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FUTURE MACHINE: Making Myths & Designing Technology for a Responsible Future
Making Myths and Entanglement: Community engagement at the edge of participatory design and user experience

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This paper explores the unique methods and strategies employed by a team of artists, in collaboration with engineers, programmers, a climate scientist, researchers and members of the public, who have come together to create the Future Machine, with the aim to continue this longitudinal project for 30 years. We explore the process of designing Future Machine – the provenance and sustainability of the materials, the participatory design process, how Future Machine's interactivity is evolving over time and how the technology might be sustained for 30 years. We investigate the role that Future Machine plays in engaging the human populations across these diverse places, exploring how the artists used strategies of entanglement and myth-making to support the interactions between the ecologies, technologies, non-human inhabitants, narratives and neighbourly relations that are emerging as the project evolves over time. In conclusion we propose that the artist strategies of entanglement and encouraging myth-making reveal new approaches to experiential design. We propose that these strategies provide opportunities to open up a set of disruptive/radical/novel design challenges for HCI, that encourage sustainable and positive forms of interactions for a world increasingly impacted by anthropogenic climate and environmental change.

CCS CONCEPTS •Human-centered computing~Human computer interaction (HCI)~HCI design and evaluation methods~Usability testing

Additional Keywords and Phrases: Climate change, Longitudinal, Environmentally Engaged Art, Interactive Art

1 Introduction

Future Machine appears, acting as a 'witness' to the social, cultural and environmental changes experienced across five contested 'natural' spaces in England - in an urban park in London, a public memorial garden in inner city Nottingham, by the Windermere-Leven waters in Cumbria, a woodland and village common in rural Oxfordshire, and a school playing field in an Anglo-Saxon village, close to a nuclear power station in rural Somerset. Appearing in the same five places every year, Future Machine continues to make its journey to each place, as the seasons change, until 2050, by which time scientists predict we are likely to reach irreversible tipping points for more extreme climate and environmental change [1]. Newly formed rituals and special occasions emerge each time Future Machine appears. People sign up to become 'Guardians of the Future Machine', committing to take part in and support the project over the years. Now in its fourth year, Future Machine has collected hundreds of messages for the future and is slowly becoming 'mythologised', as part of the stories and identities of the communities and places in which it appears.

Future Machine is distinguished from other HCI/Art interactive and data-driven projects by its 30-year time frame, its focus on the contested ecologies, people and places it encounters, the specificity of its interactions across five places in England, and how its presence stimulates and becomes part of the changes it witnesses. Future Machine is not a neutral device embedded in everyday objects that 'do' longitudinal monitoring - it was designed to move, encounter, remember and reveal the entangled relationships it enters into, as it completes a seasonal and ritualised journey across England, every year for 30 years.



Figure 1: A participant ‘speaking to the future’ with Future Machine in London. Photo: Reece Straw

In this paper we propose that employing strategies of myth making, entangled interactions and sustainability are central to the design of this interactive device. Each of these strategies enables new ways of considering participatory design in the context of human-nature-technology interactions. These strategies expand on the more ‘standard’ approaches and framings by which we traditionally consider Human-Computer Interaction, whilst widening the debates around the human-nature dichotomy. Whilst the notion of myth-making might appear to be somewhat radical when we look at the fields of Human-Computer Interaction, design and data-driven experiences, we are working in and around the topic of climate change. The nature of this topic is such that the impacts take place at different scales, on a global and personal level, upon communities, continents and countries, and the speed by which climate change is impacting upon us is changing our perceptions of what was and is to come. This uncertainty about the future is not something which standard approaches and methods to understanding design and user experience tend to deal with, but, we propose that humans are able to look at the world through a range of lenses and in doing so are able to share ideas, myths and concepts about how we might work with others (humans and non-humans) in a more responsible way, to address our concerns of what the future may hold.

1.1 Background

Future Machine was designed on the basis of an initial question - ‘what will we need when the future comes?’ - posed by the lead artist to all the collaborators and participants who contributed to the participatory and iterative design process, described later in the paper.

From the initial discussions and participatory making sessions Hari Sheldon from Asimov’s Foundation Series [2], the Monolith from 2001: Space Odyssey [3] and the afro-futurist Sun-Ra [4] emerged as key influences on the aesthetic design and physical presence of the artwork, with a particular emphasis on a device that has a mythical presence that is somehow ‘out of time’. It was also influenced by the large Indian temple chariots made of stone and wood, the Jagannath that represents the ‘Lord of the Universe’, wheeled around during the Hindu Rathayatra Festival [5] and ‘Beating the Bounds’, an ancient custom from England and Wales where people come together to swat local landmarks with branches to collectively remember and celebrate the Parish boundaries [6]. In many respects this design process reveals what already exists for many people, a sense of understanding of the world that goes beyond the epistemic of science, of time-in-motion studies dictated by abstract quantitative metrics. Through Future Machine, we therefore wanted to be able to

explore some of the core notions that still inhabit our land, about our existence and behavior in the landscape, now and into the future.

The data-driven nature of the artwork was informed by previous research 'investigating the unique contributions of artists engaging the public with climate data' [7] and a perceived need to bring a longitudinal approach to engaging with climate data, representing impacts over a lifetime and generations, rather than the short time frames we normally engage with in our everyday lives. The artists' previous collaborations with climate scientists have involved conceptualising a complex range of climate projections into the future [8], whilst also attempting to understand the deep timescales of Paleoclimatology, climate data from 800,000 years ago [9], the industrial revolution - when global temperature increases started to be driven by increased CO2 emissions [10], and from the 1950's - when temperatures and CO2 concentrations began to noticeably increase above their pre-industrial averages [11]. Working with scientists based at the British Antarctic Survey, the lead artist began to consider how non-experts can relate to these longitudinal time frames and issues of uncertainty, whilst finding positive ways to think about the future.

Research shows that artists who engage with climate data often create unique connections between our emotional responses and the cognitive and rational processes required to generate an understanding of complex scientific data and modelling of future scenarios [12, 13]. Whilst these artists have climate and environmental science at the heart of their work, many other forms of environmental art actively reject a scientific or technological frame, seeking human-nature interactions that go beyond an empirical paradigm, claiming that true connection to nature requires us to move beyond a quantitative, scientific world view [14]. The now dominant concept of nature as separate from humans, the 'nature/culture' dichotomy, has been highlighted by Haraway [15], Latour [16] and Puig de la Bellacasa [17] through notions of 'entanglement' and 'care', where humans are always in a relational state of becoming with other species - whether our culture perceives it or not. As many indigenous elders, writers and philosophers argue [18], the human-nature paradigm is a complex and fictional frame that can disrupt our ability to care, value and protect the planetary systems that are vital to our species survival [19].

As a new generation of indigenous writers, academics and activists are emerging, alternative designs for technology, public space, infrastructure, and engineering informed by the entangled relations between human and the non-human are becoming more widely understood, including the concept of 'making kin with machines' [20] and the Lo-TEK movement [21]. These approaches explore how we can design for 'care' and 'reciprocity' with our more than human entanglements, in response to our spiritual, moral and ethical responsibilities across both private and public domains [17]. These approaches run parallel to a growing interest in biotechnologies in computer science and engineering [22] and an increasing awareness of the full environmental costs of HCI, the internet of things and artificial intelligence, not only in terms of the huge amount of energy required to run the systems behind them but the resulting CO2 emissions and water requirements for cooling the vast systems that power the necessary increases in computing power and efficiency, alongside the damaging extractions required for manufacturing the hardware. We need to think about projects in a much more responsible holistic way in order to account for the impacts, both positive and negative, that such projects can have throughout their lifecycle, from conception, to design and deployment. Projects such as the Solar Protocol Network [23] begin to explore the impacts of these processes and presents a form of human-nature-technology reciprocal design that suggests more sustainable solutions that go beyond the fantasy of unlimited power and infinite computing capacity [24].

Noticeable examples of other longitudinal projects include: The Long Now Foundation [25], The Long Time Project [26], Longplayer [27]. Whilst longitudinal environmentally engaged artworks such as The Future Library [28] are rare, some works of Land Art such as Nash's Ash Dome [29] and Beuy's 7000 Oaks [30] endure as sculptural art becomes part of the landscape.

Studying longitudinal HCI projects is also a complex domain, where there is much debate on how to define the metrics, methods of study and duration [31, 32]. AI/machine learning is increasingly allowing interactive everyday objects to learn from their ongoing interactions with the world, whilst concerns around what they are learning and why, how biases become built in and whether they are providing what is wanted rather than needed, remains contentious [33, 34]. In the domains of mixed reality, digital arts and interactive data-driven experiences, longitudinal research is less usual, where examples of interdisciplinary HCI projects such as Benford's 'Carolan Guitar' [35] and Blast Theory's 'Karen' [36] that were not necessarily designed to continue over a long time period, have developed a longitudinal

momentum of their own. Restrained by funding cycles, academic career pathways and built-in obsolescence - sustaining longitudinal projects for over 10 years seems near impossible.

1.1 What is a Future Machine?

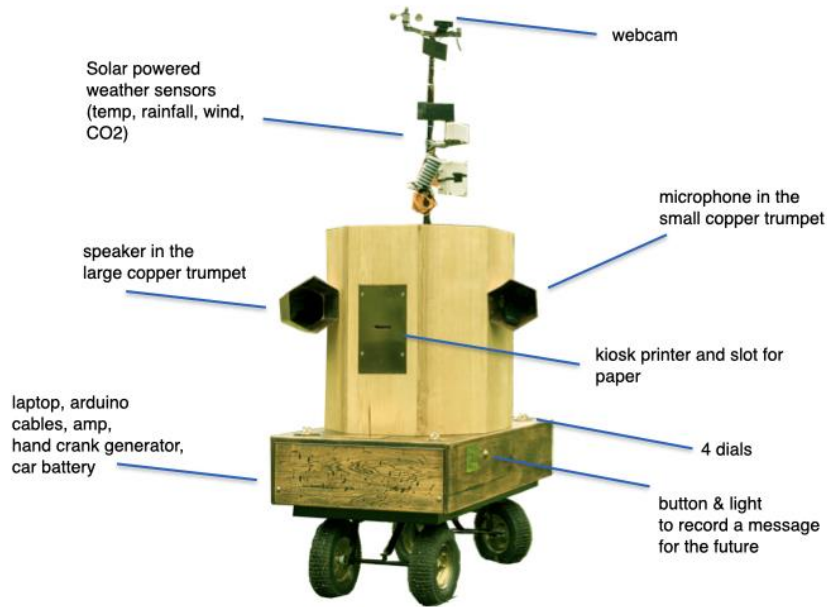


Figure 2: Future Machine

Future Machine is a large sculptural artwork, an octagon on a rectangular base on wheels, made of ash, oak, steel, brass, rubber and copper, with a hand crank, lever and dials. Future Machine collects messages for the future, plays the messages left by people in the past, prints out stories for people to take away with them, and plays sounds that respond to live data, from weather and pollution sensors on a pole at the back of the machine, capturing and interpreting climate and weather data. A webcam captures images of the horizon, and audio is captured in the form of the 'messages for the future' recorded by the people that gather around when it appears in the five specific locations.

Future Machine is 'woken up' by turning a handle on the side, which powers a generator and trickles energy to a car battery, inside the base of the artwork that powers the device.



Figure 3: Left to right, turning the handle to power Future Machine, the lever and dials at the back of the base, a woman reading a print out, a woman speaking into the trumpet. Photo: Reece Straw & Jaiwana Monaghan

The live weather data is turned into layered music that is played by turning a lever at the back of the machine to the ‘present’ position. Participants turn 4 dials on the base that combine local and global data collected by the artist and climate scientist. These inform stories that are printed out when the lever is in the ‘future’ position. At the bottom of these stories participants are invited to ‘speak to the future’ by pressing a button on the side and speaking into a microphone hidden in the small copper trumpet. A countdown sounds for several minutes until the participant presses the button. If the button isn’t pressed the countdown stops and Future Machine goes back to sleep (the app waits until the handle is again turned). If the button is pressed, the audio is recorded for 60 seconds. A loud foghorn is played to indicate the recording has stopped. Messages left in the past are replayed when the lever is turned to the ‘past’ position. A solar umbrella is used, alongside mains power, to recharge the device between appearances.

2 Strategies for building a Future Machine

Future Machine was initially developed as part of the artist-led research project ‘Performing the Future’ [37] that explored how we might imagine positive futures in the face of anthropogenic climate and environmental change leading to a collaboration between the lead artist, five other artists and the places each of them called home, researchers and scientists from HCI and the British Antarctic Survey.

2.1 Participatory Design Process

A participatory design process emerged from this research, involving a public workshop at an art gallery in Nottingham and a series of monthly workshops ‘Building a Future Machine’ in an arts space in Finsbury Park, London. At each workshop the lead artist and invited guests presented different themes relating to the project, including a Professor of Ancient History, whose research looks at fate, luck and fortune and myths relating to landscape in Ancient Greece [38], the collaborating climate scientist from the British Antarctic Survey, looking at the complexity of scientific data from the polar regions, and how we might relate to longitudinal data from the perspective of our own personal and family histories. One of the HCI researchers explored how to build sustainable, technology driven interactions by looking back at technologies that had survived for the last 30 years. The participants then focused on different elements of Future Machine’s design in response. This strategy of combining expert knowledge and participatory processes echoes other approaches to engaging non-experts with issues of climate change – including Climate Assemblies [39] and Latour’s

'Gaia's Global Circus' [40]. As a result of this participatory process over 50 visions of what a Future Machine might be were created.

The lead artist went through a second design process, with the team of collaborating artists, a carpenter, engineer, musicians, the climate scientists, programmers and researchers to design the final iteration of Future Machine. They designed the interactive, technical and engineering elements in parallel to the aesthetic, material experience of this strange device with the 'insides' informing the 'outsides' and vice versa, iterating these designs until a 'final' functioning form was built by the team. This was further modified once the interactive artwork was launched, in response to its interactions with the people, places and ecologies where it appeared.

The 'in the wild' nature of Future Machine defines the approach to engagement, that in turn supports us to understand the nature of participation throughout the project. This participatory design process has emerged from the lead artists' ongoing socially engaged digital arts practice, informed by a live art and theatrical background - where interactive technologies are created, tested, rehearsed, and treated as live experiences- that emerge and evolve 'in the wild' as an ongoing participatory process [41, 42].

2.2 Myth-Making

Armstrong describes how myth, ritual and historical events are inseparable [43]

“Since the eighteenth century we have developed a scientific view of history; we are concerned above all with what actually happened. But in the pre-modern world, when people wrote about the past they were more concerned with what an event meant. A myth was an event, which in some sense happened once, but which also happened all the time.”

This is echoed in the physical, 'mythical' presence and the importance of metaphor, embedded in the design of Future Machine and the ritualized events that happen around it. Future Machine's octagon shape is deliberately confusing to the eye – octagons are often used in religious architecture, the Dome of the Rock in Jerusalem, the Tower of the Winds in Athens. Future Machine's physicality is deliberately heavy, cumbersome and wobbly, making it intentionally inefficient as both a technology device and a moveable object. Designed to be counter to our throwaway, fast culture and transient relations to everyday objects, it is not for mass production. Participants and collaborators have previously described these elements of Future Machine's physicality as 'cathartic', 'celebratory', 'joyful' and 'a friendly technology'. Many participants and guardians have claimed to feel 'love' for it, responding to it in emotional ways, as a being of mythical status, as kin, as one participant stated in an interview:

“...the technology feels very hidden within it, it feels very kind of human. There's a sort of human heartbeat behind it. You don't see all of the like, coding, everything that must be in there. So it's kind of nice that that technology's hidden away.”

Another participant described how important the physicality was to their engagement:

“The actual object itself is far from, you know, fully abstracted, it's got both... it is abstracted but it's not entirely so, it's got a very evidence and material element to it. But bringing in the sort of importance of emotion, of myth, of storytelling, and personal connection to the machine and to all our fates, is kind of quite important. Again it's kind of grounding it in a different way from the way it might be, as a science project.”

Creating a different Future Machine for each place, or smaller versions for ease of travel, was discussed during the design process, but it was decided that this Future Machine should be a container for all that has happened around it and all that will happen in the future and that it should be present in these places, in some way.

The ritual/events and the stories told by people around them could appear to be small and insignificant on their own, simply one of a series of activities linked through the branding of the project (like a festival). Yet, by replaying the messages from the past, and the other places it visits, these local places are opened up to the bigger networks we are all part of. In doing so, it begins to weave stories and myth-making around these places – projecting a larger presence out to the world. Future Machine brings the wider world with it, global, universal, mythical stories are told through the stories it prints out.

A key element of Future Machine's interactions is informed by Hulme's myths from his book 'Why We Disagree About Climate Change' [44]. These explore the notion that the narratives we tell ourselves about future climate change

can only ever be models, predictions or projections - that we can only imagine what the future holds based on our current understanding of the past and present, and the evidence at hand.

<p style="text-align: center;">Lamenting Eden</p> <p style="text-align: center;">a return to a pure, wild nature that humans have destroyed</p>	<p style="text-align: center;">Bringing on the Apocalypse</p> <p style="text-align: center;">The end of the world</p>	<p style="text-align: center;">Constructing Babel</p> <p style="text-align: center;">We can build a new world, a utopia and solve everything with technology</p>	<p style="text-align: center;">Celebrating Jubilee</p> <p style="text-align: center;">We can create a just, moral world if we do the right thing</p>
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Figure 4: A table showing the lead artists' interpretation of the four myths outlined by Hulme

Hulme's 'myths' combined with scientific data projections create a context for the way Future Machine encourages decision making, understanding and response, aiming to help non-experts weave a path through some of the complexities of scientific evidence, future risk and uncertainty. This notion is embedded into the machine through the set of four dials on the oak base, enabling the participants to choose different myths and moods, and planetary regions – each creating narrative representations of global and local climate data.

The choices participants make when they turn the dials generates the stories that are printed out when the lever is in 'future' position, as a way to consider and rehearse the different myths we hold about the future, prior to leaving their own messages and can be kept by the participants as a memento. These stories are also documented on the website as 'news from the planet', written by the lead artist in collaboration with the climate scientist before Future Machine appears in each place, responding to news stories, climate science research and data taken from 3 scientific sources – Arctic and Antarctic sea ice levels, NASA's Vital Signs of the Planet and the MET Office UK's HADcet Central England Mean Temperature [45].

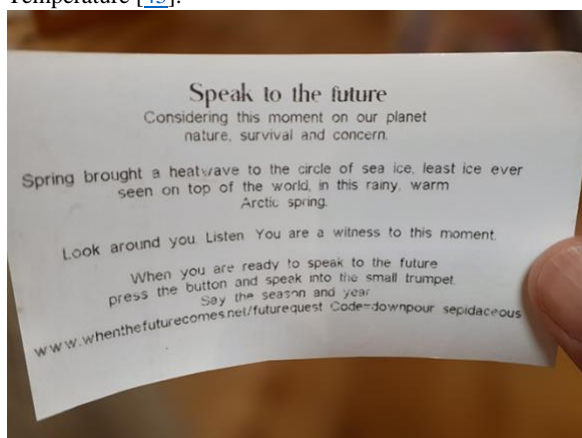


Figure 5: A print out from the Future Machine

Not all of the participants want to leave their own messages for the future, or interact directly with the machine. The interactions can take several minutes (considered a long time in this age!) and is a fairly complicated process, which can be a barrier to participation. When lots of people gather around, a queue sometimes occurs. Some watch from a distance, some people have said they are uncomfortable with taking part. Participants have said that they often find it difficult to think of what to say, are frightened to record something that will be kept for 30 years, or nervous of their voice potentially played out loud in a public space. Whilst this can be seen as an issue in terms of user experience, the lead artist has evolved a script that invites people to spend time thinking about what they would like to say to the future. When they are ready they are invited to 'meet the machine', playing through the past, present and future modes, then

when truly ready they can 'speak to the future', and thus become part of the myth-making process. The script seems to foster more meaningful interactions, experienced as an 'extra-ordinary act', only for the prepared and the brave, rather than a throw-away performative interaction that isn't properly considered. As Future Machine continues to appear, the artists are learning more about how and why people want to interact or not, which in turn informs new developments to the interactivity.

Heim suggests that the experience of art can also present 'differing and intertwining experiences of time' [46]. In this specific case, Future Machine appears in these five places as the seasons change, every year until 2050. The journey to each place, the preparations, the rituals that are emerging as the artists create these interventions act as pointers - revealing and celebrating the nature of these places at these very specific moments in time, whilst acting as a witness to the changes in each place, over time, which in turn affects the evolving myths around each appearance. The preparations are slow and at times laborious, acting as a preparatory ritual prior to the journey to each place – much like tuning an instrument.

In reality, Future Machine can't always be present at the moment it is meant to appear. Already we have encountered extreme storms, the Covid pandemic and other personal, local and global events that have prevented it from appearing when planned. In these cases other ways for it to be present have emerged, either through zoom, live video streaming or in one case, when its journey and the ritualised meeting in Oxfordshire had to be cancelled at the last moment, a small cardboard maquette was made by the collaborating artist, taken on a walk, meeting people on the way, and documented to ensure Future Machine still appeared that year. These happenings, that potentially break the commitment for Future Machine to appear in each place at the same time every year, in turn become mythologised over time, emerging as an important part of the entangled experience of maintaining a longitudinal interactive project in these uncertain times.

2.3 Strategies of Entanglement

Committing to a 30 year project that places issues of care, reciprocity and entanglement at its heart is full of personal and professional risks, and ethical dilemmas. In response the artists have proposed a 'strategy of entanglement' to meet the ongoing design challenges of this longitudinal project and the complex realities of the people, places and ecologies where Future Machine appears. This strategy is informed by the theories of 'entanglement' outlined by Haraway [15] and Latour [16], Heim [46], and Puig de la Bellacasa's notions of 'care' [18], and the lead artists' previous work on abundance as a celebration of the existing opportunities for creativity, community, human-non-human-nature interactions and co-creation [47].

One of the participants who took part in the study of the launch event described how they experienced the entangled nature of Future Machine and how this in turn might inform alternative ways to consider issues of climate change:

“...first art, then technology and the community it has created here today. I think it's very important to the understanding of technology or the understanding of art...it's a very community based experience... but I also think it has its own comebacks, very positive comebacks to art and technology and awareness, like if someone spent one more minute on thinking about climate change today, I think that works!”

Since Future Machine was first launched in London in November 2019, the reality of its interactions with the people, places and ecologies of each place continues to reveal more about the contested nature of the places, the entangled and abundant networks that surround them, and the commitments and capacity for people to come together in each place, echoing the artist's previous works across forests in the UK and Brazil [48]. The five places, their ecologies and people hold many difficulties, tensions and conflicts. Some of the places are unloved, neglected or sites of conflict and segregation. Despite the artists' initial aim to create encounters with no agenda, they are discovering that they are already tangled up in the politics and realities of these spaces. As Haraway has shown [15], it is not possible for a device such as Future Machine to remain neutral. One of the participants interviewed at the launch event pointed to how this is revealed by the longitudinal nature and presence of Future Machine:

“There's sort of investment in this actual area makes me feel personally connected, and I suppose if I had been someone who'd been given a mission brief from the machine, if I wanted to fully connect with that idea then that could be a life-changing experience. You know, if you took it on board the fact that it comes out of an impersonal-looking machine would give it a certain amount of authority, even though you may on one

level believe ‘well this is just something that someone wrote earlier and this is just the next one to come out’, well you could see it as being ‘this was the one that I was meant to get’ in the same way that you might get a fortune cookie, and really take it to heart. So yeah, I think it can be very personal is its level of engagement.”

An example of how these entanglements are embedded into the design of Future Machine’s is in the way it turns the live weather and climate local to each place into music. At the back of Future Machine is a weather station on a large pole with a series of sensors attached. The weather station has temperature, wind speed, rainfall, moisture and CO2 sensors, a webcam at the top of the pole points up to the horizon rather than down at the humans. Data is captured from the sensors every 30 seconds and sent to an Arduino hidden inside the base of the artwork via a wireless sensor. An app created in Unity on a laptop also hidden in the base connects the data to a set of layered sound files, using a spreadsheet of temperature, wind and rain averages for the month in each of the places where Future Machine appears, to create a set of rules for which sounds are played under different weather conditions.

The music is played out when the lever is in the 'present' position, the layered sounds change as the data changes, creating endlessly new sound formations. The music was created by the collaborating musicians who responded to weather words written by the lead artist, composing the music using pre-composed sound palettes and motifs. These were then edited into separate files that are layered together in response to the data. The music is inspired by the lead musician's West African heritage and traditions, coming from a family of traditional rainmakers in rural Burkina Faso – which has given the name 'The Rainmakers' to the musicians who perform the weather live, along with Future Machine, as part of the annual ritualised meetings in Finsbury Park.



Figure 6: The musicians and Future Machine performing the autumn weather in Finsbury Park

These entanglements are also reflected in the narratives that surround when and how the 'rituals' emerge in each place, in response to the weather, the seasons and the more-than-human environments, as opposed the human-culture entanglements that tend to inform our contemporary cultural lives. In this case, Future Machine appears in Christ Church Gardens, Nottingham when the cherry trees blossom, at the Windermere-Leven waters in Cumbria at summer's end, in Rotherfield Peppard Oxfordshire when winter turns to spring, in Cannington Somerset in mid-summer when the green leaves are abundant on the trees and in Finsbury Park, London when the autumn leaves fall.

These more than human entanglements are described by a participant as:

“...that kind of lovely element of kind of...the seasons, a point on a tree turns into a, you know... it becomes a different season on a tree, it responds in that way, that's kind of a really lovely way of

inciting people to come back together, rather than it being on a more like practical or technological term, that it's something that's embedded in nature that brings us back together.”



Figure 7: Left to right - Future Machine appearing in Finsbury Park (London), Backbarrow (Cumbria), Rotherfield Peppard (Oxfordshire), Christ Church Gardens (Nottingham).

2.4 Strategies for sustainability

The strategies for sustainability emerge from the entangled and mythical nature of the design of Future Machine. The materials that form the sculptural elements of the artwork have been carefully chosen due to their symbolic and physical properties, with their provenance checked where possible. For example, Ash trees are seen as the 'navel of the world' in Nordic mythology, they are under threat due to Ash Dieback disease, and may no longer be a familiar sight in England by 2050. The wooden octagon is made from a specific Ash tree, felled by the carpenter in a locally managed woodland. Oak is the iconic tree of Nottinghamshire where Future Machine was built, native to the UK and Sherwood Forest. The oak base was locally sourced from woodland close to the timber yard where it was bought.

The hardware that enables the interactions are mostly refurbished or repurposed from previous projects, powered by a combination of trickle energy from participants turning the handle, recharging the car battery inside the base via mains electricity or the solar umbrella, when there is enough sunshine.

The biggest issues of material sustainability are the small parts and power generator. All are newly bought and whilst some may be in use for 30 years, many will need regular replacing. There have also been various accidents. The mini-PC has been replaced with a refurbished windows laptop, which is unlikely to last until 2050 and has already encountered software, system maintenance and update issues. The thermal cards required by the kiosk printer are the most unsustainable part of the artwork. When the lead artist tried to use recycled thermal paper participants tended to screw them up and put them in their pocket, whilst the hope is that people will keep them as mementos until they eventually fade away.

The final issue of sustainability is the transportation of Future Machine. Currently this is only possible with a large van or partly dismantled in an estate car. More sustainable options are being researched, including freight train. The current state of public transport in the UK makes this impossible, and electric van hire is also prohibitively expensive.

As shown by these examples, creating a sustainable, net zero interactive device appears near impossible, particularly one that will run for 30 years. Therefore the team are constantly reviewing and refining the interactive elements with the view that the technology might be simplified and automated - to reduce the slow processes required to test, maintain and facilitate the interactions, the resulting power needs, card and other equipment wastage – or alternatively to slowly reduce the interactions, until eventually Future Machine no longer exists as an interactive device, turning it simply into a strange mystical sculpture, more totem than robot.

3 Creating technologies for the future

Future Machine asks us to consider what we will need in a future impacted by anthropogenic climate and environmental change, based on the understanding that the way we construct, power, design, study and deploy technology needs to fundamentally change. We offer up the following challenges to studying and designing technologies for the future in response.

3.1 Studying Future Machine

When Future Machine was originally envisioned, the main research question focused on how to conduct research within a well-established methodology – an artistic technology probe – but instead of the project lasting a few weeks or maybe a year, it would span over a third of the average person’s lifetime. The implications of responsibility for the physical machine, its technological components, the relationships formed with members of the public and other stakeholders including the university and artist(s) over such a long time – these were the obvious, and fascinating, issues to address. However, this was before the time of Covid-19, so we foresaw no problems in having a machine that the public could handle closely and whisper into, or for researchers to interact with in person at various public outings. Our main concerns were practical, in terms of institutional expectations and personal involvement.

By 2021, changes resulting from both the global pandemic and our own evolving understanding of Future Machine’s potential shifted the primary research question slightly. It became somewhat murkier. What exactly are we studying? During our few forays with Future Machine before lockdowns began, the stakeholder groups had already begun to grow from simply the ‘artists’ and the ‘public’. The list soon included: the core group of artists, each of whom determined the very different and localised ways in which Future Machine would be used in their locations; contributing artists and musicians whose contributions lent a cultural and geographic richness we had never anticipated; the workshop participants whose had helped shape the design of Future Machine and would come to visit it in future; our longstanding collaborator from the BAS; community groups and schools local to the various locations that would temporarily house Future Machine each year; members of the public who interacted with Future Machine more or less as intended; those who watched it from afar but might come to recognise it as it appeared each year; bystanders who did not know what to make of it; and bystanders who engaged with it in entirely unexpected ways that did not further our original research aims but whose interpretations were no less valid than our own.

As of July 2022, the research picture had clarified greatly, thanks primarily to the ongoing work and discussions of the artists involved. Future Machine is no longer the focus of the research. Rather, we are researching the future itself: what happens to the locations that temporarily host Future Machine each year, what happens to the artists and their visions, what happens as stakeholder groups come and go, what happens as public understanding of climate change shifts; what happens as their relationship with Future Machine changes; what happens as we attempt to conduct research over a time period that will see both funding and personnel changes; what happens to the physicality of where we and Future Machine interact; and what happens when everything shifts again, and again, and again.

3.2 Re-considering our assumptions about the future

As HCI researchers we need to push beyond notions of Agile research and perhaps move towards a responsive and reflective position which gives us the confidence to shift, identify, design and move where the motivation and action is happening. Research in this world is not static, and a dogmatic approach would not be participatory, but would in effect diminish the openness and honesty which allowed people to engage and open up such a rich vein of design possibilities

in the project. Informed by Hulme's myths (see [Figure 4](#)), can we reconsider our assumptions and standard practices in order to imagine the future from different perspectives and with an understanding of the role of myth making in our assumptions about the future? How might our assumptions change if we understand that the future might unfold as any of the options outlined by Hulme, or as a complex combination of all of them?

3.3 Embedding entanglements

Whilst our increasingly urbanised culture often relies on the separation of human and nature, most modern technologies are designed without thought for the entangled, seasonal & reciprocal relations that exist within our communities, ecologies and everyday lives. When studying Future Machine we realized that we were clearly studying more of an ecosystem than an interactive object. In appreciating the nature of a system that is an ecosystem we were appreciating the multi-faceted entangled nature of the ways in which the material and metaphysical are bound together. Future Machine therefore provides an opportunity to consider strategies of entanglement and reciprocal relations as a core design principle for devising new technologies, by asking the following questions:

- How do these interactions reflect the entangled nature of the ecologies, people and places where the technology will be embedded and studied?
- How does the design support reciprocal relations between humans and (non-human) nature?
- How does the design support longitudinal and sustainable possibilities for human-nature interactions?

As we have outlined, in HCI research terms Future Machine is a tool for understanding the future and peoples' understanding of it, designed for emerging encounters in response to seasons, weather, climate, personal, local and global events. This approach offers both a challenge and a liberation for the study and design of future technologies as it requires both interactive designers and HCI researchers to be responsive and iterative.

3.4 Sustainability, provenance and longitudinal time frames

As the strategies for sustainability employed by the artists in the design and journey of Future Machine across all five places over time has shown designing an interactive device with net zero CO2 emissions is near impossible, yet employing a strategy of sustainability, keeping provenance and a longitudinal perspective in mind can inform decisions about aesthetics, materiality, power and hardware that can support a more sustainable approach.

3.5 Considering how entangled interactions might act as a trigger for change

Future Machine focuses on the entangled relations between ecology, place and community built into the design as part of an iterative process and how this enables people to think about a future influenced by anthropogenic climate and environmental change, potentially shifting their thinking, decision making and interrogating the myths they hold about the future. In this case this occurs through embedding a combination of sensing technologies that track, interpret and reveal climate and environmental changes over time, encouraging the participants to make choices by using the dials to rehearse different myths and decisions about the future, creating their own 'messages for the future' and committing to return when Future Machine returns to the same place every year, for 30 years.

3.6 Embedding opportunities for abundance

Future Machine is a celebration of the existing abundance of the specific ecologies, places and communities where it appears. The collaborating artists, the guardians and participants in each place are creating newly formed rituals, focused on care, joy, community and celebration. Future Machine highlights the importance of ritualised interventions and interaction and how they can help create new mythologies that can support us to respond to the uncertainties of the future, creating a container for our hopes, fears, dreams, happenings, difficulties, and encouraging people to come together to celebrate all that is already there, rather than relying on assumptions of scarcity and unlimited resources [\[24\]](#).

4 Conclusion

This paper presents an example of a data-driven interactive artwork that acts as an encounter, a witness, and a trigger for people to come together to celebrate the past, care for the present and consider the future, where ritualised artist interventions and interactions can create new mythologies. The longitudinal nature of the project is a metaphor for hope - that we will be able to continue to celebrate the people and ecologies in these places for the next 30 years.

If the future projected by climate scientists comes to pass (continuing along the trajectory we are now on) we will increasingly be faced with new challenges for our human/nature/technology interactions, that may contradict our existing cultural assumptions of what the future might look like and what our human/nature relations appear to be. Future Machine presents us with a unique approach to designing technologies for these future human-nature interactions, by embedding strategies of myth making, entanglement and sustainability into their design. As a result, the authors propose a new set of research and design challenges that: (a) reconsider our assumptions about the future (b) embed an awareness of the entanglements inherent in our human/nature interactions (c) create opportunities for human/nature encounters (d) take into account sustainability, provenance and long time frames (e) consider how these interactions might act as a trigger for change (f) embed opportunities for abundance, joy, celebration and care.

This work suggests that these new approaches to designing future technologies can encourage sustainable and positive forms of interactions between humans and non-humans in a future increasingly impacted by anthropogenic climate and environmental change.

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