# Stork Interaction(s) for, *'Digitally Sustainable Societies'*

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We interact with environments through our senses: taste, sight, smell, touch, and sound. Our human experiences and interactions are extended (within distant worlds) through digital sensing. In turn, our mobile technologies are metaphorical bridges for us to access; wayfinding, personalise experiences, ecologically based IoT and more. Digital sensing enables us to interact with previously inaccessible locations, gather mutually beneficial data and transition to a more 'digitally sustainable society'. Distributed technologies and off-the-shelf hardware have transformed accessible and ethical interaction opportunities. In turn, machine learning opens landscapes for audio sensing, but is currently hard to access for third sectors.

This article documents a design-led technological deployment of *machine learning audio technologies,* aiming to foster 'digitally sustainable societies'. Authors use 'research in the wild' methods, open hardware, and avantgarde conservation sites. Authors signpost and comprehend; impacts, pitfalls, and benefits of leveraging machine learning in design-led audio environments. Technological proposals were deployed in; internationally renowned rewilding site, *The Knepp Estate*, in collaboration with *Oppo,* technology manufacturer. Situations investigated; explorative, serendipitous, and planned audio interactions, supported by reflections and stakeholder critique(s). Reviews included wildlife rangers, yielding good practice insights for; 'digitally sustainable societies'. The research objective *comprehends the potential: impacts, pitfalls, benefits, and opportunities of leveraging remote audio interactions, using 'research through design' & 'deployment' methods.*

Sustainability, Digital Economy, Sensing, Design-led, Machine Learning.

***Introduction***

The development of sensors and accessible technologies has transformed exponentially in recent years. We can now monitor remotely (NHS, 2020), analyse data informing science (PLOS, 2022), even design accessible tools for others to internationally replicate (Public Lab contributors, n.d.) and more, delivering a sustainable digital society. Within that society we are reliant on communities, new models, manufacturing and working together. Our state of climate requires urgent action (The Economist, 2022). Sensing can assist us in learning from others, e.g., how to grow food in places of parallel climate(s) (Jung *et al.,* 2021). Currently we have become distanced from natural worlds, we used to be fully connected to, causing a shift in our impacts and behaviour (Papworth *et al*., 2009). Current society: exports our material waste internationally (Statista, 2021). These trends are replicating across industries impacting our (public) view on sustainable

practices and implementation(s). However, if we have personal experiences (of nature, wellbeing, and environment) it transitions our behaviour and approaches (Lekies *et al.,* 2015). The articles project emulated two out of five *Nature Positive* values, *1.* "Invest in innovative technologies enabling more efficient and effective conservation and sustainable use of natural resources" and *2.* "Invest in human capital, to develop skills" (Nature Positive, 2021). Audio sensing is used for experiences, training, e.g., physiotherapy training (Postolache, 2017), community agriculture, and birdsong recognition (Arce-Lopera *et al.,* 2021). The 'design space' crosses technological, ethical and user divides, holding potential, requiring scoping via ethical design-led means. Finally, it re-enforces "the more we engage, the more we care about our environment, the more chance it has a priority in our personal/national decision making" (Foster, 2018). Authors summarise linking places, stimulate our senses/experiences, impacting behaviour and wellbeing for sustainable benefit(s).

Public Interest Technologies (PIT's), an emerging design discipline, empower communities and municipalities, creating 'optimum' conditions. PIT's enable data sharing for good, leading to 'evidence based' societal change. PIT's inform digital economies and "how data is forming a currency people want stake(s) in", benefiting human/non-human species rights (McGuinness, *et al.,* 2021). They leverage individual amenities for the betterment of wider audiences. In *Understanding Remote Presence* Tollmar *et al.,* defines remote presence (RP) is a "media for interpersonal communication" (2000). At time of writing, RP is commonplace in design practice(s) addressing healthcare, tremor monitoring, sports training and more. Oppo (technology manufacturer), "strive to be a sustainable company contribut[ing] to a better world, elevat[ing] life through technological artistry" (OPPO n.d.). Oppo is part of *Sensor City*, a hub for IoT, RP and extending public capabilities through mobile/sensing technologies. In summary, authors believe that enriched experiences through data and digital interactions can have long-term benefits. I.e., deploying technologies to perceive impacts on transition design and transforming our public and expert behaviour, for good sustainable practice(s). It is not the authors' intention to ever replace physical experience(s). But provide safe distanced interactions that enrich people's lives without disturbing natural world(s), but nurture it, increasing our wonder of it. Our research objective, *comprehending potential: impacts, pitfalls, and benefits of leveraging remote audio interactions, using 'research through design' and 'deployment' methods.* The research gap(s) are the inter-related opportunities for audio monitoring informing a 'sustainable digital society', which we signpost, informed by design literature.

***Technological Deployment Site***

Knepp is a 3,500-acre estate in West Sussex. Since 2001, Knepp is a pioneered rewilding project, using grazing animals as the drivers of habitat creation, and with the restoration of dynamic, water courses, seeing extraordinary increases in wildlife. Extremely "rare species i.e., turtle doves, nightingales, peregrine falcons, and purple emperor butterflies are now breeding" (Schulte *et al*., 2022). The Knepp Project is radically different to conventional nature conservations, as it is not driven by goals/target species. It's "driving principle is to establish a

functioning ecosystem where nature is given freedom" (Tree, 2017). Knepp is part of *'Weald to Waves'* nature recovery network; enabling land managers to create habitats improving wildlife connections. *The White Stork Project* (at Knepp) is restoring 50 breeding pairs (of storks) by 2030, birds are now free flying, living in local areas.

***Method***

Deploying products is "essential to move design out of the lab and making it into an unremarkable feature of everyday life" (Tolmie, *et al.* 2010, 181). The "most profound technologies are those that disappear, weaving themselves into the fabric of everyday life until they are indistinguishable from it" (Weiser 1991, 66). Deploying proposals enables "better understand[ing of] its 'real world' capabilities" (Tolmie, *et al.* 2012, 183). Deploying proposals has results, through actions it inspires. Gaver *et al* comment "the design isn't complete until it's been used" (Gaver, *et al.* 2007, 893). Project deployments in real life situations are akin to 'research in the wild' practices, testing artefacts and documenting responses. *Fig. 1* depicts onsite technological deployment(s). *Ethical study conditions:* recordings used discreet non-accessible, non-public devices and locations. Deployment phases were conducted with informed consent. Work leveraged contexts and organisations, that would not usually engage with these technologies. Sensor kits were deployed for 2 weeks, in three static locations, using Bird.net opensource technology.

Figure 1. Deployment, Stork conservation site, *images courtesy of James McCauley Photography.*

***Results & Key Stakeholder Reflections***

Our method was supported by stakeholder interviews (Shafieisabet, *et al.* 2020), including Knepp rangers reflected on the following themes:

1. *Potential scope for public purposes & communication for human species?*
2. *Potential for scientific rationale(s), for sustainability of non-human species?*

***Impacts***

- *Emotive responses;* "Sound alone can be overwhelming. we do Nightingale safaris, in the dark. It's just auditory. We've had people, so overwhelmed by emotion of what they're experiencing, in the dark." *(Ranger 01).*
- *Remote connections;* Connecting "people with nature has huge scope, also the scientific monitoring side, being able to survey an area better than perhaps you could if you were just a person on foot. *(Ranger 02).*

- *Wider Communities:* There are so many developments levering the sound of our immediate natural environments and domiciles. I.e., for hospitals, wellbeing, schools, and community groups.

***Pitfalls***

- *Openly Public;* Bird song apps are misused by amateurs, encouraging birds to "sing more frequently", changing natural behaviours (BBC News, 2013)
- *Skills Divide;* We are reliant on tech and "no longer building our unique nature aware skill set, i.e., identifying birdsong" (Moss, S. 2021).
- *Mis-use;* through our deployment, technologies were never 'openly broadcasting', data was captured onsite, accessible via password protected devices. Public contexts, set a different ethical challenge.

***Benefits & Opportunities***

- *Autonomy:* Linking inaccessible spaces to people, for example remote piers, remote cliff habitats increasing interest but reducing damaging physical footfall.
- *Sustainable practice(s):* Audio interactions that can not only benefit the stakeholders, but also improve our decision making and subsequent behaviours, e.g., audio of surrounding nature reserves influencing our behaviour and actions.
- *Health Environments:* Hospital spaces with outdoor spaces can be linked to alternate spaces for health and wellbeing impacts. Akin to BBC *'Slow TV'* movement. Encouraging sustainable architecture and conservation actions in the area.
- *The Digital Economy:* Leveraging data collection for employment, by approved or 'pre-trained' parties, e.g., supplying annual data on waterways, air quality etc.

***Conclusion***

Insight(s) from reflections is the potential to not only benefit science practice, but also educate local populations. Rangers stated their communities respond totally differently when they have evidence and recorded activity. This is a larger research area that can link sensing and wellbeing, through digital sustainable interactions.

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