The Bird Whisperer

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ABSTRACT
This report explores how to design with a posthuman perspective. This view is in contrast to the common human-centric view which is inherently present in design. However, current and future socio-technical and environmental challenges are often caused by human impact. They affect much more than us as the world is a complex network of interdependent relationships. Therefore, a need to include these relationships into the design process is required, which translates to a posthuman design process. The major obstacle however, is the fact that humans play a dominant role in the design process. Thus, we let some of the design process over to a non-human, a generative model. The underlying challenge here is understanding how non-humans shape human behavior and vice versa, and what their relations entail. Observing, and possibly understanding these relationships provides insights into the impact and role a design has in a non-human context. Our research through design aims to inspire designers to meaningfully respond to the emerging landscape of posthuman design. and to cotribute to the consensus of the idea that non-anthropocentric theories have increasing relevance for contemporary design.

Authors Keywords
posthumanism; posthuman design; more-than-human design; anthropocentric design; designing for the unknown; artificial intelligence; generative models; adversarial audio synthesis; animal-computer interaction

final prototype of the "Bird Whisperer"

INTRODUCTION
As emerging technologies are reshaping everyday life and playing big parts in contemporary socio-cultural, political and economic transformations, the boundaries between human and nonhuman – both environmental and socio-technical – are increasingly blurred [12]. Given the gravity of these transformations and modern day global challenges, we more and more realize that both our technological landscape and natural environment are characterized by complexity, agency and relationality. This presents critical challenges to existing human-technology practices and thinking [26], and furthermore challenges the human-centric design paradigms and anthropocentric worldview that have dominated the Western world for the past decades. In a networked world with multiplicities of agencies, entanglements and interdependencies, addressing modern challenges from simply a human-centered perspective has been proven insufficient thus far and rather calls for better design methods, frameworks and practices. After all, prescribing a unique center to a complex system, can never properly characterize the full design space [4]. To address the blurred boundaries and redefine ways of being in the world, hybrid modes of thinking are therefore needed for the field of design [12]. To grapple with current and future social-technical and environmental problems, a posthuman perspective is needed that moves beyond solely human centered design, towards more-than-human design.

In order to do so, the field of design can consider the following relevant stances from philosophy and anthropology, namely ANT (actor-network theory) [16] and OOO (object oriented ontology) [15], nature cultures [19], and post-phenomenology [6, 33, 34]. But also emerging fields such as Animal-Computer Interaction (ACI) which finds its roots in Human-Computer Interaction (HCI). However, the rising impact of AI brings forth a challenge when adopting a posthuman perspective. The paradox of AI is that it is often advocated as the technology for the posthuman

era, yet it is a product created by humans, where its very structure is modeled after a traditional view on human logic. This has resulted in an increasing network of humanistic, smart, ontological objects (such as a Roomba) sharing center stage with humans and non-humans (such as a cat, a tree, a lamp or a river) [10]. This challenged the authors to speculate about possible networks of multiple entities, including smart artefacts that are more aligned with posthuman values such as interdependency, collectivity and relationality [3].

This research through design is interested in understanding interrelations and co-shaping that is happening in a networked ecology of entities, and subsequently how to design with these interrelations in mind. From a posthuman design perspective, this means that we are in fact designing for the unknown [30]; we have too little information on what these co-shaping relations fully consist of, look like, and how they are formed, shaped and influenced. Our inquiry touches upon some of the core values of the aforementioned stances from philosophy and anthropology. Throughout our reflective research and design process we have worked with the following assumptions we extrapolated out of these movements:

(1) Everything (referring to our networked ecology of entities, and beyond) is interrelated (2) All entities within our network of entities, and beyond have equal agency (3) The human must be decentralized from the design practice, but not excluded from it.

To explore this, a research artefact named "The Bird Whisperer" was created, and deployed for 10 days, within the urban environment of Eindhoven. The Bird Whisperer is an artefact which plays artificially generated birdsongs based upon recorded sounds of real birds using WaveGAN [8], a generative adversarial network for audio synthesis. The deployment of the artefact ultimately explores in a broad sense what posthuman design may entail and what steps can be taken to support it further.

The deployment of our designed artefact in a networked ecology of entities, aims to facilitate a new form of communication between entities, which can potentially shape new relationships, interactions and new kinds or forms of agency, simultaneously gaining new insights in how these relationships are established. Subsequently, the authors have empirically observed and reflected on if (and what form of) co-shaping between human and non-human entities occurs as a result of this. Furthermore, our narrative is elaborated through a video artefact that acts as an additional visual demonstrator. The video explores different perspectives on what posthuman (and more-than-human) design could mean or look like, what possible steps can be taken to support it, and it moreover poses challenges within posthuman design. Ultimately, the visual demonstrator served as a tool of discussion among two experts that co-evaluated the artefact and its relation to posthumanism.

This exploration hopes to contribute with valuable reflections and points of discussion in if and how interrelations in a networked ecology of entities are co-shaped, and how these align with the posthuman discourse. Although we do not currently know how a posthuman paradigmatic shift will shape itself and come up, our research through design aims to inspire designers to meaningfully respond to the emerging landscape of posthuman design, and to contribute to the consensus of the idea that non-anthropocentric theories have increasing relevance for contemporary design.

RELATED WORK & BACKGROUND

A posthuman perspective

The term posthumanism has become an umbrella term, referring to a variety of perspectives and philosophical movements that have emerged to cope with the urgency of integral redefinition of the notion of being [11]. As such, posthumanism is often defined as a "post-" humanism and anthropocentrism, emerging from critique of the hierarchical social constructs and human-centric assumptions embodied in both stances. Similarly, from a design perspective the posthuman discourse has emerged from critique on human-centered and anthropocentric design practices and thinking. In particular, these previous understandings are being called into question as our awareness of the complexity and entanglements of the natural world and sociotechnical systems intensifies. The integral notion of the posthuman thus expands our understandings of the multiple agencies and interrelations making up our world. Here, the consideration of the nonhuman, be it animal and natural environment or things and the artificial world, redefines humanity's role in environmental and sociotechnical transformations invoking reflection on the ways these transformations shape humans and the world [12].

Inspiration for a more-than-human design process can be found in Latour's analysis of the soil in the Amazon forest in Boa Vista by soil scientists [17]. This was later further elaborated in the work of Bennet [1] and Puig de la Bellacasa [27], naming it soil stories. These non-humanist thinkers valued posthuman empiricism of getting dirty, meaning, immersing oneself to live with soil to see the permeability and the interaction between worms and soil, over the humanistic, ethnographic account of the soil scientists. Here, posthuman thinkers emphasize how a 'lived-with experience' contributes to a posthuman methodology for co-designing things while also not fully knowing things. Ultimately, this lived-with experience will help humans to better speak on behalf of other non-human entities and participate together if on many levels [32]. Several areas of thought sharing theoretical ground on posthuman concepts are illustrated here.

An overview of posthuman thought from philosophy and anthropology

Critical posthumanism: It is generally agreed that science and technology have power relations to our understanding of self and the relationships we humans have with other non-humans. Braidotti's critical posthumanism is drawn from anti-humanist philosophies of subjectivity (related to ideas of consciousness, agency, truth and reality),

and additionally acknowledges the connection between the human and environment. She defines the critical posthuman subject as relational and situated in multiple belongings, therefore working across differences but internally differentiated [3]. Along these lines, a group of cultural anthropologists has explored ways of bridging human-nonhuman relations and differences using the sense of smell, that is the shared sensitivity to chemicals by both humans and mushrooms [21]. Thus, they imagine the mushroom as a collaborator and create a new form of collaboration, arguing that studying global and multi-sited phenomena demands more iterative, generative and expansive (anthropological) methods and practices and corollary institutional changes. As such, (critical) posthuman subjectivity is expressed by Braidotti as "... embodied and embedded and hence partial form of accountability, based on a strong sense of collectivity, relationality and hence community building. "[3]

Actor-Network Theory (ANT): ANT draws from science and technology studies (STS) and is an approach to social theory, which acknowledges the relationships, interconnections, and interdependencies between humans and nonhumans (animal and machine) on various scales, but moreover considers all entities within a network or "assemblage" to share equal agency in the participation of shaping of (social) issues [16]. According to ANT, the social and natural world is made up of constantly shifting networks of relationships. Non-humans therefore embed specific socio-political values and ethical commitments, thus serving as important factors in social situations of the human and more specifically, serving to enroll the human actor into certain programs of action.

Object-oriented ontology (OOO): OOO draws from the philosophical branch of speculative realism, concerned with the "real and sensual" qualities and aesthetics of objects. Here, OOO puts things at the center of being, that is things "whether, human, immaterial, durable or fleeting" [2, 15].

Postphenomenology: Postphenomenology is a philosophy stance that aims to empirically analyze how technologies mediate experiences in the world. It blurs the division between humans, non-humans and technologies by arguing that humans have developed with non-human entities, (instead of alongside each other), in a continuous process of co-shaping. Furthermore, Postphenomenology supports the idea that multiple perspectives, the ability to imagine/interpret an object, situation or experience from more than one vantage point (for example a combined perspective of humans, animals, and technology), are required to understand phenomena [6, 33, 34].

Naturecultures: Donna Haraway's notion of naturecultures, the synthesis of nature and culture, recognizes the inseparability of the two. It rejects the dualism that is deeply embedded in our science (e.g.: human/animal, culture/nature), and it gives us a way to talk about the interconnectedness between natural and cultural elements [19]. In an urban environment for example, a traffic light may provide a resting place for birds, where they can have a clear overview of food that gets thrown out of cars. And at night, the light coming from the traffic light may attract non-human entities such as moths. There are numerous unknown intersections between technology, humans and animals. Adopting the notion of naturecultures can help design practitioners to think about integrating a wider range of perspectives (that include non-human entities) in the design practice [28].

Animal-Computer Interaction: Arising from the power inequalities in the relations between humans and other animals, the emerging discipline of ACI takes a specific focus on the mediation between technology, human and animal, by taking an animal-centered approach [20]. An example of this is *Augmented Nature* (fig. 1), a set of robotic, animal tags that augment the capabilities of endangered species, and helps them to adapt to mass extinction [13]. Such an approach systematically applies design principles that consider the animal as a legitimate user and design contributor, placing it at the center of the iterative development process. ACI argues for such reframing in thinking and practices, to better account for diverse multispecies agents in interaction design, towards more inclusive technologized worlds. Furthermore, such a perspective could strengthen Human-Computer Interaction (HCI) as a discipline, broaden participation in Interaction Design, and support commitments to sustainability [20].

1. augmented nature: https://www.arthurgouillart.com /augmented-nature

Artificial Intelligence in a posthuman world: The paradox of AI is that it is often advocated as the technology for the posthuman era, yet it is a product created by humans, where its very structure is modeled after a traditional view on human logic. Smart algorithms embedded in objects are trained and tested on data which is carefully selected by humans. The output is inherently a human judgement implemented by programmers (humans) themselves. Intelligent objects equipped with AI imports a rather traditional, Cartesian model of human logic [13]. Cartesian here refers to the philosophical movement founded by Renee Descartes, famous for his sentence: I think, therefore I am, and his view on mind-body dualism. This cartesian human logic can be found in autonomous intelligent agents who have a 'mind' (integrated intelligent algorithms) and a body where they sense and act with (sensors and actuators). AI should endure a change in its very own technological structure, in order to become more aligned with the posthuman thoughts described above.

Generative Models (GM): In this research, a special interest is taken in generative models that are used for

audio synthesis. GM are a subdomain of unsupervised machine learning. A GM is a representational model of a dataset, and it generates unique and non-existent samples with desired properties out of a dataset. These samples have a high correspondence to the raw data, and thus to examples from the real world. Specifically GAN's (generative adversarial networks), made its way into the mainstream media, often in the form of face filters and deep fakes. For example, This Person Does Not Exist, an AI powered website, uses a GAN to render hyper-realistic portraits of people that are completely fake [29]. Sofia Crespo's *Artificial Remnants* (fig. 2), is an ongoing exploration of artificial life using generative models to generate insects, their names and anatomical descriptions. Through the creation of new specimens that are digital natives, it aims to question its relation with the existing system [5]. Generative models have extended beyond the mere visual domain, to the audible domain. Up till now, SampleRNN (Recurrent Neural Network) [23], WaveNet [25] and WaveGAN [8] yielded desirable audible generative outputs. An example of this is Magenta's open-source project Google NSynth, a synthesizer that uses a WaveNet to generate completely new sounds out of the acoustic sound qualities (features) of existing sounds [14]. Another example is LyreBird, a company that creates voices for chatbots, audiobooks, video games, movies etc. It uses a technique called voice cloning, where it basically creates a deep fake voice. LyreBird claims that it can clone anyone's voice by listening to just a single minute of sample audio [7].

2. Artificial Remnants: https://artificialremnants.com/

DESIGN AND DESIGN RESEARCH PROCESS

The red threads we found in the the posthuman perspective and thoughts which were discuss in the previous section, informed our reflective research through the design process. Throughout the process, a research artefact and a video demonstrator were created, namely the artefact "the Bird Whisperer" and the video "Our Posthuman Future - Episode: the Bird Whisperer" were created to investigate the interrelations between humans, birds, and the the designed research artefac

"The Bird Whisperer":

The designed research artefact is an object that outputs bird songs that are generated by using the WaveGAN algorithm [8]. The main purpose of The Bird Whisperer is to explore interrelations with the birds it is surrounded by, and possible with other entities. It furthermore explores if it could form some sort of communication with birds through generative bird sounds (e.g. generative chirps, calls, songs). Through the use of a microphone, The Bird Whisperer "listens" to decide whether an active bird is closeby, and reacts upon that by playing a generated bird sound. Besides, The Bird Whisperer also occasionally plays generated bird sound at random intervals.

Aesthetical considerations (appearance and sound): The vertically stacked electronic components determined the shape of the outer casing in a distinctive manner (fig. 4). The aesthetic of the appearance of the case was inspired by organic irregular shapes and natural materials. A dried layer of soft moss that was attached to most parts of the casing. These features were considered to be more inviting to birds as opposed to a harsh shapes man-made materials. Although the quality of the generated sounds have a high likelihood with the raw data (e.g. the sound from a blue tit), they sound slightly more "synthetic", due to some choppiness, distortion and warble that appears in varying degrees in each separate sound. These flaws are clearly audible when listening to the files directly, but fade to some extent when emitted by the Bird Whisperer. This is partially due to the muffling of the sound by the casing and moss, yet the concatenation of several bird sounds as a bird song also helps to hide these imperfections. The resulting bird songs sound quite convincing from a distance for us humans.

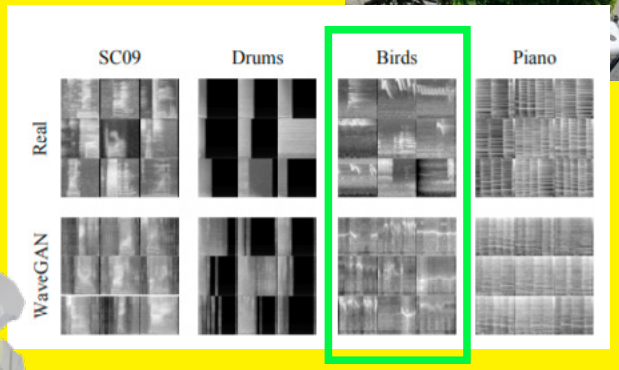
Technical considerations: The deployed artefact (see Fig. 3) consist of a Raspberry Pi 3B+ (fig. 7) as main computing unit, an amplifier (fig 6), a USB sound card and a speaker. The microphone is placed outside of the casing for more flexible placement (fig. 9). Training and generating birdsongs on a Raspberry Pi is not recommended, since it requires a high level of GPU power and training time. Therefore, the bird sounds were generated in Google Colab, using a pre-trained model, and afterwards saved on a folder in the Pi. The Raspberry PI runs a Python script continuously, which analyzes the decibel levels of the environment sounds by looking at the live audio input from an external microphone, and selects and plays a generated mp3 file according to that. This can consist of up to five randomly picked generated sounds, played back to back to form an approximation of a bird call. The threshold value was experimentally picked based on whether the function would trigger in case of a nearby notable sound. It was also tested with human conversational sounds and clapping. In addition to this trigger based on threshold value, the script would randomly trigger the function every 5 to 10 minutes.

A pretrained WaveGAN model, a GAN capable of synthesizing new audio files based on raw audio files (https://s3.amazonaws.com/wavegan-v1/) was used to as input for a python script (ap.2) which generated the bird sounds in Google Colab. While the output samples certainly sounded like bird chirps and calls, it is important to note that the pretrained model used input data that consisted (mostly) of foreign bird species. And thus, we should consider that the output might deviate from the bird sounds that occur naturally around the envisioned deployment location. For the purposes of this research, however, theu audio quality and aestehics were sufficient enough, as this was not seen as a limitation for relations between the generative model and bird entities.

3. The Birdwhisperer mounted on balcony

9. microphone connected to artefact

4. render of casing



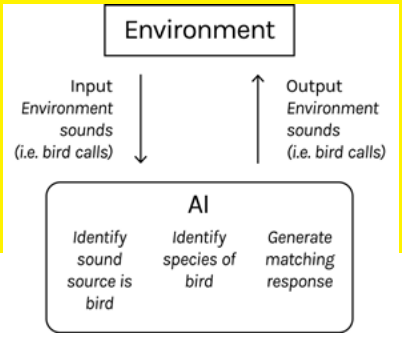
8. Top: Random samples from each of the four datasets used in this study, illustrating the wide variety of spectral characteristics. Bottom: Random samples generated by WaveGAN for each domain. WaveGAN operates in the time domain but results are displayed here in the frequency domain for visual comparison [8].

10. gaps in the prototype to let sound coming through

5. 3D printed casing

6. speaker placement

7. RPi placement



11. The conceptual functionality: However, within the time period avaible and expertise, the classification of incoming data was not included in the prototype for the deployment.

Ideally, the generative model of the AI should first be trained on a dataset of various bird sounds from bird entities commonly found in the Netherlands (e.g. Eurasian blue tit, common chiffchaff, feral pigeon). The entity should also contain a classification algorithm that is trained on the same audio dataset (fig. 11). A microphone that is connected to the AI entity then captures environment audio and the live audio input is analyzed in real time by the classification algorithm, resulting in identification of the currently present species of bird entity. Based on this, the generator model generates a response bird sound that matches the species of bird it has identified; e.g. the AI entity would talk back to a feral pigeon in 'feral pigeon speak'.

This was assumed as an important element for communication, as it depends on shared understanding of the meaning of sounds. Approximating the bird's native language would presumably make communication easier through a bird's familiarity with the sounds. The final deployed artefact, however, deviates slightly from the conceptual functionality mentioned above. In the next part, the technical considerations will be detailed on, together with the resulting functional compromises and consequent conceptual implications.

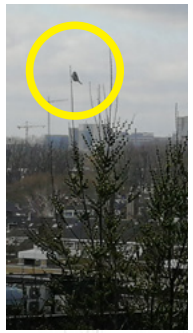
Our Posthuman Future - Episode: the Birdwhisperer

The second research artefact is a video demonstrator of the conceptual system and is viewable online via the following link: https://vimeo.com/530194266. The aim of this video artefact is to clearly communicate the subject of posthumanism as presented in this paper, the interrelations between bird, human and AI entities, as well as to provoke discussion around this subject. A real life scenario is presented that occurred during a short deployment period, in which the physical research artefact, a pigeon entity and a human entity are shown in their common habitat: on a balcony in the vicinity of an often-occupied tree. It features a voice-over explaining the motivation and narrative behind this study and the physical research artefact (see Introduction), along with an explanation of the artefact and scenarios that result from its deployment. To add to the provocative nature of the video, it was styled after wildlife documentaries such as Planet Earth; this is also why it is also narrated by a deep fake David Attenborough voice. This style and voice were specifically chosen to show the contrast between traditional wildlife documentaries, which are inherently human-centric as they try to describe animals from our perspective, and the video artefact, which tries to see every interaction as a possible relation between two entities. The video was used to start discussion among a group of university students and professors, as well as for evaluation by several experts in posthumanist design (see Discussion).

12, 13. Screentshots from the video "Our Posthuman Planet" https://vimeo.com/530194266

14. the appartment

15. bird in tree



16. bird on balcony

STUDY SETUP

<u>*Location:*</u> The deployment with the prototype took place on a balcony on the 7th floor (fig. 14). Near this balcony birds gather inside the trees (fig. 15) and sometimes even visit the balcony itself (fig. 16), suggesting that the birds are used to a domestic environment. Therefore, it seemed like a good spot to deploy our artefact.

<u>*Deployment period:*</u> The research prototype has been deployed for a period of ten consecutive days, during which a large variety of weather conditions went by. The weather seemed to affect the activity of the birds, since they were much more active during the sunny warm days. We think this may also have affected the relationship between the AI and the birds, as it could have affected the willingness of birds to go near the balcony for example.

OBSERVATIONS

During the deployment, several observations were done, however these observations are still from a human point of view, so we must be careful in our analysis. In order to prevent a human-centric bias, we will refrain from extensively interpreting the results. These observations should provide insight into different relations, of which the underlying intention is (yet) unknown [20, 30].

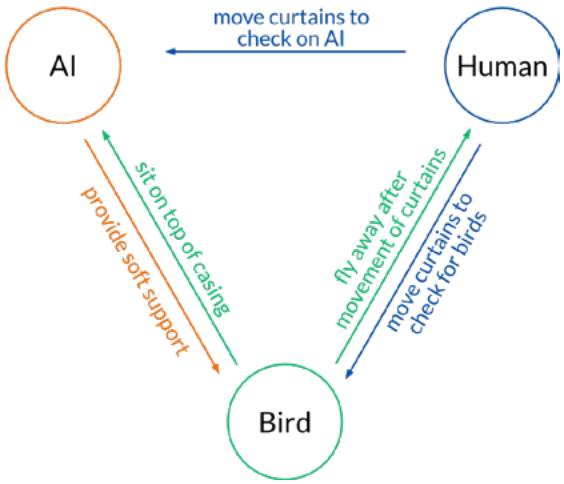
Observed relation 1: (fig. 17). Two times, a crow sat on top of the mossy surface of the prototype. Possibly, the crow saw an opportunity to sit on a soft mossy surface or perhaps was judging the moss as building material for a nest. Both of these encounters took place in the early morning, once at 4:30 AM and the other around 8:00 AM. Surprising was the second interaction, since at that time, the prototype was packed in a bright yellow plastic bag to protect it from potential rain. This did not seem to scare off the crow, but the movement of the curtain did unfortunately appear to have this effect.

Observerd relation 2: A Magpie bird sat right next to the AI and was chirping to it. In response, the AI chirped back with randomly selected pre-generated chirps. This conversation went on for a few moments before the Magpie took off (fig. 18).

Observed relation 3:A human-AI interaction that has been observed was the need to protect the AI from the rain (fig P - plastic bag over prototype). This illustrates the different relation between human-bird and human-AI. Birds need water to feed themselves, while the AI will break down because of it (fig. 19).This difference elicited the human behavior of needing to “care for” the AI. Despite the casing turning out to be waterproof after all, each night and during rain it was covered again.

Observed relation 4: humans feeding the birds to attract them. This relation goes from human to AI and from AI to bird and back (fig. 20). This relation is initiated from a human point of view, but does not exist without - and is shaped by the birds. They did not respond, as far as we observed, therefore seemingly indicating to have no interest in dry bread on top of an AI.

17.



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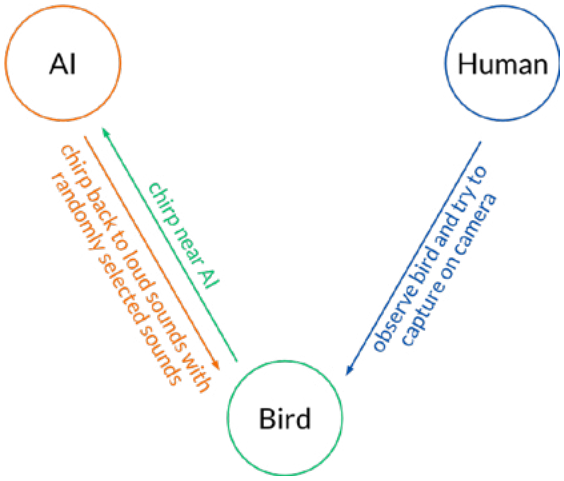

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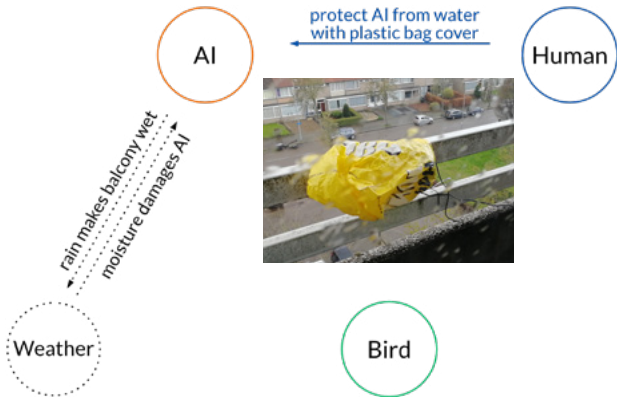

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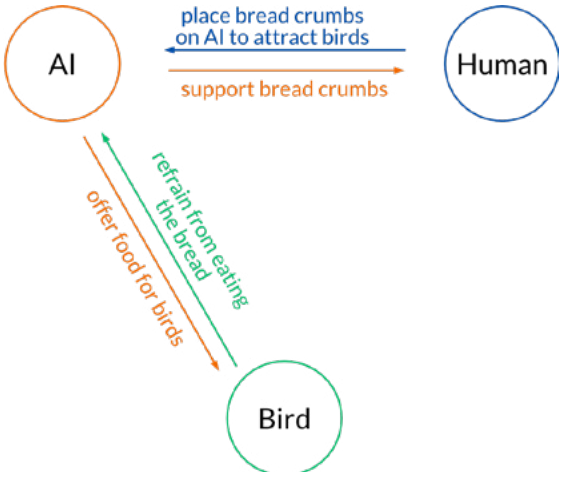

DISCUSSION

In this study, we have explored and conducted a design process and deployment through a posthuman lens. In this section, we will reflect on this design process and deployment to discuss the insights and perspectives we have gained during these stages, as well as the emerging discussions as a result of the presentation of our concept and artefacts. This will be further complemented through the elaboration of different perspectives and insights gained from interviews with experts in various fields of interaction design. With this, we hope to give recommendations and inspire other designers to explore the posthuman perspective and what posthumanism can mean for design, as a means to develop new methods and practices to grapple with the contemporary global challenges of today.

Implications for posthuman design

The Bird Whisperer is a vehicle of inquiry into posthuman relations and allowed for exploration of what possible relations between bird, AI and human entities could look like. The deployment in this study was too short and narrow to conclude anything definite about these relations. Additionally, the bird sounds emitted by the AI artefact have been generated using a pretrained model and thus have characteristics which might not match with the local bird entities at the deployment location. A possible effect of this is that birds could be repelled by the sounds of other bird species. Such effects could relate to inter-bird relationships which we humans have not observed and should therefore be explored in the future. Furthermore, birds contain a variety of different calls, for different purposes. As humans we might not be able to interpret these nuances in the eventual sound output, which could additionally influence the meaning of the sounds the AI entity emits. However, the design process of the Bird Whisperer does provide a new method for research into interrelations between AI and surrounding entities. Through physicalizing a non-human entity, namely The Bird Whisperer, its relation to surrounding entities becomes observable and concrete while also highlighting possible new relations between other entities than itself, even though these relations might be influenced by the current implementation.

Many valuable insights were obtained from the design process in which designing from a posthuman lens was attempted and explored. We highlight these insights through the evaluation of our artefact and illustrating several frictions that arose during the process. While the goal of the Bird Whisperer is certainly in line with stepping outside of the dominant humanistic perspective, it is interesting to evaluate how posthuman the ultimate design actually is. Firstly, the posthuman perspective is pursued through the consideration of other non-human entities and acknowledgement of the interrelations connecting us with these entities. The artefact is not meant to have any direct purpose or usage to the human and is not aimed to (directly) interact with the human. Still, it is a new entity introduced in the system who undoubtedly has a relationship to the human (and bird). Although admittedly biased, for the small group of humans and simultaneously designers of the artefact, it is a means for the human to observe and analyze the interrelations between itself, the bird entities and the technological object they have created. A deployment with less-involved human entities than the researchers would undoubtedly give more insights about further potential relationships. Yet, for this establishment of relationships surely more time is needed than the short deployment period presented in this study. However, that does not take away from the fact that through designing for relational engagement, the Bird Whisperer acknowledges the relationality and hence accountability of entities within an environment. Hence, values such as collectivity and community building are supported, which are coherent with the critical posthuman values as defined by Braidotti [3].

We should however note that the design of the Bird Whisperer is based on humanistic assumptions about the aesthetic or visual preferences of bird entities, i.e. natural-looking shapes and materials are necessary to make the AI entity neutral, non-intimidating, and somewhat relatable to its current habitat (e.g. nest, trees). Similarly, assumptions about the aesthetics of communication of the Bird Whisperer lead to the use of a (non-human) generative model to create similar but distinctly unique new bird sounds as a communication method between the AI and bird entities. Therefore, although the entire design process has been conducted through a so-called posthuman lens, it is inherently shaped by their perspective and therefore almost inevitable to leave out any humanistic presumptions. Yet the design is also not entirely humanistic. If the bird entities were not around, then the artefact would have no clear function or purpose for us humans and therefore become a separate entity acting on its own with little relation to the human. In addition, the little amount of control humans have over the eventual output of the generated model furthermore gives the AI entity agency. And so do the birds which have informed and therefore co-shaped the design based on our knowledge of birds. It is to say that although the posthuman perspective rejects current humanistic thinking and practices, it is not devoiding the human entity from the system. This means that although humanistic presumptions are inevitable, we should be careful acknowledging when and where anthropomorphic ways of seeing and thinking are applied and considering the effects of this.

The presentation of our concept and artefacts further highlights the misconception among many young designers less well known with posthuman concepts, that posthumanism means ‘not caring about the human’, or that agency comes only in the form of free will. Therefore, in a posthuman design they presume that all entities must benefit equally, which could mean devaluing the human as a result of it. However, it is important to note that posthumanism and agency are related to the acknowledgement of interrelationality. Here, we realize that as humans our behaviour and interaction is informed by other non-human entities, be it animals or things, and vice versa. Thus, it is not about e.g. giving the bee more space to live, roam, breed, and be free, but to give the

bee more space for its survival that is crucial for flora and fauna to persist and thus also for humans to persist. That is the entanglement and networks we humans are situated in, and the co-shaping that is happening as a result of it.

The design process presented here offers insights that could possibly inform new methods and practices of designing for posthumanism and thus non-human entities, in which the design is co-shaped both aesthetically and interactionally based on notions of interrelationality with entities. It addresses abstract theories of interrelationality and posthumanism by taking them into practice in a real environment.

Expert evaluation

Since posthumanism is still at its baby steps for the field of design, it is necessary to clarify the concept and what posthumanism might mean for design. Similarly, useful insights can be gained from other emerging interaction design fields that share theoretical background with posthumanism, i.e. Animal Computer Interaction (ACI). As such, expert interviews were carried out in parallel with the deployment to discuss preliminary observations and challenges with posthuman (design) expert Ron Wakkary [31] and an ACI researcher Clara Mancini [20]. Several topics were covered within these interviews: clarifying posthumanism, potential design approach or starting point to design for posthumanism, and evaluation observations and outcomes from a posthuman perspective.

According to Wakkary [31], the assumption of posthumanism is that everything is interrelated. Humans and nature are not separate but influence each other, thus resulting in constant co-shaping of behaviour and interactions in between these entities. While posthumanism aims to understand these other non-human entities, as to clarify these relationships, human-centered thinking assumes that we fully understand everything (our world). Humans are not exceptional from a posthuman point of view, we do not actually know what is going on when observing the world and birds around us. We are still merely looking from a humanistic perspective. The challenge is therefore to design with the unknowing part, you do know what the relationship will be and will actually never know, and you need design with never actually knowing. However, as humans our intelligent and empathic nature creates awareness, and the ability and need to interpret and empathize with other non-human entities (although nonetheless in a humanist way). The task and challenge of the human in posthumanism is therefore trying to understand how non-humans shape human behavior and vice versa, and what these relations entail.

This designing for the unknown is further highlighted by Mancini [20] who states “What saves us interaction designers is that interaction design is an open ended process, and the foundation of interaction design is iteration. You need to make peace with the fact that you do not get definitive answers but only some additional knowledge and that should be enough to orientate you to make the next choice…” Therefore, “... the devil is in the details...” in which it is important to have parameters clear which can be varied, excluded or focussed on throughout iterations. It is also important to explore to what extent the idea of relevance or meaning may influence the interaction between the different agents. How do they interpret other entities and the artefact and which actors are engaged in this meaning making and which are not.

From an ACI point of view, meaning-making and sense-making can therefore perhaps be used as criteria or starting points to design for non-human entities (animals). Another criteria can be looking at what is relevant to an animal. By observing what the animal does spontaneously in its life, we can acknowledge that all living beings want to live and keep safe, and want resources to do this e.g. food and shelter. Thus, one can look at what matters to an animal, what resources they are looking for, how do they go about getting the resources they need and what interactions they have with others. So, a basic needs approach can help us in reducing the anthropomorphic assumptions and interpretation we make on what the animal might feel.

This brings us to our last point, how to interpret the observations to evaluate design parameters, concepts and outcomes without being too humanistic. Here, Wakkary [31] mentions the importance of “being horizontal” for trying what you want to understand. We should not try to understand the non-humans, but simply observe them without projecting human constructs onto them. Similarly, Mancini [20] remarks that although we can only perceive and observe things from where we stand, we can still try to suspend our judgement and not do too much interpreting. She mentions “the key is here not to think that we know what they think, but to see what they choose, what they do, and where they go, and to try to be guided by that.” Therefore, she states although interpreting is inevitable, just ‘objectively’ quantifying or measuring things will not make us empathetic. Empathy is needed for good design and posthuman designers should therefore try to take what they see and respect what they see without too much interpretation, allowing this to guide them in design.

CONCLUSION

During this study, a design process based around the role of artificial intelligence in posthumanism has been explored through the creation and deployment of a non-human entity: The Bird Whisperer. It is equipped with a generative adversarial network (WaveGAN) for generating completely new bird-like sounds out of existing bird calls/chirps/songs. The research through design process revealed the challenges, limitations, and opportunities of designing for an interrelated network of equal entities (bird, human, artificial intelligent entity) and has resulted in important notions that can be used in future posthuman design projects. It highlighted the importance of observing relations and behavior of entities without excessive judgment or humanistic interpretation, in order to give all entities equal agency in the design process. By raising awareness of these

relations in a design process in a concrete way, designers can be better informed of the impact of their work and it becomes possible to design the human world in line with coexistence with other entities through co-shaping. Future work should therefore focus on concrete design (research) methodologies of highlighting interrelations to support posthuman values in design, because, by deploying an AI with humans and birds, this study only shows one possible approach of making these relations visible and concrete.

ACKNOWLEDGMENTS

We thank our coaches and supervisors from the TU/e: Stephan Wensveen, Mathias Funk, Janet Huang. We would specifically like to thank Ron Wakkary, Clara Machini and Julia Noothout for their feedback and help. This paper would not count as a posthuman design paper if we were not thanking the non-human entities that participated. So, thanks to the birds, for being and around.

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APPENDIX 1: INDIVIDUAL CONTRIBUTIONS

Danvy

Background: Propaedeutic in ID (2016-2017), Bachelor in AP (2017-2020), Master in ID (2020-present). Track: RDD, specialization: CA+ MDC.

Main interests: Using emerging and advanced technologies to inform design and making, in order to create new experiences. Interested in topics such as computational design, generative design, AI, additive manufacturing techniques and materiality, at the intersection between design and making, between the digital and physical.

Eva

Background: Bachelor in ID (2015-2018), Worked for 6 months as a UX designer, Master in ID (2019 - present). Track: RDD, specialisation: CA + MDC

Main interest: Speculative design, relationships we form with technologies (specifically AI and IoT). Experiential and creative technologies. Hands on approach, designing with matter. Computational and generative design.

Rick

Background: Bachelor in ID (2017 - 2020), Master in ID (2020 - present) - Track: RDD, specialisation: CA + TR

Main interests: Meaningful and intelligent interaction and product design. Seamless integration of interaction into everyday life. The role of AI in everyday life, beyond automation and personalisation. Learning by experiencing, therefore making concepts come to life using prototyping skills.

Jef

Background: Bachelor in ID (2017 - 2020), Master in ID (2020 - present) - Track: RDD, Specialisation areas: CA + TR

Main interests: Designs that facilitate personal expression, creative inspiration. Open-ended design. Sound design. Multisensorial interaction and experiences for creative inspiration and expressivity. Communication with intelligent everyday objects. Design with and for music.

During this project, tasks were evenly divided over the team members. The major contributions of each team member are described below.

Literature research	Group
Ideating	Group
Brainstorms	Group
Mid term presentation	Group
Prototyping the casing	Jef + Rick
Assembly	Jef
Deployment / observations	Rick
Python script	Eva
WaveGAN experiments	Eva
Generating samples	Eva
Collecting audio samples	Danvy + Rick
Video demonstrator:	Eva +
“Our Posthuman Planet”	(bird + AI + Rick)
Midterm video	Rick
Expert interviews	Danvy (+ Group)
Giving presentations:	Danvy
Report:	Group

APPENDIX 2: CODE FOR GENERATING BIRD SOUNDS

Based upon: https://colab.research.google.com/drive/1e9o2NB2GDDjadptGr3rwQwTcw-IrFOnm#scrollTo=8ECZccyTMMZX

```
%tensorflow_version 1.15
import tensorflow
#Then check the version:
print(tensorflow.__version__)
# Confirm GPU is running
from tensorflow.python.client import device_lib
def get_available_gpus():
    local_device_protos = device_lib.list_local_devices()
    return [x.name for x in local_device_protos if x.device_type == 'GPU']
if len(get_available_gpus()) == 0:
  for i in range(4):
    print('WARNING: Not running on a GPU! See above for faster generation')
# Download model
elif dataset == 'birds':
  !wget https://s3.amazonaws.com/wavegan-v1/models/birds.ckpt.index -O model.ckpt.index
  !wget https://s3.amazonaws.com/wavegan-v1/models/birds.ckpt.data-00000-of-00001 -O model.ckpt.data-00000-of-00001
  !wget https://s3.amazonaws.com/wavegan-v1/models/birds_infer.meta -O infer.meta
else:
  raise NotImplementedError()
# Load the model
import tensorflow as tf
tf.reset_default_graph()
saver = tf.train.import_meta_graph('infer.meta')
graph = tf.get_default_graph()
sess = tf.InteractiveSession()
saver.restore(sess, 'model.ckpt')
# Generate and display audio -->CHANGE THESE to change number of examples generated/displayed
ngenerate = 100
import numpy as np
import PIL.Image
import time as time
# Sample latent vectors
_z = (np.random.rand(ngenerate, 100) * 2.) - 1.
# Generate
z = graph.get_tensor_by_name('z:0')
G_z = graph.get_tensor_by_name('G_z:0')[:, :, 0]
start = time.time()
_G_z, = sess.run([G_z], {z: _z})
print('Finished! (Took {} seconds)'.format(time.time() - start))
for i in range(ndisplay):
  print('-' * 80)
  print('Example {}'.format(i))
  display(Audio(_G_z[i], rate=16000))
```

APPENDIX 3: RASPBERRY PI CODE

```
import time
import datetime
import os
import random
import schedule
import analyse
import numpy
import pyaudio
import subprocess

'''
--------------------------------------------------------------------------------
PREPERATION:
--------------------------------------------------------------------------------

Install the dependencies RUN THE FOLLOWING COMMANDS

sudo apt-get install libasound-dev
wget http://www.portaudio.com/archives/pa_stable_v190600_20161030.tgz
tar -xvf pa_stable_v190600_20161030.tgz

Build PortAudio from source RUN THE FOLLOWING COMMANDS

cd portaudio
./configure && make
sudo make install
sudo ldconfig

Install time, random, scedule, NumPy, PyAudio and SoundAnalyse:

pip install numpy
pip install PyAudio
pip install SoundAnalyse

# the parameters for pyaud.open may be different depending on the used microphone.
# the parameters can be determined by iterating over the devices and use: pyaud.get_device_info_by_index(i)

'''
pyaud = pyaudio.PyAudio()
stream = pyaud.open(format = pyaudio.paInt16,channels = 1,rate=44100,input_device_index=None,input=True,output=True)#Change input_device_in-
dex to appropriate number

#threshold decibel level --> experiment with this
th_audio = -15
#get time
```

```
now = datetime.datetime.now()

def random_birdcall():
    print(datetime.datetime.now())
    print("random bird call!")
    random_wav1 = random.choice(os.listdir('/home/pi/Desktop/bird_generator_caodai/data/'))
    random_wav2 = random.choice(os.listdir('/home/pi/Desktop/bird_generator_caodai/data/'))
    random_wav3 = random.choice(os.listdir('/home/pi/Desktop/bird_generator_caodai/data/'))
    random_wav4 = random.choice(os.listdir('/home/pi/Desktop/bird_generator_caodai/data/'))
    random_wav5 = random.choice(os.listdir('/home/pi/Desktop/bird_generator_caodai/data/'))

    call1 = '/home/pi/Desktop/bird_generator_caodai/data/' + random_wav1
    call2 = '/home/pi/Desktop/bird_generator_caodai/data/' + random_wav2
    call3 = '/home/pi/Desktop/bird_generator_caodai/data/' + random_wav3
    call4 = '/home/pi/Desktop/bird_generator_caodai/data/' + random_wav4
    call5 = '/home/pi/Desktop/bird_generator_caodai/data/' + random_wav5

    possible_calls = ['one_syl', 'two_syl', 'three_syl', 'four_syl', 'five_syl']
    call_type = (random.choice(possible_calls))

    #check to see which type of call is selected
    print(call_type)
    #print(call1)
    #os.system('omxplayer -p -o local --amp 1000 ' + call1)#test call

    if call_type == 'one_syl':
        #os.system('omxplayer -o alsa:hw:1,0' + call1)
        subprocess.call('omxplayer -p -o local --vol 352 ' + call1, shell=True)
        #time.sleep(2)

    elif call_type == 'two_syl':
        subprocess.call('omxplayer -p -o local --vol 352 ' + call1, shell=True)

        subprocess.call('omxplayer -p -o local --vol 352 ' + call2, shell=True)
        #time.sleep(2)

    elif call_type == 'three_syl':
        subprocess.call('omxplayer -p -o local --vol 352 ' + call1, shell=True)

        subprocess.call('omxplayer -p -o local --vol 352 ' + call2, shell=True)

        subprocess.call('omxplayer -p -o local --vol 352 ' + call3, shell=True)
        #time.sleep(2)

    elif call_type == 'four_syl':
        subprocess.call('omxplayer -p -o local --vol 352 ' + call1, shell=True)

        subprocess.call('omxplayer -p -o local --vol 352 ' + call2, shell=True)
```

```
        subprocess.call('omxplayer -p -o local --vol 352 ' + call3, shell=True)

        subprocess.call('omxplayer -p -o local --vol 352 ' + call4, shell=True)
        #time.sleep(2)


    else:
        subprocess.call('omxplayer -p -o local --vol 352 ' + call1, shell=True)

        subprocess.call('omxplayer -p -o local --vol 352 ' + call2, shell=True)

        subprocess.call('omxplayer -p -o local --vol 352 ' + call3, shell=True)

        subprocess.call('omxplayer -p -o local --vol 352 ' + call4, shell=True)

        subprocess.call('omxplayer -p -o local --vol 352 ' + call5, shell=True)
        #time.sleep(2)


# every 5 till 15 second do the funcomxplayer python only showing helption above
schedule.every(5).to(10).minutes.do(random_birdcall)

# run this continiously
while True:
    #do the sceduled job
    schedule.run_pending()

    #measure incoming audio
    raws=stream.read(4800, exception_on_overflow = False)
    samples= numpy.fromstring(raws, dtype=numpy.int16)
    loudness = analyse.loudness(samples)
    print(loudness)

    # between 6 and 8 in the morning, go in active state --> respond in quickly to other birds that are around birds
    #if now.hour > 6 and now.hour < 8 and loudness > th_audio: #uncomment for deployment
    if loudness > th_audio:
        random_birdcall()
        print "do bird call"
        #time.sleep(2)
```