-linear view, rejecting a blind imitation of Western models, recognizing the value of new and alternative approaches, and supporting new ways of creating knowledge. It also means having a critical stance toward sciences and technology [32].

Keeping in mind the aforementioned theoretical aspects and the general perspective of decolonization, it is possible to highlight different other traits that design should take on: having a transcultural approach to technology [42] by valuing cultural differences [6]; fostering inclusion [6] of every natural actor by de-humanizing emerging technology; drawing methodologies from anthropology futures [43], and participatory action research [44]; relying on critical [45] and speculative [46] approaches to stimulate awareness; addressing social and racial justice [47], and environmental and more-than-human justice and agency [8], also exploiting good practices of use of technology [4].

4 THE POST-HUMAN FEMINIST PERSPECTIVE AND THE CONCEPT OF ALIENATION

The feminist perspective introduces an additional key to the concepts of 'post-human' and 'decolonization', showing how everything is closely connected within a complex system and demonstrating the need to converge different viewpoints and movements that have similar and coherent aims at their base.

Feminists refuse to reduce feminism to homologation or integration to the masculine Eurocentric standard of equality [3, 48, 49], developing a more accurate analysis of the power relations

underlying which, according to Rosi Braidotti, lies the humanist paradigm. She also mentions "the decentring of Anthropos as species exceptionalism and the rejection of anthropocentrism as a habit of thought" [3]. According to the post-human perspective, it is humanism itself that needs to be deconstructed and critically reread. If the human (male) body has always been the measure of all things - from Vitruvian man to Le Corbusier's Modulor to robotics - it is now but "an obsolete piece of machinery by comparison with the speed and liveliness of the new technologies."

Man as the measure of everything and human/humanistic thinking as a "universal" point of view that in reality is not universal.

Here is where the concept of alienation is inserted. Alienation represents what one feels with respect to the "heteronormative idea of the human built into European humanism" [3]; but also the means of de-identifying with such an embedded worldview.

In this perspective, it becomes urgent to cultivate the ability to practice collective de-identification to distance oneself from the humanist paradigm. Alienation can be an impetus, a generative force to give birth to new worlds: "It is through, and not despite, our alienated condition that we can free ourselves from the muck of immediacy. Freedom is not a given – and it is certainly not given by anything 'natural'. The construction of freedom involves not less but more alienation; alienation is the labor of freedom's construction" [50].

4.1 Technology as a Non-Human Entity

Ours is a world in vertigo. It is a world that swarms with technological mediation, interlacing our daily lives with abstraction, virtuality, and complexity [50]

Braidotti includes, among the precursors of the post-human and post-anthropocentric perspective, the ecofeminist movement [51], which according to the author, "starts with the reappraisal of the organic animals, plants and the entire planet, but in the course of time grows to encompass also inorganic entities such as technological artifacts, networks, codes and algorithms" [3]. And it is precisely to the role of technology from the posthuman and feminist posthuman perspective that attention is to be brought.

According to this perspective, digital technologies and the virtual world are not separable from the material reality that undergirds them; therefore, it is not intended to discuss the supremacy of the virtual over the material or of the material over the virtual, but rather to grasp their points of power or powerlessness in order to initiate a reflection on the contribution that technology can make in the transition from a Eurocentric and androcentric viewpoint to a perspective untethered from any bias of humanistic heritage, capable of deconstructing hierarchies and, according to the ecofeminist perspective, abolishing the nature-culture polarization.

Technology isn't inherently progressive. Its uses are fused with culture in a positive feedback loop that makes linear sequencing, prediction, and absolute caution impossible. [50]

If technology to date is thought of and used according to a Europe-centric androcentric point of view, in "Xenofeminist Manifesto: a politics for alienation," the authors question why there is still no concrete effort to reuse technologies for progressive purposes - they specifically talk about gender progressivism, but the concept can be extended to non-human entities. If the conservative use of technology contributes to the continuation of the - toxic - hegemony of humans, the question arises whether it is possible to strategically use existing technologies to redesign the world and the way we perceive ourselves and others within the world.

5 INSIGHTS FROM THE PLURIVERSE: CASE STUDY ANALYSIS

If the theme of reflection-in-action acts as the fil-rouge of this contribution – understood as a way to connect theoretical aspects of design research to their implementation and transformation into the real world–, the case studies presented here provide concrete examples by bringing attention to different yet relatable aspects.

Therefore, the case studies have been selected considering: the data completeness, i.e., searching for the project websites and documentation; the presence of the different agencies considered in this work, i.e., human, non-human living, and non-human non-living entities; the kind of interaction between the different agencies, discarding human-centered approaches. One case study for each lens was finally selected as a synthesis related to human-nature interactions mediated by technology in each specific case. Therefore, three different case studies were analyzed in this work.

The case studies have as their object the use and experimentation of technology aimed at a shift in perspective – from human-centered to post-human-centered – and represent three different approaches from the discipline of design in a path from the theoretical to the practical. In fact, starting from a critical approach entirely aimed at developing reflections on theoretical aspects, as in the case of the first case study, we arrive at an example of a creative and generative approach that practically experiments with new technologies that facilitate the interaction between human and non-human. The cases also provide three interpretational keys through three different lenses: from posthuman feminisms, particularly eco-eco-punk feminism, to decolonialism, focusing on practical inquiry tools to reflect on theoretical aspects [12].

5.1 Losing Control over Technology for a Real Shift in Perspective – a Feminist with a Drone

The first case study we focus on is Joanna Zyilinska's "Feminist with a drone", presented at the 11th European Feminist Research Conference (June 2022), which opens up a reflection on the use of technology to investigate new views of the world. Zyilinska's work stands in a transversal mode between theory and practice, man and machine, representation, and reality, opening up different ways of thinking and seeing.

The work lies between critical media-practice and feminist theories [52, 53], focusing on dominant representational models and the use of technology. Embracing the eco-eco-punk feminist movement (eco-logical and eco-nomic), the case study contrasts media-thinking and media-making that underlies human-centric, androcentric, Europe-centric, and colonialist rules and viewpoints, seeking a way out of the media-polluted world through the use of technology, pursuing the idea of alienation from the 'white man

savior'. Before going into the merits of the case study, it is useful to open a parenthesis on the issue of representation. According to Luciana Parisi, "the model of representation reduces all differences - biological, physical, social, economic, technical - to the universal order of linguistic signification constituted by binary oppositions where one term negates the existence of the other" [54]. The translational models underlying the creation of images are based on mental schemas and habitus inherited from an androcentric worldview. This confuses the humancentric viewpoint - here in the feminist sense - with the 'universal'. If images reflect the way we see the world and at the same time influence it [55], defining what is "normal" and what is not [56], a radical change of perspective is needed, one that is less heroic and does not flatten the world or elevate man as the creator and destroyer of the world, seeking an alternative planetary vision. Zylinska's work focuses on the concept of nonhuman photography [53], referring to photographs that are not of or taken by humans in order to combat our partial view of the world.

In the case of "A feminist with a drone," the researcher focuses on the loss of control over technology, opening a reflection on the role of technology left to act 'autonomously', according to a chaotic approach.

From a procedural point of view, the experimentation is very simple: it involves losing a drone and later collecting images that are taken 'autonomously'. In this way, the human has no control over the translational processes and is unable to bring their own biased point of view back into the image. Zylinska's goal is the negation of "les belles-images" [57], disrupting dominant representational models and experimenting with a form of post-anthropocentric visuality once that does not sanitize the world, obtaining a more purist planet-scape. This practical experimentation has led to the establishment of archives of "loser images," alternative visions that form a counter-visuality that also questions all those disciplines, such as geography, history, architecture ... of humanistic heritage, which incorporate a colonialist vision.

5.2 Future Ancestral Technology by Cannupa Hanska Luger

Both design and technology are political, and thus, they can be colonial and decolonial, so their use and exploitation could both nurture the current paradigm or address, propose, and flourish alternative worldviews and mindsets.

Future Ancestral Technologies is a multimedia project by the Native American artist and designer Cannupa Hanska Luger, which tells and makes visible how in a post-capitalist and post-colonialist future, Indigenous people have been able to produce sustainable technologies that should help them in living as nomads with a profound connection with the environment (http://www.cannupahanska.com/fat.. It is a speculative and science fiction project aiming to influence global consciousness, exploiting creative storytelling and imagination, and is characterized by different tools and products that let the viewers experience an Indigenous future and practice empathy and resourcefulness in times to come.

The narrative developed through installations and land-based works challenge the collective thinking to recontextualize technology in a continuous dialogue between past and future to enhance the interconnectedness between the land and human beings. One interesting kind of artifact developed by the artist represents the monster archetypes, which are the manifestations of societal ills; other ones should act as weapons and regalia of the heroes who have been able to slay the monsters. The project exploits different media such as installation, video, and land-based work.

The project is interesting for the aim of the research because it retraces many aspects that a decolonized design should have: it shows how it could be possible to restore a balanced relationship with nature; it draws from indigenous cultures to define the values, the shapes, and the aim of the project; it proposes a transcultural approach to technology, not neglecting, but embracing it by means of sustainable values; it relies on critical and speculative approaches to stimulate awareness in the audience of the project; and, finally, it addresses environmental justice.

5.3 ecoLogicStudio

As a growing number of design projects are focusing on the pluriversal perception of the world, dealing with human-nature interaction from a pragmatic perspective becomes crucial to foster non-hierarchical interconnections. To this end, non-human entities should be considered as proper users of the design outcomes.

This assumption may be seen as a pragmatic way to include more-than-human entities within real contexts where design practice allows their inclusion as stakeholders. Although moving toward a post-human perspective helps in reaching non-hierarchical interactions between different agencies, it still remains quite difficult to properly understand non-human perspectives and wishes as humans [8]. However, reflecting on possible human-nature non-hierarchical connections, i.e., nature rights, represents a meaningful way to provoke further debate on this complex topic, at least about the possible steps for their actual implementation. Hence, provocations can assume a crucial role in this conceptual transition, and design projects offer the opportunity to foster this reflection by means of provotypes. These provocative artifacts aim to foster discussion and reflections on complex issues through prototypes with unfilled gaps, leading to new questions arising [58].

A pragmatic approach to human-nature interaction enabled by technology is represented by the professional work of ecoLogicStudio, a design studio based in London, UK, here considered a proper case study. Its work focuses on reflection-action through tangible artifacts and experiences, which can be seen as real provotypes, and often intertwines non-human perspectives, especially by including biotechnology within its projects (https://www.ecologicstudio.com/.. Two projects of ecoLogicStudio may resume this pragmatic approach to human-nature interaction: H.O.R.T.U.S. XL Astaxanthin.g and Bit.Bio.Bot.

The former is a 3D printed bio-sculpture that dialogues with human and non-human agencies, encouraging new symbiosis models. Non-human entities, represented by photosynthetic cyanobacteria, are mediated through digital fabrication technologies. These microorganisms are inoculated by the designers into 3D printed structures generated by using computational algorithms to stimulate their adaptive growth. Hence, human agents act as enablers of the non-human relationship between the living and non-living entities, facilitating the encountering of these two words.

This sculpture has been presented in different museums, such as the Mori Art Museum in Tokyo and the Centre Pompidou in Paris, acting as a reflective provocation for the human audience on the human-non-human interaction. The latter is a collective architectural experiment exhibited at "La Biennale di Venezia" from May to November 2021 (Venice, Italy). It mainly represents the domestic cultivation of non-human entities, especially blue-green microalgae, within a non-human-centric environment.

As the previous project, Bit.Bio.Bot. merges computational strategies with digital fabrication and microbiological cultivation, creating an interconnected system represented by tangible architectural indoor and outdoor elements. In this case, human and non-human living entities build a symbiotic carbon-negative interaction where the photosynthesis of the microorganisms is maintained by the CO2 produced by the human presence, which, in turn, uses the oxygen produced by the blue-green microalgae.

According to the topics of this study, these projects highlight the human-nature interaction and the role of technology by means of pragmatic actions and provocations. In detail, computational design and digital fabrication participate in the multispecies debate by collecting and fulfilling the needs of the different agencies, moving to a post-human perspective [59]. Technology actively discovers new shapes and tangible forms to foster microbiological actors, i.e., by generating new 3D models through simulating algorithms [27, 29]. Furthermore, non-hierarchical relations between humans and non-humans are encouraged within the ecoLogicStudio work by creating possible symbiotic interactions, taking mutual advantage to the two different agencies. Therefore, more-than-human ecologies are intertwined through different perspectives, i.e., considering the same resources as waste or nutrients such as CO2 and oxygen [60].

From a different point of view, the two projects can be seen as provotypes related to human-nature non-hierarchical interactions. H.O.R.T.U.S. XL Astaxanthin.g aims to explicit this provocation through a designed object that shows the interaction of the different agencies, i.e., nature, humans, and technology. Even if the sculpture has not a functional aim, its purpose is to stimulate critical reflection in the audience and generate new possible paths to reach non-hierarchical connections.

Accordingly, Bit.Bio.Bot. represents a further step towards the implementation of non-hierarchical interactions because a mutual connection is clearly shown by the product, which starts to assume a sort of functional purpose. Even though there is not a real possibility to understand the willingness of non-human actors in the participation, the link between algae photosynthesis and human respiration emphasizes the existing interaction between the two agencies, and the project tries to make a step forward toward real human-nature non-hierarchical interconnections mediated by technology.

6 CONCLUSION

The case studies made it possible to outline a path that examines different approaches and different points of view, united by a single goal: to incentivize the translation, equipped through the practice of design, from the human-centric concept to the post-human, an environment in which hierarchies between species are dissolved in favor of positive cooperation for the whole system.

Starting from the specificity of the three lenses applied to research and recognizing their interconnected aspects that can be generalized, this work led to the identification and outlining of a set of insights and key points to be placed at the basis of the project or co-design in the post-human perspective. The points reported here are not intended to be universal or exhaustive but rather to constitute a set of useful suggestions for post-human designers: they should be read as critics toward traditional paradigms, useful also to foster the dialogues around these topics.

To design and co-design within these complex systems, to apply post-human thinking means, on a theoretical level:

The rejection of anthropocentrism as a habit of thought and the pursuit of alienation, which can be found within the principles of post-human feminism when mentioning "the decentring of Anthropos" as species exceptionalism and the rejection of anthropocentrism as a habit of thought" [3].

Assuming a non-centric, peripheral, non-biased, and non-linear point of view that can make sense of the current crisis of values which contributes to both environmental and social crises [36]: decolonized and pluriversal worldviews would enrich the discourses about those crises and the paths to reach just and sustainable futures.

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Rejecting a blind imitation of Western androcentric models, recognizing the value of new and alternative approaches. Therefore, from post-human feminism, conceiving man as the measure of everything and human/humanistic thinking as a "universal" point of view may be a source for those crises. The concept of alienation assumes fundamental importance because it becomes extremely relevant to nurture the practice of collective de-identification to distance oneself from the humanist paradigm.

The reappraisal of both organic and inorganic entities (such as technological artifacts, networks, codes, and algorithms) and supporting new ways of creating knowledge, avoiding the continuous reiteration of dichotomies between subject and object, between humans and nature, between Global North and Global South.

It also means having a critical stance toward sciences and technology: if the conservative use of technology contributes to the hegemony of humans, the question arises whether it is possible to radically change the use and application of existing technologies to redesign the world and the way we perceive ourselves and others within it.

While on a more practical side, it means:

Having a transcultural and trans-species approach to technology by valuing cultural differences that should become the sources to guide the process of design and to enrich it by exploiting the

situated background, knowledge, and imagination of each actor involved in it.

Fostering inclusion of every natural actor by de-humanizing emerging technology, which means avoiding a human-centered perspective and including many other perspectives while understanding the potential impact of technology, its use, and misuse.

Drawing methodologies from anthropology futures, and participatory action research, which prove to be the most suitable for the reference issues. Anthropological futures can provide elements and tools for analysis and contextualization, while participatory action research brings with it the principles of collaboration and actions inherent in a definition of co-design with more-than-human. Relying on critical and speculative approaches to stimulate awareness, which is one of the first steps that need to be undertaken to be engaged with the themes of relevance for this discussion.

Addressing social, racial, and gender justice, and environmental and more-than-human justice and agency, also exploiting good practices of use of technology, which should act as a tool for multispecies interaction, a sort of catalyst and facilitator for new or rediscovered relationships.

Thinking at similar real contexts and scenarios where human and non-human entities already interact, to experience and understand how these collaborations has been achieved, what actions have been done to fulfil them and what values they added.

Analyzing the kind of interaction that human and non-human actors already have, listing the different entities, to create a sort of map of more-than-human interactions, that should work as a guide for new projects.

Detecting resources, artifacts, or actions that are linked to these kinds of interactions, as well as their different role amongst the involved entities, to be intended as best practices and as good example of what can be done in these directions.

Listing the different needs of the actors, highlighting the possible connections and the symbiotic or controversial situations, to understand how a system should or should not behave.

Analyzing the real pro and cons of the project by assuming the different more-than-human perspectives, avoiding the human-centric point of view, to prevent the bias caused by applying only one point of view.

Designing new concrete artifacts, products, or processes by mediating possible conflictual situations and fostering mutual symbiotic behaviors: tangible outputs are able to show the opportunities and the possibilities opened by assuming a more-than-human perspective.

Checking the meaning of each design outcome from different more-than-human perspectives, again to avoid potential bias on a systemic level.

According to the guidelines, new design projects and practice-based inquiries may be fostered by framing new pragmatic tools for the integration of human-nature interaction within real contexts. Among those, a new approach has been defined as a possible modality to involve more-than-human actors as real stakeholders within co-design processes. A further approach has been added to the "Multispecies Symposium" [8] after the reflective steps of the "Open Interspecies Debate" and "Post Symposium Debate": the "User needs from the Pluriverse". This hypothesized approach aims to define one or a set of briefs, which represent the starting point of a new concrete action or design project. Similar to conventional design processes, it starts from the collection and definition of the users' needs, assuming their point of view. In this case, the analysis would consider the different entities within the specific real contexts, which means both human and non-human actors. At the beginning, the analysis would be focused on the specific needs of each group of actors, whereas the relationships would be analyzed at a later stage. The interconnections between the different pluriversal agencies are therefore emphasized to find out not only the possible symbiotic matches but also the potential conflictual situations of the scenario or practical context. Accordingly, these critical aspects may be highlighted to start a mediation process for the definition of one or more briefs that should take into consideration the different perspectives in a post-human and non-hierarchical way. Even though the non-biased consideration of human-nature interactions still represents a challenge within real contexts, post-human and more-than-human perspectives may facilitate the spread of pragmatic approaches to embroider human and non-human needs in concrete actions, stimulating the perspective-shifting towards more-than-human entities seen as pluriversal users and stakeholders.

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REFERENCES

[1] Haraway, D. 2016. Staying with the trouble. Duke University Press.
[2] Escobar, A. 2018. Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds. Duke University Press.
[3] Braidotti, R. 2021. Posthuman Feminism. Polity Press.
[4] Smith, R.C. *et al.* 2021. Decolonizing Design Practices: Towards Pluriversality. Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems (New York, NY, USA, May 2021), 1–5.
[5] Nicenboim, I. *et al.* 2020. More-Than-Human Design and AI: In Conversation with Agents. Companion Publication of the 2020 ACM Designing Interactive Systems Conference (New York, NY, USA, 2020), 397–400.
[6] Cruz, C.C. 2021. Decolonizing Philosophy of Technology: Learning from Bottom-Up and Top-Down Approaches to Decolonial Technical Design. Philosophy & Technology. 34, 4 (Dec. 2021), 1847–1881. DOI:https://doi.org/10.1007/s13347-021-00489-w.
[7] Borthwick, M. *et al.* 2022. From human-centred to life-centred design: Considering environmental and ethical concerns in the design of interactive products. Journal of Responsible Technology. 10, (Jul. 2022), 100032. DOI:https://doi.org/10.1016/j.jrt.2022.100032.
[8] Romani, A. *et al.* 2022. Codesign with more-than-humans: toward a meta co-design tool for human-non-human collaborations. European Journal of Futures Research. 10, 1 (Jul. 2022), 17. DOI:https://doi.org/10.1186/s40309-022-00205-7.
[9] Cross, N. 2001. Designerly Ways of Knowing: Design Discipline Versus Design Science. Design Issues. 17, 3 (Jul. 2001), 49–55. DOI:https://doi.org/10.1162/074793601750357196.
[10] Dalsgaard, P. 2014. Pragmatism and Design Thinking. 8, 1 (2014), 13.
[11] Frega, R. 2011. Introduction. *Pragmatist Epistemologies*. Lexington Books. 1–4.
[12] Reich, Y. 2017. The principle of reflexive practice. Design Science. 3, (2017), e4. DOI:https://doi.org/10.1017/dsj.2017.3.
[13] Schön, D.A. 1992. Design as a Reflective Conversation with the Situation. The Reflective Practitioner. Routledge.
[14] Rupprecht, C.D.D. *et al.* 2020. Multispecies sustainability. Global Sustainability. 3, (ed 2020). DOI:https://doi.org/10.1017/sus.2020.28.
[15] Forlano, L. 2017. Posthumanism and Design. She Ji: The Journal of Design, Economics, and Innovation. 3, 1 (2017), 16–29. DOI:https://doi.org/10.1016/j.sheji.2017.08.001.
[16] Manzini, E. 2014. Design in a changing, connected world. Strategic Design Research Journal. 7, 2 (Dec. 2014), 95–99.
[17] Rylander, A. 2012. Pragmatism and Design Research. An overview. Ingår i Designfakultetens serie kunskapssammanställningar. (2012), 42.

[18] Goldkuhl, G. 2012. Design Research in Search for a Paradigm: Pragmatism Is the Answer. Practical Aspects of Design Science. M. Helfert and B. Donnellan, eds. Springer Berlin Heidelberg. 84–95.
[19] Goldkuhl, G. and Sjöström, J. 2018. Design Science in the Field: Practice Design Research. Designing for a Digital and Globalized World (Cham, 2018), 67–81.
[20] Davidova, M. and Z. 2020. Post-Anthropocene:The Design after the Human Centered Design Age. D. Holzer, W. Nakapan, A. Globa, I. Koh (eds.), RE: Anthropocene, Design in the Age of Humans - Proceedings of the 25th CAADRIA Conference - Volume 2, Chulalongkorn University, Bangkok, Thailand, 5-6 August 2020, pp. 203-212 (2020).
[21] Fieuw, W. *et al.* 2022. Towards a More-than-Human Approach to Smart and Sustainable Urban Development: Designing for Multispecies Justice. Sustainability. 14, 2 (Jan. 2022), 948. DOI:https://doi.org/10.3390/su14020948.
[22] Clarke, R. *et al.* 2019. More-than-Human Participation: Design for Sustainable Smart City Futures. Interactions. 26, 3 (Apr. 2019), 60–63. DOI:https://doi.org/10.1145/3319075.
[23] Elsden, C. *et al.* 2017. On Speculative Enactments. Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (New York, NY, USA, 2017), 5386–5399.
[24] Mogas-Soldevila, L. and Oxman, N. 2015. Water-based Engineering & Fabrication: Large-Scale Additive Manufacturing of Biomaterials. MRS Proceedings. 1800, (2015), mrss15-2135989. DOI:https://doi.org/10.1557/opl.2015.659.
[25] Pettersen, I.N. *et al.* 2018. The Tree as Method: Co-Creating with Urban Ecosystems. Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (New York, NY, USA, 2018), 1–6.
[26] Whitelaw, M. *et al.* 2021. Design Collaboration and Exaptation in a Habitat Restoration Project. She Ji: The Journal of Design, Economics, and Innovation. 7, 2 (Jun. 2021), 223–241. DOI:https://doi.org/10.1016/j.sheji.2020.08.011.
[27] Krish, S. 2011. A practical generative design method. CAD Computer Aided Design. 43, 1 (2011), 88–100. DOI:https://doi.org/10.1016/j.cad.2010.09.009.
[28] Vierlinger, R. and Bollinger, K. 2014. Accommodating change in parametric design. ACADIA 2014 - Design Agency: Proceedings of the 34th Annual Conference of the Association for Computer Aided Design in Architecture. 2014-Octob, (2014), 609–618.
[29] Devendorf, L. *et al.* 2016. Probing the Potential of Post-Anthropocentric 3D Printing. Proceedings of the 2016 ACM Conference on Designing Interactive Systems (New York, NY, USA, Jun. 2016), 170–181.
[30] Ashcroft, B. *et al.* 2000. Post-Colonial Studies: The Key Concepts. Routledge.
[31] Quijano, A. 2000. Coloniality of Power and Eurocentrism in Latin America. International Sociology. 15, 2 (Jun. 2000), 215–232. DOI:https://doi.org/10.1177/0268580900015002005.
[32] Mohamed, S. *et al.* 2020. Decolonial AI: Decolonial Theory as Sociotechnical Foresight in Artificial Intelligence. Philosophy & Technology. 33, 4 (Dec. 2020), 659–684. DOI:https://doi.org/10.1007/s13347-020-00405-8.
[33] Escobar, A. 2020. Pluriversal Politics: The Real and the Possible. Duke University Press.
[34] Álvarez, L. and Coolsaet, B. 2020. Decolonizing Environmental Justice Studies: A Latin American Perspective. Capitalism Nature Socialism. 31, 2 (Apr. 2020), 50–69. DOI:https://doi.org/10.1080/10455752.2018.1558272.
[35] Escobar-Tello, M.C. *et al.* 2021. Decolonising design in peacebuilding contexts. Design Studies. 73, (Mar. 2021), 101001. DOI:https://doi.org/10.1016/j.destud.2021.101001.
[36] Epstein, S. 2022. Rights of nature, human species identity, and political thought in the anthropocene. The Anthropocene Review. (May 2022), 20530196221078930. DOI:https://doi.org/10.1177/20530196221078929.
[37] Guzmán, J.J. 2019. Decolonizing Law and expanding Human Rights: Indigenous Conceptions and the Rights of Nature in Ecuador. Deusto Journal of Human Rights. 4 (Dec. 2019), 59–86. DOI:https://doi.org/10.18543/djhr-4-2019pp59-86.
[38] Abdulla, D. *et al.* 2019. A Manifesto for Decolonising Design * Journal of Futures Studies. Journal of Futures Studies. 23, 3 (2019), 129–132. DOI:https://doi.org/10.6531/JFS.201903_23(3).0012.
[39] Tsing, A.L. *et al.* 2021. Feral Atlas: The More-Than-Human Anthropocene | Edited by Anna L. Tsing, Jennifer Deger, Alder Saxena Keleman and Feifei Zhou. Stanford University Press.
[40] Gram-Hanssen, I. *et al.* 2022. Decolonizing transformations through 'right relations.' Sustainability Science. 17, 2 (Mar. 2022), 673–685. DOI:https://doi.org/10.1007/s11625-021-00960-9.
[41] Smith, R.C. *et al.* 2020. Decolonising Participatory Design Practices: Towards Participations Otherwise. Proceedings of the 16th Participatory Design Conference 2020 - Participation(s) Otherwise - Volume 2 (New York, NY, USA, Jun. 2020), 206–208.
[42] Bidwell, N.J. 2016. Decolonising HCI and interaction design discourse: some considerations in planning AfriCHI. XRDS: Crossroads, The ACM Magazine for Students. 22, 4 (Jun. 2016), 22–27. DOI:https://doi.org/10.1145/2930884.
[43] Smith, C. *et al.* 2016. Design Anthropological Futures. Bloomsbury Publishing.
[44] Freire, P. 1998. Pedagogy Of Freedom: Ethics, Democracy, and Civic Courage. Rowman & Littlefeld Publishers.
[45] Fordyce, S. 2022. Design Struggles: Intersecting Histories, Pedagogies, and Perspectives. Design and Culture. 14, 2 (May 2022), 240–243. DOI:https://doi.org/10.1080/17547075.2021.1996934.
[46] Hupkes, T. and Hedman, A. 2022. Shifting towards non-anthropocentrism: In dialogue with speculative design futures. Futures. 140, (Jun. 2022), 102950. DOI:https://doi.org/10.1016/j.futures.2022.102950.
[47] Fox, S. *et al.* 2016. Exploring Social Justice, Design, and HCI. Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (New York, NY, USA, May 2016), 3293–3300.
[48] Alaimo, S. 2018. Material Feminism in the Anthropocene. A Feminist Companion to the Posthumanities. C. Åsberg and R. Braidotti, eds. Springer International Publishing. 45–54.
[49] Alcoff, L.M. 2015. The Future of Whiteness | Wiley. Wiley-VCH.
[50] Cuboniks, L. 2018. The Xenofeminist Manifesto: A Politics for Alienation. Verso Books.
[51] Allen, I.K. 2020. Thinking with a Feminist Political Ecology of Air-and-breathing-bodies. Body & Society. 26, 2 (2020), 79–105. DOI:https://doi.org/10.1177/1357034X19900526.
[52] Sharma, S. 2020. A Manifesto for the Broken Machine. Camera Obscura: Feminism, Culture, and Media Studies. 35, 2 (104) (Sep. 2020), 171–179. DOI:https://doi.org/10.1215/02705346-8359652.
[53] Zylinska, J. 2020. AI Art: Machine Visions and Warped Dreams. Open Humanites Press.
[54] Parisi, L. 2004. Abstract Sex: Philosophy, Bio-technology and the Mutations of Desire. Continuum Intl Pub Group.
[55] Mirzoeff, N. 2016. How to See the World: An Introduction to Images, from Self-Portraits to Selfies, Maps to Movies, and More. Basic Books.
[56] Pinotti, A. 2021. Alla soglia dell'immagine. Da Narciso alla realtà virtuale. Einaudi.
[57] De Beauvoir, S. 1969. Les Belles Images. Putnam.
[58] Mogensen, P.H. 1992. Towards a provotyping approach in systems development. DAIMI Report Series. 21, (1992), 412. DOI:https://doi.org/10.7146/dpb.v21i412.6725.
[59] Jeldes, J.C. *et al.* 2022. Aconcagua Fablab: Learning to Become with the World through Design and Digital Fabrication Technologies. International Journal of Art & Design Education. 41, 1 (2022), 23–38. DOI:https://doi.org/10.1111/jade.12394.
[60] Maller, C. 2021. Re-orienting nature-based solutions with more-than-human thinking. Cities. 113, (Jun. 2021), 103155. DOI:https://doi.org/10.1016/j.cities.2021.103155.