D2.2 Social Implications and Preconditions for Technological Design, Update

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0.2	May 15, 2024		TWE	- Added current and future use cases (see Appendix B) - Explained the role of design for technology - Added literature on “Techno-moral Scenarios” as a design method - Expanded on Guidance Ethics results - Introduced steps for future ethical reports

Executive Summary

The goal of this report is to introduce the social implications and preconditions for the responsible design of holography with dense wireless networks. In this updated version of the report, we include a methodology for arriving at responsible design requirements using “Techno-moral Scenarios” in combination with Guidance Ethics. Additionally, we share more findings from our Guidance Ethics workshop.

This report begins with a brief overview of the development of HOLDEN technology in context with society, followed by an analysis on how stakeholders and the context in which the technology is applied impact the social implications and responsibility. Following, three approaches to responsible design are introduced. The first being established literature on Function Creep, Contextual Integrity, Ambient Intelligence, and Technological Environmentality. Second, Techno-moral Scenarios are shown to be a tool to interpret future moral norms. Lastly, Guidance Ethics, which focuses on stakeholder values and embedding responsible design into the product, is introduced.

Next, the features that may differentiate this technology from pre-existing technologies are presented with some analysis on their societal effects. Finally, results from a Guidance Ethics workshop are shared. This workshop included researchers from HOLDEN and invited guests representing relevant stakeholders. There were three goals of the workshop: 1) discover contexts for use, 2) discern stakeholder values, and 3) take initial steps towards responsible design.

This report reveals that the features and contexts with which this technology is applied will have varying societal impacts. Therefore, the fewer roles, the lower the gravity of each role, and less data stored by HOLDEN technologies, the easier it will be to design ethical use cases. For example, if the technology has multiple roles within a home, including high responsibility tasks such as ensuring the health and safety of someone chronically ill, all while collecting data that could be repurposed, ensuring ethical use will be more difficult than a system with one use case that has an external system of checks and balances. The domains in which the data collected by this technology can be used should also be regulated to prevent both naïveté and abuse.

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1. Introduction

The goal of this report is to introduce the social implications of holography with dense wireless networks as the technology pertains to the aims of the EU-funded HOLDEN project and develop a methodology for responsible design of the technology in differing contexts. Our challenge is to bring the philosopher into the design process, so that the technology may be developed in a way that allows meaningful progress without undermining societal ethical values. Therefore, we apply a series of techniques to determine ethical use, starting with relevant pre-existing literature highlighting the essential values that might be undermined or affected by the technology. Next, we recommend the use of "Techno-moral Scenarios" to determine the preferable future moral landscapes. Lastly, we employ a Guidance Ethics approach with essential stakeholders.

1.1. HOLDEN

HOLDEN is an EU-funded grant dedicated to the ethical development of technology utilizing RF-wave sensing to create "vision." The built environment is awash with electromagnetic waves outside of the scope of human sensing. A portion of these waves derive from wireless network sources such as WIFI routers, telecommunication towers, and cell phones. These radio frequency (RF) waves can travel through walls and reflect off surfaces. HOLDEN aims to visualise the environment and the people in it in a way that respects ethical values and norms, i.e. through the responsible use of sensor feedback from dense wireless networks.

HOLDEN accomplishes this mission using three different methods. 1) forming holography from electromagnetic scattering, 2) discrete point measurement using beamforming/steering and smart antennas, and 3) incorporating machine learning with electromagnetic waves produced from 5G and beyond to understand increasingly complex environments, movements, and behaviours. Built into the grant is the requirement that each phase of the project be ethical. This can be a challenge for socially disruptive technologies with unforeseen impacts. Therefore, this report is a first step for providing an overview of the social implications and preconditions for responsible design.

1.2. State of RF Wave Sensing Research

The first successful transatlantic morse code radio message of 'S' pulsated from an antenna, traveling from Cornwall, England to St. Johns, Newfoundland to reach a receiver in 1901 [1]. Fast forward over a century and the technology has evolved to where it is today, where RF waves are emitted carrying voice messages from cell towers to cell phones, delivering search engine results from routers to laptops, and transporting an array of sensor derived data between a plethora of "smart" devices. It is now common to access free WIFI in malls, on buses and even on planes. Demand for mobile and wireless technology has expanded research in internet communication technologies (ICT) and increased the amount of RF waves unknowingly interacted with each day.

It is somewhat predictable that RF waves are now being used for vision. Afterall, the most relatable connection humans have to the electromagnetic spectrum are the colours we see from red to violet. This light covers a fraction of the electromagnetic spectrum with waves ranging from 380nm to 750nm. Even further down the spectrum, where the wavelengths are so short that they disrupt our cells, are X-rays and MRIs, which can expose the innerworkings of the body. Compared to X-ray and MRIs waves, RF waves, are relatively harmless – so low in frequency and long in wavelength that they are non-ionizing and would be quite inefficient tearing down our cells. Nonetheless, as with any technological advancement, there may be yet undiscovered effects (bodily or otherwise) inflicted by waves in the RF spectrum to humans, the environment, or animals. However, the influence of waves on our physical or mental constitution may be very relevant but is not the subject of this project.

So far it has been discovered that RF waves are indeed an option for holography. RF waves have been used to detect gestures in the dark and through walls [2], [3], recognize emotions [4], track sleep [5], detect breath and heartrate [6], [7], track where someone is in their home and what they are doing [8], and even in studies to recognize the early signs of dementia by tracking movement and behaviour [9]. Each of these contexts have unique ethical concerns and social implications, on which we will focus.

The fidelity of the "vision" produced from the technology is dependent on the density of the waves and the receivers. The more receivers, though, the lower the quality of the waves, because they drain energy from the original signals. Meaning that implementing this technology through increasing the number of receivers could lower the quality of telecommunication signals. The variance in detail afforded by RF wave holography means that it is possible to get a sense of where people are or what they are doing without recognizing individual faces.

Yet, there are ways to recognize people beyond clothing and facial recognition. Research has shown, that with the help of machine learning, it was possible to recognize and differentiate two similarly dressed individuals from RF waves [10]. Once machine learning is introduced and more sensors and antennas are added, more can be seen and recognized. The impact of machine learning on the ethics of HOLDEN technologies is important and will be elaborated in Section 2.2 and further discussed in the second iteration of this report.

This technology has numerous potential application areas. Elderly care is commonly described as an immediate use case for the technology. Within HOLDEN, the technology has already been used for person and object detection and localization, antennae diagnostics, radar imaging, indoor gesture recognition, and fall detection. Additionally, considered contexts within the project include device free measurement, people counting, smart living, assisted living, behaviour analytics, and industrial robotics (See Appendix B for more detail.) This technology, while still under development, is primed to be brought to the market while most of the population has never considered holography from "the cloud" to be a possibility. This means legally, society is ill equipped to handle this emerging technology, especially when the possible use cases are so vast.

Furthermore, RF wave vision has expanded beyond academia resulting in patents. An overview of patents is included in the internal HOLDEN Report D1.1.

1.3. Challenges for Ethical Design and Importance of Context

HOLDEN is working on a relatively new technology that can generate a multitude of applications. Each application may be used or abused differently. A camera, for example, can be used to document a holiday or to spy on an unknowing victim. This is not to say that technologies themselves do not have moral weight and that all the responsibility lies with the user. "Abusing" a piece of paper likely will have less dastardly effects than abusing a gun. Furthermore, different forms of technology better lend themselves to different forms of harm or misuse. Sharp paper will lead to more papercuts, thin paper, while using less materials, may bleed through, making it ironically more difficult to sustainably use both sides. Technologies have varying affordances [11]; therefore, it is necessary to consider ethical design and social implications.

Socially disruptive technologies are defined as technologies that can "disrupt social relations, institutions, epistemic paradigms, foundational concepts, values, and even the nature of human cognition and experience" [12]. Technologies in this realm can be challenging to comprehend and relate to, especially when not yet developed, thus requiring some imagination to understand. The methodology of using scenarios to distinguish ethical requirements will be elaborated in section 2.2 Techno-moral Scenarios. To lay the groundwork for the ethical implications of holography with dense wireless networks we will start by looking at the potentialities of the technology at large.

Just as cameras redefined our notion of privacy, so too may the notion of *ubiquitous* sensing be redefined by this technology. One day, wherever the network surrounds us sufficiently, we could be "seen" with gesture and movement recordings. These sensors seem to herald an omnipresent and inescapable technological gaze [13]. Those who wish to escape the possibility of being tracked would have to be quite literally "off the grid." Aspects of this imagined reality are already the case today. Babies are monitored over video, children are tracked with their watches, phones, and AirTags, the elderly and sick are monitored to lessen the caretaking load. Workers are supervised through cameras and time tracking down to the individual tasks that they are working on each hour. Many carry a smart phone that is constantly collecting data both in the physical and digital realm – apps used, websites visited, real world location, places visited. Unlike these "obtrusive" devices that could theoretically be discarded or burned, there will be limited means of escape from RF wave vision, and there will likely be an even more limited understanding of "where" it is and what exactly it is doing.

Each stakeholder in society will have a different relationship with the technology for each context in which it is applied. If we consider non-humans, plants, animals, and the environment, there will be new positives and negatives to consider. Do certain species of animals react differently to RF waves than humans? How energy depleting are these algorithms? Will this cause more dense wireless infrastructures to be built and will that influence the planet and its inhabitants? Might this tech have an influence on technologies that we have already developed? The answers to these questions would help ascertain the social, global, and environmental impact of the technology, but will take time and research to answer. The answers to these questions are also outside of the scope of the HOLDEN ethics group. The global market is not patient when it comes to innovation [14]. Therefore, possible fallout and redesign is bound to occur after the technology is already installed and running.

Who then is responsible for the outcomes of this technology? Until the public is made aware of the technology, how it works, when it is used, and why it is being implemented, it is impossible for society to advocate for or against its use. Fully informing the public is challenging and easily succumbs to discrimination, as it is often more challenging to disseminate information to those with language barriers, lacking access and interest in news and policy, and those who might lack the capacity to understand the technology. False consent due to lack of knowledge should not put the onus on the individual. Meanwhile, the government ideally protects the interests of its citizens, but needs the knowledge of the technology and its impacts (which, as previously shown, might not be clear until the technology is already in use) to institute laws, policies, and regulations. Scientists often work in the pursuit of discovery and not implementation. Those discoveries can then be brought to market with an urgency to optimize a single sector and generate increasing revenue, sometimes wilfully ignorant of the repercussions for second degree stakeholders. The more roles demanded from the technology and the higher expectations of the service; the more responsibility will be placed on the tool.

"Being ethical" is not a straightforward process. In the following section we discuss three frameworks to encourage ethical development from differing approaches.

2. Ethical Tactics

As demonstrated in Section 1.3, holography with dense wireless networks qualifies as a potentially "socially disruptive technology." Moreover, the technology can take on multiple use cases and forms. To determine ethical use, we first share top-down concerns that have already been researched for relating technologies. Next, we elaborate on the methodology for Techno-moral Scenarios (TMS). Finally, we introduce a Guidance Ethics approach to further involve stakeholders.

2.1. Top-Down Concerns

Ethics is dedicated to determining, defending, and systematizing right from wrong. Values assist in reckoning between moral and immoral states. There are various ways of evaluating systems as ethical or unethical such as looking at the consequences (consequentialism) or at the actions themselves (deontology). Is happiness for all most important or is the scientific advancement of humanity? Much of traditional western philosophy upheld virtues of autonomy, freedom, and justice but excluded slaves, females, and "inferior" racial groups from their normative decision making. It is essential to be transparent not only about how a technology works and what it does, but also the values driving its production and how evenly the values are applied to all stakeholders. Does the technology boost the safety of one racial group while simultaneously making another group unsafe? Does it improve the environment for humans but make it inhabitable for other animals? In the design stage, testing value assumptions will be essential to know the repercussions the technology.

Other established concepts can also help avoid pitfalls. "Function creep" occurs when technology that was created and installed for one purpose is gradually used for another often, unrelated motive [15]. It is an easy way to build the infrastructure for a use case that would be unpopular by providing a desired service. Theoretically, bringing ultra-fast 5G connectivity into homes and cities and then using the waves emitting WIFI for ubiquitous sensing would fit this description. The dream of surveillance without "added" infrastructure piggybacks on the drive for knowledge and connectivity. This drive has led to the quick evolution through five generations (5G) of ICT. Would people be so supportive of increased ICT infrastructure if they knew what increased wireless density may bring?

Health concerns and unsubstantiated paranoia from members of the public, suggests that many do not want increased RF wave density at any cost, especially of the higher frequency radio waves introduced by 5G that allow for faster transfers of information at a closer range. Misinformation spread during the corona virus pandemic, leading people to violence, attacking cell phone towers under the belief that 5G was helping spread COVID19 [16]. While higher frequency RF waves are still non-ionizing, and, unlike lower frequency RF waves, too short to pass through skin and walls, they still heat cells (to a much lesser degree than the sun) and are less studied, causing confusion amongst lawmakers as to what level of exposure, distance, and usage is optimal [17]. This leads to circumstances such as the Apple iPhone 12 being produced, brought to market, and sold worldwide, and then banned for sale in France by Agence nationale des fréquences (ANFR) due to the specific absorption rate (SAR) exceeding the legal limit for on-body emissions [18]. Meanwhile, 5G has been labeled as a form of environmental pollution [19].

Narrowing down to practical use cases, some established schools of thought may be helpful to understand the social implications and preconditions for design. Helen Nissenbaum's view of privacy as contextual integrity focuses on what people really care about when they speak of privacy [20]. People want their partners and close friends and family to know intimate details of their life. They want their doctor to have access to their medical history and they want their alma mater to know what courses they took and grades that they received. This does not mean that they want that information to leak into the non-relevant zones of their life. Applying this theory to HOLDEN would mean that to protect privacy we must ensure that data stays in realms relevant to the user and is not carried over to unapproved use cases. For example, it could be required that the technology can only store relevant data, keep data locally, delete data when it is not needed, and only be accessible and retrievable by relevant parties. Similarly, it could be required that the technology only record data to the resolution relevant for approved tasks.

If HOLDEN develops ubiquitous vision not only to store information, but to generate reactive or interactive environmental responses, it will be a form of Ambient Intelligence (AmI), where the environment is invisibly smart and interactive. AmI systems are formulated as increasing autonomy because they generate more ways to control or interact with the environment and may take cognitive load off the individual by the environment itself being smart. However, philosopher Philip Brey has pointed out that AmI can also lead to loss of control. Some forms of loss of control might be 1) the system misunderstanding what the user is trying to convey; 2) the system only having limited means of communication so the user has to transform their behavior to match that of the system; 3) where the interests of the system align more or equally with a 3rd party than the user itself; or 4) when the system is primarily a means of surveillance [21].

Technological Environmentality has been introduced as a term to connect smart environments to both Material Engagement Theory and Post-phenomenology. As demonstrated by Ciano Aydin, Margoth González Woge and Peter-Paul Verbeek, humans shape infrastructure and the infrastructures in turn shape humanity [22]. One can envision a school, office building, or road and how each elicit certain behaviours. Even “natural” infrastructure affects the individual – the view from the *trail* of a hike becomes the internal depiction of the natural environment, even though most would agree that the most authentic part of a forest would require bushwhacking to reach. The technological environment both mediates the world and, as it is ubiquitous and invisible, becomes the world. This makes the potential impact quite high as it is bound to reshape behaviour and experience. How the system is developed and the features it promotes will fundamentally shift the social implications of the technology.

2.2. Techno-moral Scenarios

Norms are derived from values applied in specific cultural, political, and infrastructural contexts. Yet, as explored in the introduction, certain technologies have the capability to fundamentally disrupt norms and change value systems. For example, ultrasounds made foetuses visible before a pregnancy is noticeable, thus elevating the status of the foetus [23]. Care robots have the potential to redistribute responsibility for elderly care [24]. Socially disruptive technologies might fundamentally shift our morality systems in ways that are challenging to predict while looking abstractly. Techno-moral Scenarios can assist to envision how morality itself might fundamentally shift.

Techno-moral Scenarios (TMS) are not predictions of the future, but instead paint differing internally consistent worlds [25]. Imagining these scenarios offers a lens on how morality itself might be reshaped by a technology as opposed to just measuring presupposed morally relevant consequences. Instead of assuming and applying current moral norms to future scenarios – for example applying current notions of privacy to a technology that might reshape what privacy even means – TMS grant perspective on how norms and morals will be reshaped by technology. Therefore, comparing differing worlds may be helpful for determining what kind of future is desirable. This is not to fall into a techno-determinism. It might be that no scenario is preferred.

A potential pitfall of TMS would be making outlandish scenarios and causing unease for unlikely circumstances. Therefore, it is essential to create scenarios based on historical knowledge and reasonable expectations for technical capabilities. Centuries ago, spending eight hours a day sitting in a chair staring into a screen, while pressing buttons, might sound like an odd form of torture and not much like “work.” Spending the remaining waking hours on the couch, exhausted, starting at an even larger screen, while occasionally checking a smaller, pocket-sized screen might have seemed like a travesty. Nonetheless, the system of right and wrong transformed with the introduction of computers and televisions. Now this way of life does not seem so fundamentally flawed. Perhaps with the right techno-moral predictions our current standard of life could have been avoided or, maybe, an even better present could have been created. We can use TMS not only to determine consequences but improve the normative moral system for future generations. As shared by Dutch philosophers Swierstra, Stemerding, and Boenink, “If we manage to imagine this new techno-moral constellation before it has become socially embedded, our reflection is less restricted by those facts and practicalities. Because in the present we still possess alternatives that in the future will be closed off, our current ethical reflection is more open and free compared to the cold morality of the future” [26].

2.3. Guidance Ethics from the Bottom Up

Guidance Ethics is an approach to philosophy of technology developed by Peter-Paul Verbeek and ECP | Platform for the Information Society. Peter-Paul Verbeek is a philosopher who expanded upon Don Ihde’s work to further develop mediation theory. In Verbeek’s view, technology is integral to the human experience, not a separate entity impacting humanity – technology *mediates* the human experience [27]. Due to technology and humanity being intertwined, it is not useful to think of technological developments purely as moral dilemmas. Instead, with a Guidance Ethics approach, technology can be developed positively in a way that pushes forward society’s needs and achieves stakeholder values.

There are three distinct characteristics of the Guidance Ethics approach. 1) It operates from the *bottom up*, meaning that instead of philosophers imposing views on the technology from pre-existing literature, the stakeholders themselves can articulate needs and values for the technology. 2) It occurs from within, which translates to the technology being developed with ethics in mind instead of facing external technology assessment after the fact. 3) It focuses on *positive ethics*, concentrating on what we want from the technology instead of worst-case scenarios [28].

One challenge with Guidance Ethics is getting all the right stakeholders in a room and the impossibility of a single stakeholder being able to represent their whole group. Individuals most at risk or most likely to “misuse” technology are challenging to bring into a research study. For holography with dense wireless waves, it is essential to talk to the elderly, children, as well as hackers and those who might wish to use this technology to manipulate and control people. Those in low paying jobs also often cannot afford to take time off work to join research studies. Lastly, individuals struggle to follow through on their own values. People say that they value health, but the desire for peace of mind, fun and ease, leaves many making choices that undermine their own wellbeing.

As previously demonstrated, there are plenty of top-down concerns regarding HOLDEN. Such top-down analysis though often leaves out practical real-world instances, where such technology might have value. Furthermore, holography through dense wireless networks already exists and is a logical appropriation of the RF wave portion of the electromagnetic spectrum that is now possible due to the increased density of wireless signals, faster computational power, and machine learning. At this point, it is crucial to create practical regulations and design requirements to ensure that the technology is developed and used in ways that better all stakeholders. This might also include regulations and tools to protect individuals and society from the technology itself.

3. Social and Ethical Implications of Features

Given that there are already systems in place for monitoring individuals, anonymous or otherwise, this section will briefly consider what makes this technology unique and then loosely apply some of the ethical methodology from the prior section to each feature. These considerations will be helpful later in the project when considering the ethical design of specific applications, as well as the impact this technology will have on how people relate to each other and themselves.

3.1. Ubiquitous Vision and Pre-Existing Infrastructure

The ability to see through barriers and in the dark lessens obvious blind spots. This technology may be theoretically implementable by either 1) setting up WIFI emitters with the hardware and software necessary to create holography, 2) adding in smart receivers to dense wireless zones, or 3) installing new units specifically for the purpose of holography. Option 1 would force people to become part of the system, because most people are dependent on WIFI, and, even if one is not carrying a WIFI receiving device, they would still be tracked. Option 2 would allow for some negotiation of when and where the receivers are placed. Perhaps it could be made visible when they are in use or not and only implemented for a specific purpose. Option 3 separates the WIFI for information sharing from the WIFI for holography, thereby avoiding function creep. Perhaps with Option 3 a different frequency could even be used to not disrupt the WIFI signal. If there was no longer a need for the monitoring, then the whole device could be removed. Of course, Option 3 forgoes the promise of double dipping on an already available resource, but it does allow for easier removal and is less of a Trojan Horse approach to the introduction of the technology.

3.2. Gesture Recognition and "Blurriness"

RF wave vision is heralded as being more privacy preserving than cameras because it is both energy and time intensive to generate pristine human legible images. Yet, with the help of machine learning, it is possible to "read" feedback from the waves to differentiate individuals, recognize individuals, and recognize gestures. If RF holography is designed to know the whereabouts and movements of an anonymous person, then a person would be more discrete doing something in public than in their own home, where it is likely that they are the one performing the action. A study has even combined energy usage data to ascertain what appliances people were using [29]. There is extensive literature on the social implications of AI, such as concerns for algorithms containing and even reinforcing existing biases or not knowing how algorithms make their decisions. This can lead to unrecognized bias and irresponsible discrimination or exclusion. Will gesture recognition work for someone missing a limb or with Tourette's Syndrome? Depending on how dependent and trusting society becomes of the system the social implications may be grave.

Just as facial recognition has led to the wrong people being arrested, including a heavily pregnant woman who could not have committed the crime [30], if this RF Holography is not as high fidelity as cameras and the raw data cannot be read by humans, then there should be discernment to what extent can the output of the algorithms be trusted. It might be helpful to legislate the extent to which data from the system can be used. Even without AI, mathematical approximations are *approximations*. If the technology is used for industrial robots working with humans, it is critical that workers not overly trust the robot by getting too close during potentially dangerous tasks.

3.3. Wirelessness and Reliance

Wirelessness disentangles us from needing wired sensors and visible devices to measure things like sleep and location. Theoretically, with wirelessness, one could play a video game without a controller or turn lights on and off without a switch. This can be helpful where the wires or device get in the way of completing the task and/or the data is very important to collect. It is uncomfortable to sleep covered in wires and inefficient to work with a robot if you are always needing to use a joystick or press buttons to pause production. The downside is that it is plausible that one system will end up carrying the load of many tasks, and that the system will get more challenging to turn off the more duties it has to fulfil. A smart watch may be a bit clunky, but one can always remove it. A smart watch may feel obtrusive, but it is at least not all encompassing. As shared in the prior section, Ambient Intelligence has the potential to generate *and* undermine autonomy. Furthermore, if the system is reactive and ubiquitous it will reshape the way humans move in the spaces where the system is installed.

3.4. Connected IoT

Holography with dense wireless networks is a meta internet of things because it “sees” from the reflections of the cloud or information traveling via RF waves through space. Given the urge to connect more appliances to the cloud, it is curious the extent to which these increasingly dense WIFI networks will impact holographic vision. Conversely, it is also interesting the extent to which the information derived from the holographic systems too will be shared through RF waves and become itself an IoT device. The smart toilet could know that someone is likely walking to it and then start to warm up its smart seat. Determining how much is shared between devices, especially for a tool that can essentially be used for surveillance, is imperative.

3.5. Seeing More than Meets the Eye

Research shows that it is possible to measure breath and heart rate using RF waves and to distinguish between various individuals' breath rates while sitting together [7]. This capability was then used for emotion recognition [4], which poses a slew of ethical consideration and concerns [31]. Already RF wave technology has proven capable (just like x-rays) to show more than meets the eye. Electronic eyes already function differently than human vision, making it difficult to anticipate how cameras work [32], but RF waves are outside the human scope of perception. Depending on how the tool is designed, it has potential to see more than a camera, while at the same time being at a worse resolution of what we normally consider “vision.”

Theoretically, emotion recognition in combination with gesture recognition could help monitor mental and physical health, but the risks mentioned earlier in this and in previous sections, still apply. Would people trust the system more than themselves or their doctor? Who would have access to this information, and could it be used by third parties or as a mood ring gimmick in a smart home? There may be cultural biases. Furthermore, heart rate and breath rate are personal biological information that theoretically the company running the system would have access to in every instance where the technology is installed. Even if HOLDEN does not pursue development of systems to monitor breath and heartrate, the fact that it might be possible to ascertain this data using the same systems, systems which could be hacked, is essential to note. This shows the importance of cleaning and deleting data and being purposeful over what data is stored. This will not only help avoid preventable leaks but be better for the environment by not taking up extra server space.

4. Guidance Ethics Workshop

4.1. Methodology

To figure out possible use cases for holography with dense wireless networks, stakeholder values, and requirements for ethical design, the University of Twente (TWE) group of HOLDEN organized a Guidance Ethics workshop for HOLDEN members and external stakeholders. This one-day workshop was approved by the University of Twente Behavioural and Management Sciences Ethics Review Committee. The workshop consisted of an individual demographics survey, a layperson's talk, an initial individual response survey, a group survey on opportunities and risks, a group survey on stakeholder values, and finally a group survey on ethical design criteria. The workshop took place on 22 November 2023 and lasted from 10:00-17:00. In total, there were 18 participants, one lead researcher and three research assistants. All participants signed a consent form and were aware of the nature of the study before participating. The info sheet and consent form are included in the appendix.

Figure 1 – Guidance Ethics Approach

The workshop was designed to mirror the Guidance Ethics Approach (Figure 1). The layperson talk contextualized the technology itself. Next, groups were formed of similar stakeholders to think of use contexts for the technology in terms of opportunities and risks. Following, new groups were comprised of mixed stakeholders, where, for various use cases, groups had to consider the values of various actors and the effects those values might have on those use cases. Finally, new groups were tasked to rank contexts and design an ethical use case of the technology, keeping in mind regulations and hardware/software considerations. Each session had four groups with four to five members. At each group table a research assistant or lead researcher was available to take observational notes and clarify survey questions.

4.2. Results

4.2.1. Demographics

The workshop consisted of 18 participants, 14 male, three female, and one who preferred not to disclose their gender. 50% of the group was 26-35 years old, 28% 36-45 years old, 17% 46-55 years old, and 6% 18-25 years old. 12% had either a mental or physical disability. 89% of the group had a graduate or professional degree. 17% of participants were primary caregivers. The group was 61% White, 17% Asian, 6% Black, 6% Arab, with 11% preferring to not disclose racial and ethnic identity.

4.2.2. Initial Responses

After the layperson's talk, individuals had the opportunity to share their responses. Some initial feedback included that the technology could be helpful for safety, but also intrusive, as it could be used for surveillance and through walls. People pointed out that it could be used for a range of applications, some of which might not be any more effective than pre-existing options. A couple individuals thought it was interesting that it might be possible to use the technology for more anonymous surveillance. 15 participants filled in a survey indicating the extent to which they agree to statements regarding the technology. The responses are shown in Figure 2.

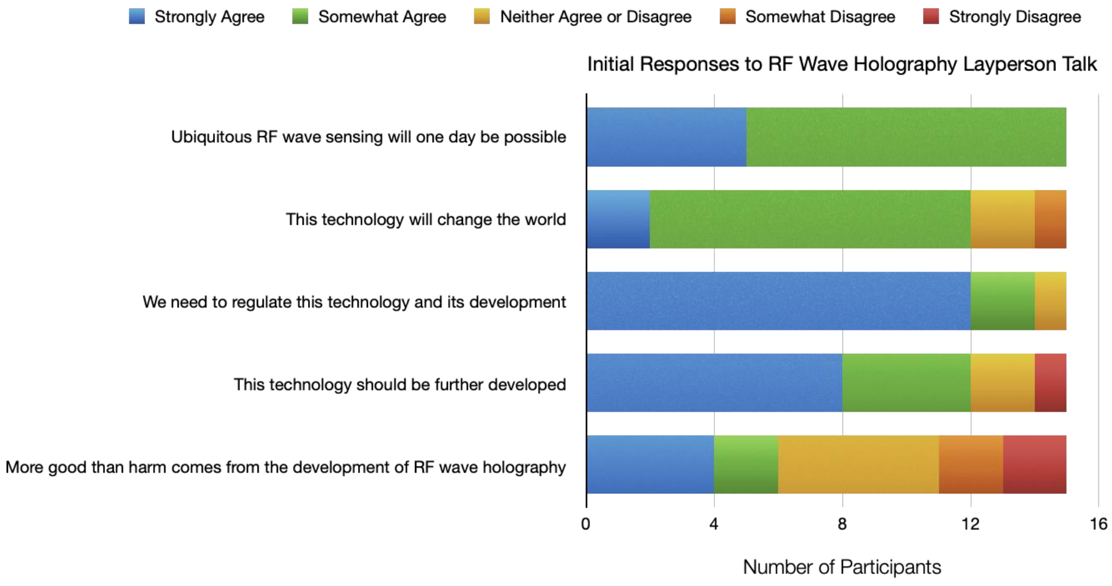

Figure 2 – Layperson Talk Initial Responses

4.2.3. Opportunities and Risks

Following the individual survey, participants were divided into four groups. Each group had to represent two stakeholder categories (business, science, government or public). The groups brainstormed opportunities and risks for the stakeholder groups that they needed to represent. There were some reoccurring opportunities and risks amongst stakeholder categories. One was to find valuable ground truth information without having to build or install new infrastructure. For example, humanitarian organizations could use the technology to see if human rights are being violated or if domestic violence is occurring, which would be a form of spying, in this case possibly for good. Anonymous data could be helpful for research and policy, but also might be used by advertisers. Risks would involve loss of autonomy and privacy as well as exposure to hacking. At the same time, the technology is seen as possibly providing more autonomy for the elderly and those who need more care by providing tools like fall detection or responsive environments. Since RF waves do not see colour in the same way, some suggested that it might eliminate bias, but there are other differing features such as size, height, and various disabilities, which may be "seen" through RF holography. Finally, the technology was seen as potentially helpful for entertainment in both gaming and art.

Many of the opportunities generated by participants depended on clarity and accuracy of the system. It does not make sense to use flawed data to make policy decisions or for academic research. Yet the more precise the data is, the harder it might be to keep anonymous and the more opportunities for misuse. The same opportunities also generated risks both for the stakeholder that that might find the innovation advantageous and for alternative stakeholders. For example, the opportunity for smart governance might lead to data dependency.

4.2.4. Moralizing Contexts

To determine what values stakeholders found important, the opportunities from stage one were grouped into similar wider contexts. Table 1 shows these findings with some rewording for clarity and simplification. Each group was given two contexts, for which they had to determine the values the context supported and undermined. Groups were able to define their own values and were not limited to a specific philosophical approach.

Context	Examples	Values Supported	Context Values Undermined
Monitoring Group (People)	Crowd Monitoring, Population Control, Surveillance for Law Enforcement, Student Counting on Campus, Behavioural Experiments	Efficiency, Control, Safety, Sustainability (resource management and energy consumption), Accessibility	Reinforce paranoia about government tracking and health impact on bodies and animals (wi-fi free communities), privacy, right of oblivion, control, undermines democracy (consent is not always asked), dehumanising and associate people to data points
Smart Environment	Indoor Navigation, Automation (Heating/Ventilation), Safety Measures for Working Environments, Home Care for Elderly and Ill, Optimising design of built environment, More advanced Smart Home Functionalities	Healthcare, Personalization, Customization	Free market and access to benefits (privatization)
Entertainment	Gaming Embedded Art Systems	Enjoyment, Education, Health, Social Cohesion, Privacy, Diversity	Privacy, Democracy, sustainability (computational requirements), (social) Justice
Monitoring Non-People	Agriculture Health Building Maintenance Environment	Animal welfare (also: wildlife detection) / animal citizenship, (animal) health, safety, efficiency, sustainability, quality, transparency.	Autonomy of animals, privacy, justice
Health	Preventive Chiropractor (system that reminds you to act in ways to improve your health)	Self-Care, Freedom of Movement, Autonomy, Self-Sustainability	**[No Time to Finish]**
Monitoring Individual (People)	Behavioural Monitoring Intrusion Detection Military Monitoring Reveal Violence and domestic abuse Transparency (Police Body Cams) Baby Monitoring	Government: might like to get more information about the population, for example, criminal	Privacy, Ethics, Trust, Data Validity, Autonomy, Human Dignity

Context	Examples	Values Supported	Context Values Undermined
		activity. Businesses: Being able to gain more data.	
Protection from the Technology	Regulate who can draw on the technology at what time (through access point) Democratic engagement in smart spaces through gestures (inclusive 'global' gestures - advantage for immigrants engaging without needing status) Gesture recognition to individually regulate the technology (and what it records)	Privacy, Fairness, Accountability, Security	Human progress (knowledge) Innovation in healthcare, Capitalism
Robotics/AI	Human recognition (smart cars/robots), Vehicle logistics	Reducing inequalities through job creation, Innovation for the benefit of humankind, improving quality of life, Profits, increase capabilities to meet other values.	Human to human interaction, Privacy, Accountability, Transparency, Fairness

Table 1 – Values of Contexts

This stage of our Guidance Ethics process would be helpful for coming up design requirements because it lays out the possible benefits and potential risks from our current techno-moral standing. Values can also be categorized into moral and non-moral values to give more weight to those that are ethically consequential. It also provides some perspective on how morals might change. Before the invention of nonbiodegradable products and mass consumerism, sustainability was about surviving year to year on available resources. Norms shifted from sustainability as a necessity to sustainability as irrelevant and are now shifting back with the realization that sustainability is still essential for the continuation of our species. Unfortunately, our new techno-moral landscape makes it challenging to return to resource frugality.

4.2.5. Ranking Contexts

In the third group activity, new groups were tasked with ranking the generated contexts from 1 to 14. Table 2 shows these final opportunities in order by median ranking amongst groups. Groups chose their own criteria for ranking. Reasons for ranking included “short term feasibility, readiness, availability, who and how many people could possibly benefit, [and the] social impact of the technology acceptance rate,” “added value of the tech, impact, potential to solve (existing or future) societal, long-term challenges like aging society,” going in a circle with everyone picking their top choices until none were left, and “benefits for stakeholders, balance of public, science interest and business relevance.”

Use Cases (Contexts)	Group 1	Group 2	Group 3	Group 4	Median Ranking	Average Ranking
Built in Safety Measures for Working Environments	3	2	12	6	4.5	5.75
Automation (Heating Ventilation)	6	7	5	1	5.5	4.75
Ability to live at home longer for those aging or with disabilities	1	5	11	8	6.5	6.25
Crowd Monitoring (Festivals, events)	5	8	9	4	6.5	6.5
Long-term Health Monitoring	2	4	13	9	6.5	7
Indoor Navigation	7	9	2	11	8	7.25
Behaviour Monitoring and Recognition	13	1	15	3	8	8
More advanced Smart Home Functionalities	9	10	8	7	8.5	8.5
Intrusion Detection	15	12	3	5	8.5	8.75
Facility Management and Monitoring	11	17	7	2	9	9.25

Use Cases (Contexts)	Group 1	Group 2	Group 3	Group 4	Median Ranking	Average Ranking
Gaming	17	6	4	12	9	9.75
Human Recognition for Robotics and AI	12	3	17	10	11	10.5
Baby Monitoring	8	16	6	15	11.5	11.25
Democratic Engagement through Global Gestures	4	14	10	17	12	11.25
Ubiquitous Surveillance for Law Enforcement	10	11	16	14	12.5	12.75
Embedded Art Systems	14	15	1	13	13.5	10.75
Ubiquitous Transparency (Like Police Body Cams)	16	13	14	16	15	14.75

Table 2 – Opportunities for Use Ranked by Groups 1-18 (1 = Best / 18 = Worst)

4.2.6. Design

During the ethical design stage of the workshop, each group designed for their top ranked context. These were “Automation (Factory Automation, Industry),” “Behaviour Monitoring and Recognition,” “Embedded Art Systems,” and “Home Monitoring and Care for the Elderly and Chronically Ill.” Top design requirements were visibility and informed consent as well as regulations to avoid function creep. At the end of this 75min session, only the groups designing for “Home Monitoring and Care for the Elderly and Chronically Ill” and Automation (Factory Automation, Industry),” thought their final designs were ethical. All groups except for the Embedded Art Systems group thought that if their regulations and design requirements were implemented their product should be brought to the real world. The Embedded Art Systems group was split 50-50 and chose to mark that their design should not be brought to market. Group insights and findings can be found in Table 3 with minimal editing (for clarity and spelling) from group surveys.

	Automation (Factory Automation, Industry)	Behaviour monitoring and recognition	Embedded Art System	Ability to live at home longer or for those aging or with disabilities
Define proper use for this context. How often would this use be helpful? Take time to brainstorm!	Proper use: Balancing and optimising resources (workforce) How often useful: all the time	Security tech (airport, festivals, sport) Crowd control (especially re panic, crisis) Facility management Border control Refugee monitoring	External parties track individuals and use art as an excuse without consent. You don't need supplies, more environmentally friendly due to less paper use, making a creative, haunted house because you can see where people are, individuals with disabilities can also use it according to their possibilities, interacting with people from a distance and being creative together, easier to motion capture, playing without instruments, redefine art.	Track and monitor people in their daily life without investing in additional infrastructure. Variety of applications, like fall detection or recognising abnormal behaviour outside a normal routine. An important aspect is that this can be visualised with the consent of all participants involved (patient doctor, etc…) How often would it be used? Continuously
What are the gains and the risks for this context? Take time to brainstorm!	Gains: - Improve or optimise production and/or working environment - Reduce the workload - Reduce waste of resources - collect automated statistics for further optimisation Risk: - reduced quality of the output - Still need (better educated) human in the loop	Behaviour monitoring and recognition (border control) Gains: - replacing existing systems, making them more robust and preventing existing ethical constrains - invisible and non-intrusive: behaviour is not adjusted or hidden;	Redefining art, make it cheaper, increase the participation, more accessible, included in art without consent, art-theft, not behaving according to the individual's intention	Improved quality of life, reduce initial cost of health system. dependency risk, reliability must be really high, home or room invasion. de-socialising

	Automation (Factory Automation, Industry)	Behaviour monitoring and recognition	Embedded Art System	Ability to live at home longer or for those aging or with disabilities
	- forgetting to leave the human in the loop (no feedback / interaction possibility) - Human interaction possibility missing	no socially preferred behaviour - can be also used in the night or less preferable lighting - larger coverage Risks: - replacing existing systems, making them more robust and introducing new ethical constrains and dilemmas - invisible and non-intrusive: intrusive, privacy infringement - particular devices could disturb the system and circumvent it - (signal) quality of the WIFI system could be diminished		
How can the technology itself be shaped to prevent risks and improve gains? Take time to brainstorm!	'- Allow space for human interaction -> leave control interface open for human to interact. - Involve people working in the case in the process to consider their needs and concerns - Integrate explanations (why is the system taking specific action/decision)	'- In particular contexts deliberately making the tech visible for some or all - Using proxy data, synthetic data sets - Establish particular laws for particular spaces or use (police) - Explicitly informing people that they are surveiled - Data processing and storage as close as possible to the sensor system	Getting rid of capitalism, gesture for consent, limitation of the accuracy of the sensor technology, digital watermark, making it more precise, going back function	personalized time window, redundancy, maintaining conventional health care (regular visits of the doctor) The gains can be improved by using historical data to suggest futural behaviour
What regulations should be made to ensure proper use? Take time to brainstorm!	'- data protection & privacy - privacy: not know who is in the room, but _that_ someone is in the room - inform users of the monitoring (by entering, you give consent)	'- Establish particular laws for particular spaces or use (police) - International laws and regulations - Control frequency and intensity of the WIFI routers - Data protection and regulation laws and regulations	regulate the use in public spaces, get permission to display in public spaces, create dedicated areas, prevent it from recording and restricting to life performances, approval of saving and recording.	Periodic control checks by governmental institution limit signal strength to certain areas
What is the worst-case scenario accounting for your ethical design. How likely is it?	Non-correlation of the automation function to the actual need of a situation/context (not harming the human etc / taking still into account human interactions) The system need not ever become so inaccurate that it may become dangerous for a human. How likely: Depends on the scale. There is a trade-off: Smaller applications may have lower risk of failing because of their lower complexity (e.g.	'- Function creep regarding expanding the use of the tech in less risky environments (no terrorist but you can use it for small crime) - The meta data of the tech is used for evil purposes (a different type of function creep) - Blurring sensitive images remains wishful thinking - Laws and regulations are not enforced	Unusual expressions of creativity with human subjects, privacy and access to the personal expressions without consent	Flaws, Inaccuracies (or even total failure) in the system which prevents somebody from getting the necessary health care while solely relying on it

	Automation (Factory Automation, Industry)	Behaviour monitoring and recognition	Embedded Art System	Ability to live at home longer or for those aging or with disabilities
	counting people entering/leaving a building), while full automation has a higher risk - but also bigger benefit/e.g return of investment.			
Is your final design ethical?	Yes	No	No	Yes
Why or why not?	We are not harming anyone; We are not disclosing personal information; We are reducing the workload from individuals;	No certainty that technical adjustments are feasible; overseen ethical challenges; agreeing on international laws is uncertain; applications of the tech that we cannot predict.	2 for no / 2 for yes: No: Surveillance as an art project making it easier for example to implement policing. When we are in a capitalist system it will be difficult to create a design that will be ethical because there is always the chance of reappropriation and unfair production. Yes: With the proper regulations and framework, the device can be used ethically. But there should be more thought put into it. It is fun!	The goals were formulated by the stakeholders, we took into account different use cases, which of course can change over time. We also tried to decrease the harms as much as possible while maintaining privacy and usability of the solution
Should this context be put into the real world if your regulations and design requirements are implemented?	Yes	Yes	No	Yes
Why or why not?	Because we are not harming people and there may be a monetary benefit for the business	More benefits than risks.	2 Yes: We can only learn about the ethical issues if we implement the device and deal with the emerging issues. 2 No: It is likely to be reappropriated in this current system.	Great benefits for large parts of the population. Risks are balanced out

Table 3 – Designing for Contexts by Groups

4.3. Findings

The Guidance Ethics approach is helpful for considering practical concerns from current stakeholders from a modern techno-moral perspective. The system does have some drawbacks that we noted in our research. Firstly, it is bound to be biased by whatever participants are present. To have a fair system it is essential to have a diverse and representative stakeholder group present. Unfortunately, those most at risk are sometimes the most difficult for researchers and businesses to bring to the table. Lower income individuals may not be able to take off work to attend a Guidance Ethics workshop. Those building the technology might not have the capability of describing how it works in terms understandable to those in differing fields. In our Guidance Ethics workshop researchers had trouble delivering layperson's talks that even all the highly educated members at the workshop could fully comprehend. As much as individuals might try to empathise with other stakeholder groups, their considerations will be hindered from lack of knowledge from lived experience.

Furthermore, Guidance Ethics differs from Techno-moral Scenarios and more traditional philosophy of technology approaches in its short-sightedness. The moral groundings are based on current notions of right and wrong and not how they may shift in the future for the better or worse. For example, perhaps climate change will become so intense that a showering daily will seem like a criminal offence although the idea seems outlandish now. By narrowing down to specific, contexts, values, stakeholders, and regulations the potential long-term ramifications can fade to the background. It may be helpful to implement Guidance Ethics with laypersons talks both on the technology and on ethics for more holistic results.

Guidance Ethics is helpful because it allows progress in a more methodologic and thoughtful manner than only designing from one stakeholder perspective for their value set. The system could easily be abused though by not bringing in the right stakeholders and by carefully prioritizing certain values over others. Nonetheless, through a one-day Guidance Ethics workshop we were able to educate stakeholders on the technology, determine risks and opportunities, design contexts and use cases, determine values that may be improved or undermined, and consider design requirements. In this way, Guidance Ethics is a productive way of doing collaborative ethics. In the conclusion we will share how it could fit well into a larger ethics of technology methodology.

5. Conclusion

In this updated report we expanded on the findings from our Guidance Ethics workshop and have clarified a system to approach the ethical development of HOLDEN technology. Some themes repeatedly surfaced in this analysis. Holography with dense wireless networks is possible and has a wide range of use cases. Societal impacts will vary amongst stakeholders and between use cases. It is essential to have multiple stakeholders present in the design process to mitigate risk. There is a risk of this technology being applied widely for a multitude of use cases due to it relying on an already existing omnipresent infrastructure. The technology has the potential to both increase and reduce autonomy as well as alter the human condition by changing how our environment functions. Its ubiquity and always-on nature can introduce a technological gaze that can support and guide people as well as objectify, limit, and undermine them. The concept of relational autonomy will therefore be explored later. Risks can be mitigated by designing for specific purposes and deleting all superfluous data. Finally, Informed consent is a baseline for ethical design.

Due to the range of applications possible with HOLDEN technology, we have determined that it is important to consider relevant literature on the ethical impacts of similar technologies on the human condition. Next, since this technology has the potential to be transformative to our moral framework, we suggest building and working through Techno-moral Scenarios for specific instances of the technology. This allows for the consideration of what humanity’s moral landscape should look like and what form of regulations and technology might best allow for that realm of scenarios. For constructing our own Techno-moral Scenarios, we can build on the findings from our literature review as well as from the initial insights from the first guidance ethics workshop. By doing so, we aim to arrive at a rather dense description of potential futures, which allows stakeholders to anticipate emerging use cases in the absence of a prototype Finally, it is important to bring together relevant stakeholders and lawmakers to consider how the technology should be designed and regulated for the specific context. We believe it is helpful to introduce these parties not just to the technology itself but also provide them with an ethical toolkit for analysis. When designing it is important to ask: Are the values worthwhile to all stakeholders involved? If not, are there formulations that might bring a more positive outcome? None of these stages should fall into techno-pessimism or techno-determinism.

In the following stages of HOLDEN, we plan to execute these steps for each technology in context. This preliminary overview looked at HOLDEN technologies widely, but it is essential to consider ethics in context for the varying formulations of the technology and use cases. From these steps we can make ethical recommendations pertaining to design requirements and whether certain formulations of the technology are worthwhile. Most innovations are not inherently good nor bad in isolation, but contexts and design can sway a tool either way.

Appendix A. Workshop Materials

A.1. Info Sheet

Information Sheet for HOLDEN Guidance Ethics Stakeholder Workshops

20/11/2023 - YOU ARE WELCOME TO KEEP THIS SHEET

Who are "We": We are members of the Philosophy of Science & Technology Section of the University of Twente. This research is conducted for HOLDEN: https://holden-project.eu/. HOLDEN is a research project funded by the European Innovation Council for the Ethical Design of Holography with Dense Wireless Networks.

Purpose of Research: The goal of this research is threefold. First, we want to determine contexts for the use of ubiquitous holography from wireless networks for a variety of stakeholders. Second, we want to understand the ethical concerns and opportunities for each use context. Finally, we want to discover technical constraints and regulations that can lead to ethical design of holography with dense wireless networks.

What We Collect: We collect general demographic data as well as observational notes of group interactions that will be anonymized. Additionally, we collect information from group forms and materials left after the workshop. Video will be recorded of the Layperson's Talk at the beginning of the workshop. Some photos will be taken to record the workshop.

What Happens to the Data: All data will initially be served in a password protected hard drive at the University of Twente. Once anonymized, the original data will be deleted, and the anonymized data will be stored on the shared EU based server of HOLDEN. Note that this anonymized data may be reused for future research purposes and thereby stored in other locations.

Benefits and Risks: Your involvement in the project can directly impact the ethical development of holography through dense wireless networks. There is a risk of your opinions being attributed back to you.

Withdrawal Procedure: If at any point you decide that you no longer want to contribute to this study, please let the lead researcher know and we will not collect or include any further data from you. However, your contributions prior to withdrawal will remain in the final dataset as it would be unfeasible to untangle them from the group responses.

Contact Information: S.I. Cammers-Goodwin, Email: s.i.cammers-goodwin@utwente.nl

Phone: [redacted]

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee of the Faculty of Behavioral, Management and Social Sciences at the University of Twente by ethicscommittee-bms@utwente.nl

A.2. Consent Form

Consent Form for HOLDEN Guidance Ethics Stakeholder Workshops

THIS IS A COPY OF THE DOCUMENT YOU SIGNED ON 22/11/23

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information dated [20/11/2023], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	□	□
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason, but my responses up to the point of withdrawal will be included in the study.	□	□
I understand that taking part in the study involves working in different groups and recording findings in questionnaires. I am additionally aware that observational notes from the workshop will be recorded, and that demographic data will be collected.	□	□
Risks associated with participating in the study		
I understand that there is a possibility that my participation in the study may be revealed, and that people may try to associate findings with my contributions even though only anonymized data will be shared and used for research purposes.	□	□
Use of the information in the study		
I understand that information I provide will be used for reports, research papers, website, and media.	□	□
I understand that personal information collected about me that can identify me, such as [e.g., my name or where I live], will not be shared beyond the study team.	□	□
I agree that my contributions can be anonymously quoted in research outputs.	□	□
Audio/Video/Photo recording		
I agree to be audio/video/photo recorded.	□	□
Future use and reuse of the information by others		
I give permission for anonymized observational data and group forms that I contribute to be archived in an open repository so it can be used for future research and learning. This data may be used for all use cases by those who requested it.	□	□
I give the researchers permission to keep my contact information and to contact me for future research projects.	□	□

A.3. Questionnaires

Individual Survey

To better understand the stakeholder groups, we need to document the diversity of perspectives represented here today. To maintain privacy in these forms you will come up with your own alias that may **not** resemble your name that will be used throughout the workshop. (Names will be changed once again to a new alias when the final dataset from the workshop is cleaned and coalesced.)

1. I want my alias to be (ex: Susan Strong):
2. I have signed the printed consent form and read the info sheet: Y/N
3. Age range: 18-25 26-35 36-45 46-55 56-60 61-65 66-70 71-75 76-80 81+
4. Gender identity: Female, Male, Non-Binary
5. Highest level of Education: High School, Bachelor's, Master's, PhD, Apprenticeship/Trade school
6. Racial Identity: Asian, Arab, Black, Hispanic, Native American, Polynesian, White
7. Which of these characteristics describes you **personally** at this moment? For today the main stakeholder categories are in the header row. The subcategories are below in the columns.

Individual	Academia/ Technologist	Business	Law/Government
Able-bodied Disabled Elderly Child Male Female Activist Minority Religious Wealthy Low Income Middle Income Western Eastern Global South LGBTQ Student Family	Academic Hobbyist Hacker Research Universities	Entrepreneur Small Business Monopoly Advertising Brick-and-Mortar Online Shops Employee Shareholders	Municipality National Government Defense Law Enforcement International Human Rights Dictators Unrecognized Governments Terrorists Elected Leader

8. Which of these characteristics, that do not represent you personally, do you feel comfortable representing either through research or interaction.

Individual	Academia/ Technologist	Business	Law/Government
Able-bodied Disabled Elderly Child Male Female Activist Minority Religious Wealthy Low Income Middle Income Western Eastern	Academic Hobbyist Hacker Research Universities	Entrepreneur Small Business Monopoly Advertising Brick-and-Mortar Online Shops Employee Shareholders	Municipality National Government Defense Law Enforcement International Human Rights Dictators Unrecognized Governments Terrorists

Global South LGBTQ Student Family			

9. What is your initial reaction to the layperson's talk:

Before submitting, please write your alias on a name tag so that you do not forget it.

Group Survey 1: Visualizing Contexts for Use

Welcome to the HOLDEN Guidance Ethics Workshops. You were invited today because you have a unique perspective based on your background and experience. It is your job to act today as a representative for the various stakeholder groups you embody and/or have extensive knowledge about.

It can be challenging for those coming from minority backgrounds or experiences to feel safe voicing their concerns in settings where they are the outlier. Due to the importance of all perspectives being heard, we ask that participants do not scrutinize or invalidate the experiences or opinions of others.

Furthermore, we ask that all participants outspokenly advocate for their viewpoints without belittling the perspectives of others. If you need assistance, please reach out to one of our student assistants or Dr. Sage Cammers-Goodwin.

1. Please introduce yourselves to the group using your aliases. Enter the aliases here:

Stakeholder Category 1

2. What is the first stakeholder category that your group is representing (ex: individual):
3. Discuss and list the perspectives in this category that are represented by your group (ex: disabled):
4. Discuss and list the stakeholder perspectives in this category that are missing from your group (ex: western):
5. Share your initial thoughts/questions about the technology with each other for this stakeholder category. List anything that did not come up in your individual survey and elaborate on conflicting views:

The following questions all pertain to your first stakeholder category! Please take time to brainstorm your answers to each question. Include a minimum of 10 examples for each question and order them according to severity. Everyone must contribute at least once to each question.

6. What are some opportunities for this technology that are represented by this group?
7. What might be some opportunities from the perspectives of those not in the group?
8. What are some risks that might harm members represented by group?
9. What are some risks that would cause harm to the unrepresented members of your group?

Stakeholder Category 2

10. What is the second stakeholder category that your group is representing (ex: individual):
11. Discuss and list the perspectives in this category that are represented by your group (ex: disabled):
12. Discuss and list the stakeholder perspectives in this category that are missing from your group (ex: western):
13. Share your initial thoughts/questions about the technology with each other for this stakeholder category. List anything that did not come up in your individual survey and elaborate on conflicting views:

The following questions all pertain to your first stakeholder category! Please take time to brainstorm your answers to each question. Include a minimum of 10 examples for each question and order them according to severity. Everyone must contribute at least once to each question.

14. What are some opportunities for this technology that are represented by this group?
15. What might be some opportunities from the perspectives of those not in the group?
16. What are some risks that might harm members represented by group?
17. What are some risks that would cause harm to the unrepresented members of your group?

Group Survey 2: Moralizing Contexts with Mixed Stakeholders

At your table are badges for each stakeholder category. Your group can decide who wears which badge at which time. When you are wearing the badge, it is your job to represent the interests of that stakeholder category. When discussing the contexts, feel free to switch between badges, just be sure for each question that all stakeholder categories have been represented.

1. Please introduce yourselves to the group using your aliases. Enter the aliases here:

Context One

2. What is the first context your group is examining:
3. Which stakeholder categories (and subcategories) are excited by this idea
4. Which stakeholder categories (and subcategories) are not excited by this idea
5. What values makes this context a good idea? Please discuss and list all:
6. What are some positive effects that would come from this context? Please discuss and list all effects:
7. What values does this context undermine? Please discuss and list all:
8. What are some negative effects that would come from this context? Please discuss and list all effects:

Context Two

1. What is the second context your group is examining:
2. Which stakeholder categories (and subcategories) are excited by this idea
3. Which stakeholder categories (and subcategories) are not excited by this idea
4. What values makes this context a good idea? Please discuss and list all:
5. What are some positive effects that would come from this context? Please discuss and list all effects:
6. What values does this context undermine? Please discuss and list all:
7. What are some negative effects that would come from this context? Please discuss and list all effects:

Context Three

1. What is the third context your group is examining:
2. Which stakeholder categories (and subcategories) are excited by this idea
3. Which stakeholder categories (and subcategories) are not excited by this idea
4. What values makes this context a good idea? Please discuss and list all:
5. What are some positive effects that would come from this context? Please discuss and list all effects:
6. What values does this context undermine? Please discuss and list all:
7. What are some negative effects that would come from this context? Please discuss and list all effects:

Group Survey 3: Ethical Design Implementation

Welcome to the final group. You are now responsible for ethical design implementation of this technology that causes the most benefit and least harm to the most stakeholders. You as a group can consider whose needs should be the most prioritized and why. Please treat this thought experiment as if you are about to release this technology to market.

1. Please introduce yourselves to the group using your aliases. Enter the aliases here:
2. Rank the contexts as a group from best to worst and explain why you have ranked them this way, please keep in mind various stakeholder perspectives:

Next you will pick your top two contexts and come up with ethical design criteria. Quality over quantity. If you do not get to or finish the second example that is fine!

Context One

3. What is the context and why did you pick it?
4. Should this context be put into the real world and under what conditions?
5. What are the gains and the risks for this context?
6. Define proper use for this context, how often would this use be helpful:
7. How can the technology itself be shaped to prevent risks and improve gains? Take time to brainstorm!
8. What regulations should be made to ensure proper use?
9. What is the worst-case scenario accounting for your ethical design. How likely is it?
10. Is your final design ethical, why, or why not?

Context Two

1. What is the context and why did you pick it?
2. Should this context be put into the real world and under what conditions?
3. What are the gains and the risks for this context?
4. Define proper use for this context, how often would this use be helpful:
5. How can the technology itself be shaped to prevent risks and improve gains? Take time to brainstorm!
6. What regulations should be made to ensure proper use?
7. What is the worst-case scenario accounting for your ethical design. How likely is it?
8. Is your final design ethical, why, or why not?

Appendix B. Technology Use Cases

B.1. TUM

1) **Examples of the contexts in which you have already used the technology you are building**
    a) Detection and localization of people (mannequins for test) or objects in a room
    b) Indoor Computation and visualization of equivalent currents in antenna diagnostics, e.g., detecting faults or printed circuit board (PCB) analysis
    c) Surface deformation analysis of reflector antennas
    d) Active and passive radar imaging of objects and humans in a controlled environment, such as body imaging, imaging of a drone, and imaging of metallic objects
    e) Movement detection of a metallic object in a static environment utilizing a planar scanner

2) **Examples of contexts that you plan to use the technology during the project**
    a) Detection and localization of people (mannequins for test) or objects in a room
    b) Indoor localization of people (mannequins for test) or objects marked by passive tags
    c) Utilize knowledge on the size and shape of a room within our simulation tools and for the imaging
    d) Perform stop-motion investigations of dynamic environments (moving objects or persons)
    e) Investigations on the accuracy of object tracking in office environments, which may or may not be also occupied with persons
    f) Investigate through the wall imaging of persons (mannequins for test) or objects

3) **Examples of contexts that you think the technology will be helpful or useful for in the future**
    a) Smart living → Detect if somebody is in a room (with permission/without permission)
    b) Count people in a room
    c) Fall detection of elderly people
    d) Device free measurements of distances in domestic environments, e.g., “what is the distance from here [place a fingertip on the TV screen] to here? [place a fingertip on the couch]”
    e) Localization of people, items, and possibly pets in an indoor environment
    f) Arts

B.2. AALTO

1) **Examples of the contexts in which you have already used the technology you are building**
    a) Detection of gestures inside an indoor environment for application to interaction with the environment or installations, namely detection of gesture inside an indoor environment, control of smart appliances [1,2]
        - [1] S. Savazzi, S. Sigg, M. Nicoli, V. Rampa, S. Kianoush and U. Spagnolini, "Device-Free Radio Vision for Assisted Living: Leveraging wireless channel quality information for human sensing," in IEEE Signal Processing Magazine, vol. 33, no. 2, pp. 45-58, March 2016.
        - [2] Palipana, S., Salami, D., Leiva, L. A., & Sigg, S. (2021). Pantomime: Mid-air gesture recognition with sparse millimeter-wave radar point clouds. *Proceedings of the ACM on interactive, mobile, wearable and ubiquitous technologies*, *5*(1), 1-27.

2) **Examples of contexts that you plan to use the technology during the project**

    In the frame of Holden, we mainly develop technology to protect the privacy of human subjects. For this we build on the existing implementations and system. The contexts are identical to the above.

    Some new investigations we have done on the existing data towards this goal:

a) Distinguishing the person performing a gesture from the way how they perform the gesture patterns

3) **Examples of contexts that you think the technology will be helpful or useful for in the future**
   a) **Elderly care and assisted living**. Mobility, life or motion patterns monitoring. Application in the field of remote monitoring of patients: passive, unobtrusive collection of data to associate the lifestyle with the risk of developing/progressing chronic diseases. The technology can be embedded in remote health monitoring devices, unobtrusive not requiring the subject to wear any radio tag. Sends notification to the cloud and push alerts to the subscriber and ISP for intervention.
   b) **Interaction with smart building/space instrumentations**. React on gestures in a building. Control interactive systems of a building through gestures

B.3. CNR

1) **Examples of the contexts in which you have already used the technology you are building**
   a) Detection of body motions inside an indoor environment for application to intrusion detection, namely detection of any movement inside an indoor environment, control of smart appliances [1]
   b) Passive localization of an operator inside an industrial workplace environment [2], fall detection [3] in pre-defined spots and locations.
      - [1] S. Savazzi, S. Sigg, M. Nicoli, V. Rampa, S. Kianoush and U. Spagnolini, "Device-Free Radio Vision for Assisted Living: Leveraging wireless channel quality information for human sensing," in IEEE Signal Processing Magazine, vol. 33, no. 2, pp. 45-58, March 2016.
      - [2] S. Savazzi, M. Nicoli, M. Bennis, S. Kianoush and L. Barbieri, "Opportunities of Federated Learning in Connected, Cooperative, and Automated Industrial Systems," in IEEE Communications Magazine, vol. 59, no. 2, pp. 16-21, February 2021
      - [3] S. Kianoush, S. Savazzi, F. Vicentini, V. Rampa and M. Giussani, "Device-Free RF Human Body Fall Detection and Localization in Industrial Workplaces," in IEEE Internet of Things Journal, vol. 4, no. 2, pp. 351-362, April 2017

2) **Examples of contexts that you plan to use the technology during the project**
   a) Room localization of the intruder/people: walking in/out the rooms, walking inside the rooms
   b) People counting in any room of the considered building or in specific (user selectable) rooms of the test house
   c) Activity recognition: identify body shape (identify the size of the human body blockage), gait walking speed: activity identification, example: fall detection
   d) Passive localization of one or multiple operators sharing the space with a robot inside a collaborative industrial environment (human-robot shared workplace)

3) **Examples of contexts that you think the technology will be helpful or useful for in the future**
   a) **Elderly care and assisted living**. Mobility, life, or motion patterns monitoring. Application in the field of remote monitoring of patients: passive, unobtrusive collection of data to associate the lifestyle with the risk of developing/progressing chronic diseases. The technology can be embedded in remote health monitoring devices, unobtrusive not requiring the subject to wear any radio tag. Sends notification to the cloud and push alerts to the subscriber and ISP for intervention.
   b) **Analytics.** study people movements in the environment, understand their behaviour to enhance service quality and push notifications and specific services to customers.
   c) **Home security and smart home**. Home security only through WiFi. Advanced: remote control of appliances, 2D/3D User Interfaces that allow users to interact with the environments in 2D/3D dimensions).
   d) **Home automation and energy management**. Monitor user behaviour in the building automatically manage the utilities in the building. Control building automation by simply detecting people movement and location and by analysing people behaviour

e) **Industrial.** Monitoring the safety of a worker while sharing the space with a robot (fenceless space). Monitoring the distance between the worker and the robot. Advanced: gesture and activity recognition: detect operator motion intentions.
f) **Vehicular/Autonomous Vehicles.** Car safety interior monitor/driver warning systems (driver activity recognition inside the car).

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