



## D6.8 Results from Appropriation Study

TWE & ADANT

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## Executive Summary

This report addresses the results of the appropriation study conducted as a part of the European Innovation Council HOLDEN grant. This appropriation study took the form of an interactive exhibit that was hosted at five locations between March 2025 and April 2026. Results and analysis of the first three locations (all in Enschede, the Netherlands) are published in D2.3 “Privacy Analysis and User Requirements on the Societal Implications of RF Sensing.” This report adds in the data collected from the Deutsches museum in Munich Germany, which had 234 participants – 93 of whom fully participated, responding to all 20 of the primary quantitative questions – as well as the data from Politecnico in Milan, which had 64 participants with 12 having fully participated.

This report uses the exhibit to uncover critical concerns about radio-frequency holography technology directly derived from public feedback. Some of these issues are *perceived* risks or concerns that may be assuaged with increased knowledge of the technology. Other concerns relate to the *capabilities* of RF sensing itself. And more, further relate to the components and algorithms surrounding the technology (their technical, algorithmic, and regulatory ecosystem). Data from the exhibit also demonstrate that context is important when addressing the ethical considerations of the technology. Just because a technology is not concerning in one context does not mean that it would be untroublesome in another.

This report seeks mitigation strategies for each critical issue presented for each application. Some of these solutions are technical in nature, while others are more regulatory or require non-technical solutions. Each mitigation measure is presented with a resolution status, so that as the technology develops issue amelioration may be tracked. Finally, the report compares how HOLDEN technologies along with their critical concerns and mitigation strategies stack up against competitor applications. (This comparison understandably is derived from only surface level observations as the consortium lacks access to the private research and development of competing technologies.)

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# 1. Introduction

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## 1.1. Background and Goals

The goal of the HOLDEN (Ethical Design of Holography with Dense Wireless Networks) appropriation study was to determine how the public would use, interact with, feel about, and refuse the radio-frequency sensing technologies developed within the HOLDEN project. These insights would inform potential pitfalls of the technology, redlines that should not be crossed, and design decisions to build ethical and socially sustainable systems. Given that the final forms of the innovations were not (and still are not) yet set in stone, we had to determine a methodology that would allow for both quantitative and qualitative analysis on the impact and societal implications of the technologies without access to high fidelity physical prototypes. We also assumed that different people would have varying dispositions towards the technology due to their background, age, profession, etc. Therefore, it would be useful to reach a larger group, which might not be possible with a traditional appropriation study, especially considering that we wanted to gather information on *three* potential innovations: Wi-Fi Care, Smart TVs and Person Object Detection. It was ultimately determined that most goals would be met by building an interactive exhibit to garner public opinion about the HOLDEN innovations and Radio-Frequency Sensing more generally. Once the format of an exhibit was chosen, our goals expanded to include informing the public about RF-sensing technology and HOLDEN research.

## 1.2. Exhibit Methodology and Concerns

The This is Not a Camera (NACE) exhibit<sup>1</sup> was led by the University of Twente group within HOLDEN with the help of two student assistants. Depending on the location, exhibit panels were sized up or down and text was available in either only English or English and the local language. Each exhibit (See **Appendix B** for the posters from the Munich exhibit) consisted of 16 posters which, in simple language, described how the technology works, current capabilities of the technology, and the HOLDEN future innovations (Wi-Fi Care, Smart TVs and Person Object Detection) framed as having already been on the market for ten years. The decision to frame the innovations as having already been embedded in society was based on our research on Techno-moral Scenarios [1]. A fundamental insight from this research is that when a technology is first introduced the morality around it is still “hot” like molten metal before being chilled into an unbreakable steel beam. Later, society (and morality) reshapes itself around the technology with *can* implying *ought*. For example, we only *ought* to save a life by shocking the heart with an AED because it is a possibility – without the means to enable a task there is no urgency to do so. Technology reshapes moral agency. We

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<sup>1</sup> The acronym of the exhibit organically shifted since deliverable 2.4 “Privacy Analysis and User Requirements on the Societal Implications of RF Sensing,” but we refer to the same exhibit here.

wanted participants to imagine how the morality had reshaped due to the technology with the insights of current day.

The exhibit begins by informing visitors that all exhibit interactions are used for HOLDEN research led by the University of Twente. At the start of the exhibit (See **Figure 1**), patrons, if they choose to *interact*, pick up a “helper board” that includes a clip for a set of unique stickers to track individual interactions across the exhibit, a pen, and sticky-notes. Visitors use the board throughout the exhibit, then at the end, throw-out their remaining stickers and return the board.



**Figure 1 Start of NACE at Deutsches Museum with Helper Boards**

The exhibit contains five interaction types, which allow for insights on preferred capabilities and innovations, as well as opportunities to express both fears and dreams regarding the technology:

- **Sliders** – Place a sticker on a scale (for example creepy to cool) (See **Figure 2**)
- **Yes/No Boxes** – Drop a Post-It with your reasoning in the yes or no box (See **Figure 2**)
- **Multiple Choice** – Place a sticker in all of the boxes that you agree with (See **Figure 2**)
- **Wi-Fi Care Form** – Form for Wi-Fi Care data sharing preferences (See **Figure 3**)
- **Bulletin** – Affix a Post-It with your thoughts (See **Figure 4**)

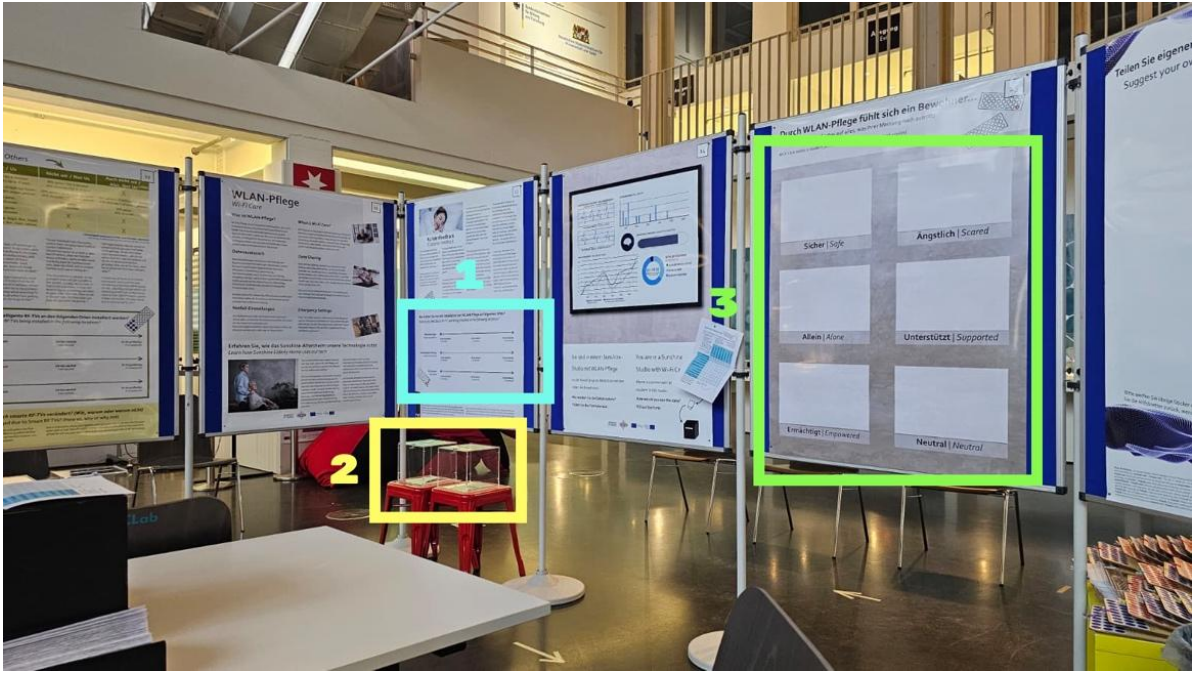


Figure 2 Interactions at Deutsches Museum (1 Sliders, 2 Yes/No Boxes, 3 Multiple Choice)

**Wi-Fi Care Preference Form**

Optional: Place a sticker OR add your sticker # and ✓ the color  
Purple  Blue  Orange

Choose ONE use case to fill out the form for:

An elderly friend or relative living at Sunshine Elderly Home with you as the legal representative

Yourself living at Sunshine Elderly Home as an elderly resident

Yourself living in a smart home with Wi-Fi Care

**Who should have access to which of the resident's data?**  
check ALL that apply

	Breath Rate	Heart rate	Sleep Tracking	Mental Wellbeing	Physical Wellbeing	Cognitive Function	Sudden Injury	Unconsciousness
Resident/Patient	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doctor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Relative(s)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Advertisers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Insurance Company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
WIFI Care Company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Researchers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Law Enforcement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The Person or Organization Paying for the System	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

This form will be used for research on how people would use Wi-Fi monitoring technology!  
Submission is optional!

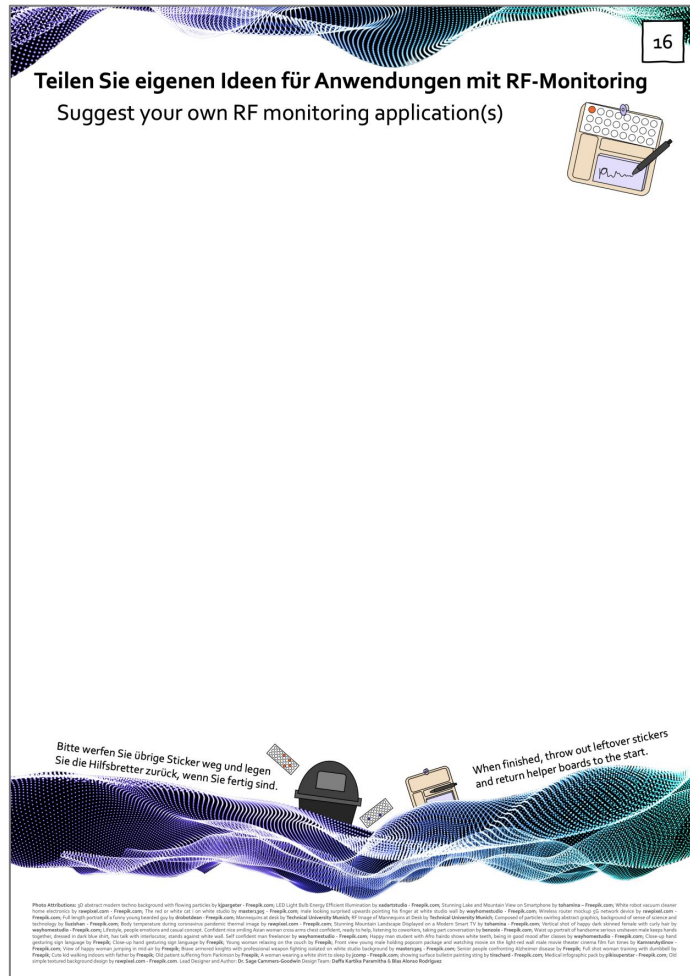
One more question on the back...

Submit this form in the box:

How will Wi-Fi Care data affect the resident's life?

English

Figure 3 Wi-Fi Care Form Front and Back




**Figure 4 Bulletin Interaction**

Visitors of the exhibits followed a clear path, beginning with two Sliders to rank *how they feel about Wi-Fi in their home* and then *how they feel about 5G towers* to get a sense of their perception of radio-frequency waves. In the following section panels informed how Wi-Fi works followed by an explanation on the basics RF-Sensing. Next, participants could rate on a Slider *how much of the information they already knew*. Subsequently, participants were asked to share the extent to which they found capabilities of Wi-Fi monitoring horrible or awesome (in some versions the scale was creepy to cool, which was later adjusted for clarity across languages, but led to similar results). Finally, patrons were asked to envision Person Object Detection, Smart TV, and Wi-Fi Care as if it was 10 years in the future and to rank with Sliders how horrible to awesome (or creepy to cool) each innovation would be in three scenarios ranging from public spaces to their home (**Figure 5**). For each of the innovations there were also Yes/No Boxes to share whether or not society changed due to the technology with the opportunity to write how so, why or why not. The Wi-Fi Care section of the exhibit additionally had Wi-Fi Care forms to delineate data sharing preferences and a Multiple-Choice panel to vote on how an elderly care resident would feel living in a space that used this technology. The exhibit ended with the opportunity to share other potential applications of RF-sensing on a Bulletin.

Smart (RF) TV


"Sure, lots of competitors have integrated RF wave monitoring technology, but we do it best!"

#### User Identification




Every person is unique, and we recognize that. Save up to six user profiles and Smart TV will go to the correct profile for individual watching.

#### Gesture Recognition




Our AI software offers gesture recognition and even sign language detection! Sign basic commands and the TV will respond accordingly.

#### Activity Recognition




Fell asleep while watching? The TV will shut off and note when you fall asleep. Left the room? Don't worry the TV will pause until you return.

#### Interactive Watching




Follow workouts and get technique tips! Game hands-free and develop your own gesture or movement controls!

#### Emotion Recognition



By measuring heart and breath rate we can develop an emotional profile to better recommend (and make) movies.

#### Always Improving



Our system is constantly learning from you and your family. Accuracy improves over time as the TV adjusts to its new environment and users!

#### Us vs. Others

*\*Accuracy is determined by over 1000hrs of tests in our lab*

	Us	Not Us	Also, Not Us
User Identification	90% Accurate   Up to 6 users	80% Accurate   Up to 4 users	X
Gesture Recognition	85% Accurate   30+ unique gestures	80% Accurate   25 unique gestures	85% Accurate   10 unique gestures
Sleep Detection	95% Accurate	90% Accurate	90% Accurate
Posture Recognition	85% Accurate	X	X
Emotion Recognition	85% Accurate: joy, fear, anger, sadness	X	X

#### What our customers say

"My daughter is deaf, and we wanted her to be able to use a smart TV that does not rely on voice controls. For basic navigation and requests it works great - she has figured out how to sign clearly for the TV to understand!"

"My doctor says I spend too much time sitting. It is nice that the TV tells me to stand in between shows and has alerted me to my problem of falling asleep while watching TV. Now it shuts off when I am getting tired and tells me to go to bed."

"Our household is 7 people, so my youngest does not get a profile in the system. Luckily, he is 3 now so that is not a problem, but we will have to figure something out when he gets older. For now, they can be a "Guest" user, but that does not fully sit right with the family."

"I used one of these at an Airbnb last month and could not stop wondering if the hosts were spying on me...like they can see what I am watching and if I am in their living room or not, right?! I mean, I guess it does not matter, it's their home, but it's kind of weird, no?"

#### How do you feel about Smart RF TVs being installed in the following locations?

Supermarket

← Creepy | I am neutral | Cool →

Your Hotel Room

← Creepy | I am neutral | Cool →


Your home

← Creepy | I am neutral | Cool →

#### Has society changed due to Smart RF TVs?

**VOTE YES OR NO**  
(How so, why or why not)

Use a notepad to share your opinion and cast your vote. Ethics in HOLDEN will use your response to build requirements for ethical RF technology.



**Figure 5 Smart TV Application NACE Panels**

NACE allowed individuals to opt in or out of the study at their own discretion without external pressure. All submissions were anonymous as researchers could only trace the sticker number and color, which could only be tracked back to the individual if someone kept track of that information and chose to share it publicly. Additionally, all shareable data was given a new ID so people who use the dataset cannot trace it back. The exhibit underwent ethics review procedure and approval at the University of Twente (the approval is included in the HOLDEN Ethics Status Monitor D8.13). The consent method is considered tacit as there is no formal written or verbal consent required to participate. This was justified because the exhibit was only hosted in public or semi-public spaces, where people knew, even without reading the exhibit information, that their contributions would be seen. If anyone contributed to the exhibit without reading about the study (which granted them permission and instructions on how and when to apply stickers to the boards), they would be vandalizing the exhibit and aware that they are interacting with an artifact that can and will be seen by others. We were unable to collect demographic information as we were concerned about potentially personally identifiable information being collected with only tacit consent. We did not want participants to be traceable at less frequented exhibit sites, especially in community spaces, where people may know each other.

There was the risk (and it turns out a reality) that some participants would randomly place stickers throughout the exhibit and not read the posters. Notations were made in the dataset when people placed multiple stickers in response to a single question. It is likely that multiple stickers can be explained by some groups deciding to do the exhibit collectively with one helper board, thereby placing multiple stickers on one interaction. We also were unable to monitor whether people

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interacted with the exhibit multiple times (one individual frequenting the exhibit each time with a unique sticker set), therefore it is important for the data to be looked at holistically as people were not supervised during participation. Especially for participants who lacked any prior knowledge on the technology it is quite possible that their interactions were biased by the framing shared on the posters. Therefore, it is important to assess the study results in tandem with the information presented on the posters, which are presented in **Appendix B**. Future research should consider reframing the innovations and analyzing if positivity scores vary.

As of May 2026, the NACE has been hosted in five locations encompassing Enschede, the Netherlands, Munich, Germany and Milan, Italy (see **Figure 6**). There are a total of 379 unique participations (which correspond to unique sticker sets) 155 of which met the criteria of “perfect” data and are included in the analysis of this report. We were able to parse “perfect” participants from the *rest* by selecting participants who did not skip or place multiple stickers on any of the Slider questions. Additionally, a total of 113 Wi-Fi Care Forms were submitted across all exhibits, 86 of which answered the short form question “How will Wi-Fi Care data affect the resident’s life?”

All data was processed by humans to digitalize results. Slider data was bucketed into 11 evenly sized pockets (0-10) based on where stickers were placed. Placing stickers off the scale of sliders was not uncommon, which accounts for responses less than zero and greater than ten.

Location	Dates	Participation		Notes   <b>Language</b>   Poster Size
		Total	Perfect	
TWE Design Lab Enschede, NL	27/3- 28/4 2025	20	9	Design and workspace for students with frequent events (No Yes/No Boxes or Wi-Fi Care Forms as the space was too small)   <b>English Only</b>   A3
Tankstation Enschede, NL	1/4- 25/4 2025	45	31	Alternative community space with strong activist culture, hosted at entrance where art exhibits are usual displayed   <b>English and Dutch</b>   A0
Tetem Enschede, NL	2/4- 7/4 2025	16	9	Creative, artsy and technical space, but the exhibit was a bit hard to find   <b>English and Dutch</b>   A0
Deutsches Museum Munich, DE	7/2- 22/2 2026	234	94	Largest science museum in the world, exhibit hosted downstairs in a rotating collection space, only location with a demonstrator and video with the palliative care example   <b>German and English</b>   A0
Politecnico Build. 13 Milan, IT	7/4- 21/4 2026	64	12	Technical university, exhibit hosted in an atrium frequented between classes, The posters became full quickly and some data might be missing due to overlap   <b>English Only</b>   A1

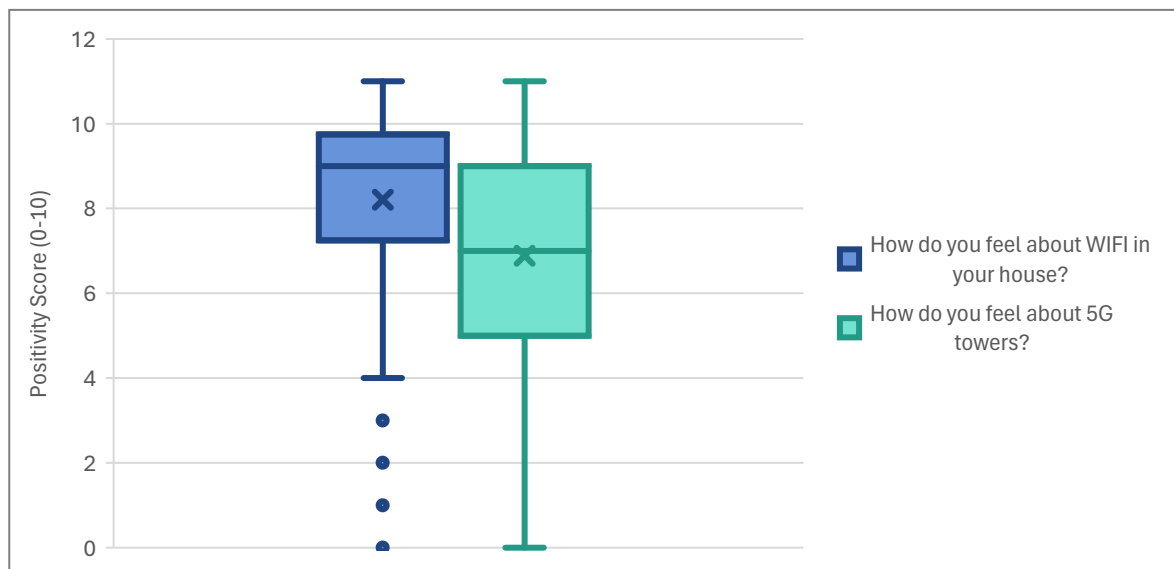
**Figure 6 Exhibit Overview (“Perfect” Means None of the Slider Questions Were Skipped)**

## 2. General Results Overview

This section generalizes results from the exhibit that are helpful for understanding the public’s reception to HOLDEN technology and informing design insights. All charts and analysis here use the “perfect” data explained in **Figure 6**. This section uses *box and whisker plots* to visualize data from NACE. For those unfamiliar, these plots show the min and max value, lower quartile, median, upper quartile and max. Additionally we have included an ‘x’ symbol to indicate mean. This section also uses *scatter plots* which allow for the comparison of two values. *All scatter plot points indicate a single individual respondent* and compare two values relating to that individual (for example their average positivity towards an application such as Wi-Fi Care in three contexts and the standard deviation between their votes for each of those three contexts.)

### 2.1.1. Wi-Fi Positivity and Pre-Existing Knowledge

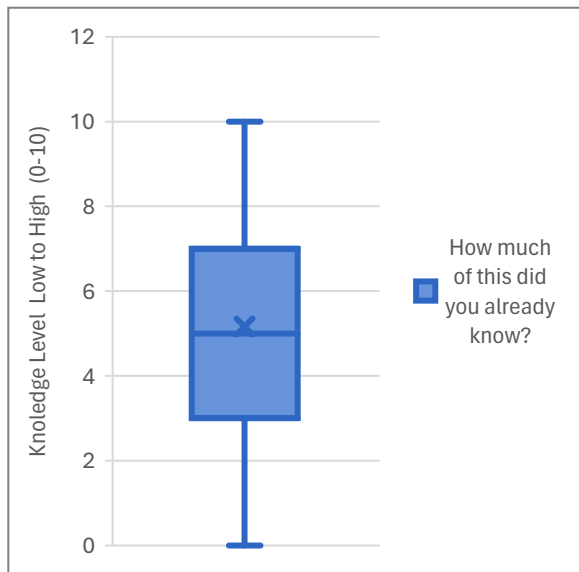
Given that HOLDEN technology is dependent on dense radio-frequency waves, it is important to have an overarching sense of perception of radio-frequency networks. **Figure 7** is a box and whisker plot showing a side-by-side of how participants ranked Wi-Fi in their home versus 5G towers. Across exhibit locations, participants found Wi-Fi in their home much cooler/more awesome than 5G towers. Although participants were not directly asked why they felt more comfortable with home Wi-Fi, it could be that they have a sense of control over the system and the direct benefit is tangible. Conversely, 5G towers not only look unseemly, may not be fully understood by the public who were content with prior generations of telecommunication infrastructure. Public discomfort and misunderstanding of 5G is also evident by public protest and destruction of 5G towers especially during the height of the Covid-19 Pandemic [2].



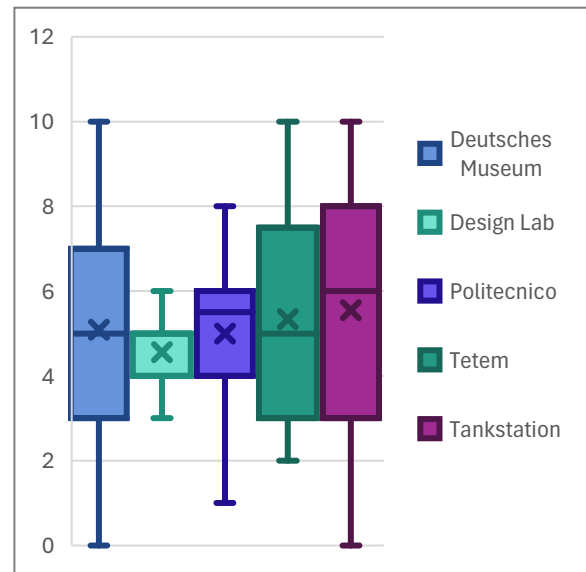
**Figure 7 Wi-Fi and 5G Tower Positivity Ranking**

Although direct demographic information was not collected, NACE did ask how much pre-existing knowledge visitors had on the subject of how Wi-Fi and RF sensing work. At almost all locations there was a range from those who knew very little on the subject to those whose knowledge

surpassed the information shared in the exhibit (**Figure 8**). The Design Lab location was the exception with a smaller, more humble range of results (**Figure 9**).

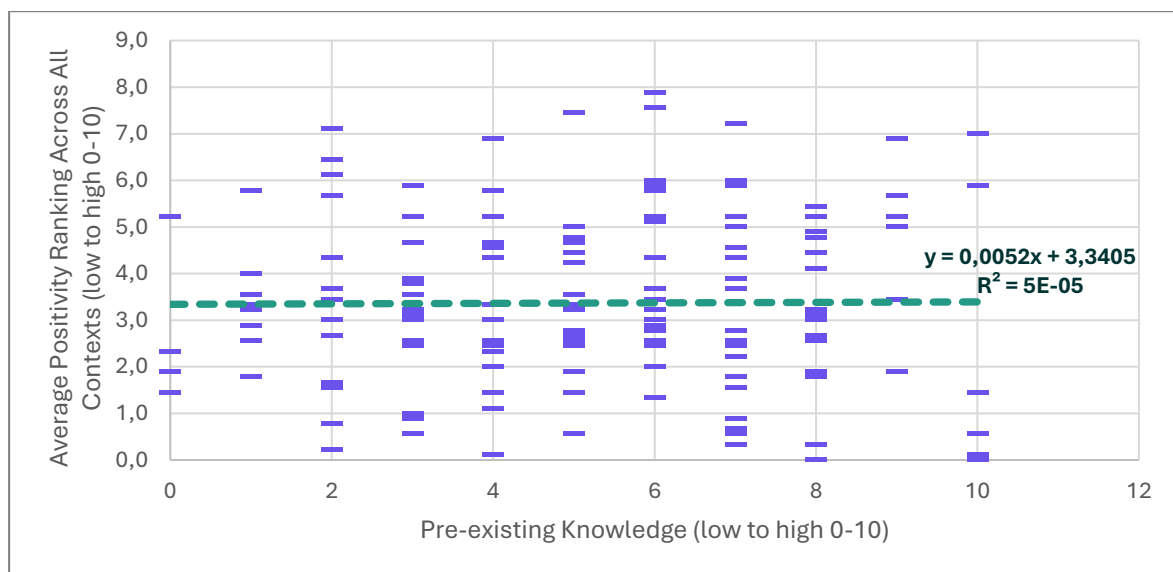


**Figure 8 Pre-Existing Knowledge Combined Results**



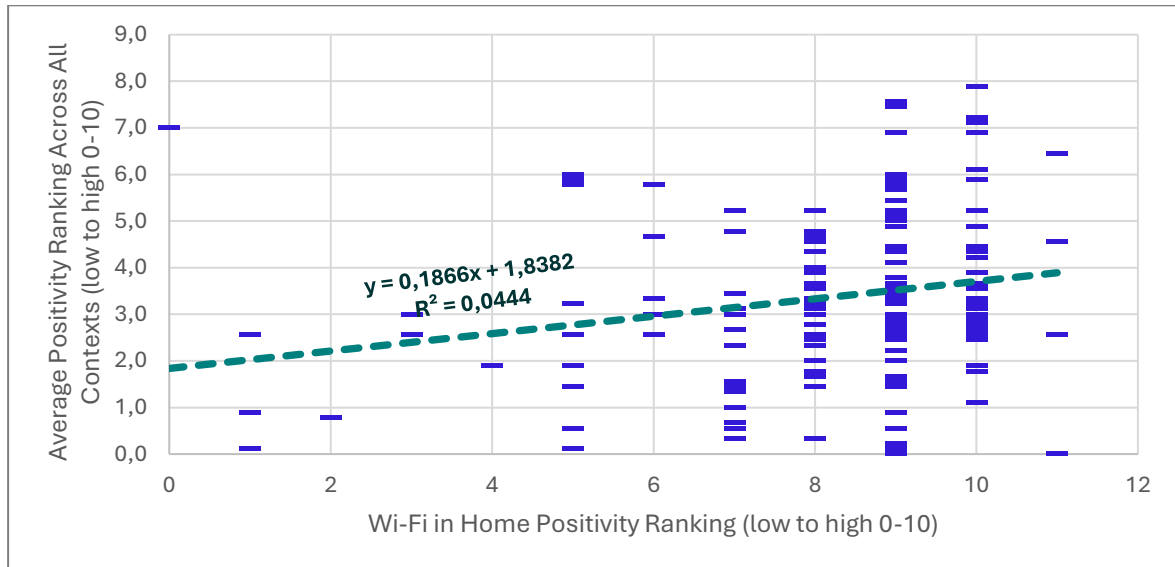
**Figure 9 Pre-Existing Knowledge on Wi-Fi and RF Sensing by Exhibit**

Interestingly, there was no significant relationship between pre-existing knowledge on RF-sensing and whether or not participants found the innovations of Person/Object Detection, Smart TV, and Wi-Fi Care as cool or awesome. Regardless of pre-existing knowledge, people on average ranked Person/Object Detection, Wi-Fi Care and Smart TVs scenarios at about 3.3 (from 0 to 10 where 0 is most creepy or horrible and 10 is more cool or awesome) with a high variance, meaning that someone with little background on the topic had about as much likelihood as someone with more knowledge to rank the use cases positively or negatively (**Figure 10**).

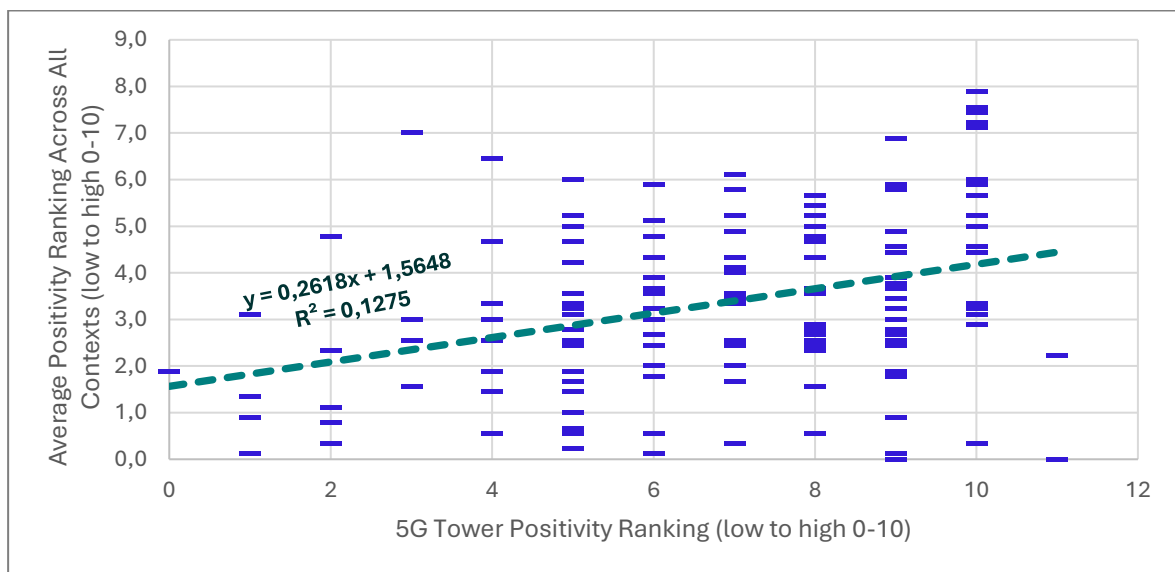


**Figure 10 Individual Respondent Pre-Existing Knowledge and Overall Average Positivity on Applications Across Scenarios**

Proclivity to Wi-Fi in home and 5G towers had a stronger correlation with how an individual ranked the applications in different contexts (see **Figure 11** and **Figure 12**) than pre-existing knowledge, but not strong enough to be able to predict individual preferences towards HOLDEN innovations. The less favourable Wi-Fi and 5G towers were perceived, the less likely other applications were to be viewed positively, but again, the relationship was weaker than hypothesized.



**Figure 11 Individual Respondent Wi-Fi in Home Ranking and Overall Average Positivity on Applications Across Scenarios**

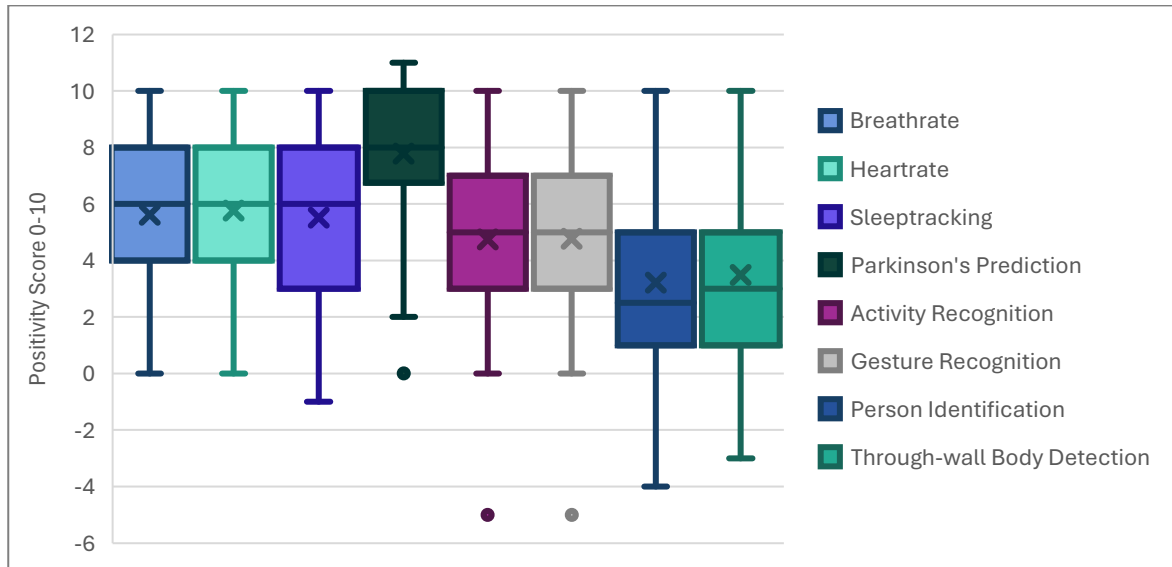


**Figure 12 Individual Respondent 5G Tower Ranking and Overall Average Positivity on Applications Across Scenarios**

### 2.1.2. RF Holography Capability Preferences

When asked about the capabilities of RF-wave holography, Parkinson’s Prediction was consistently a top preference while Through-wall Body Detection and Person Identification were less favorable (See **Figure 13**). This is an interesting finding given that all of these capabilities can be viewed as

invasive. It might be that Parkinson’s Prediction is a solution to an existing problem, whereas through-wall body detection and person identification may seem to further contribute to privacy related issues. Breath rate, Heart rate and Sleep tracking also ranked relatively higher. Following this logic, these cases also solve a problem, providing potentially helpful data without wearables which may be cool enough to outweigh the potentially creepy nature of the technology.



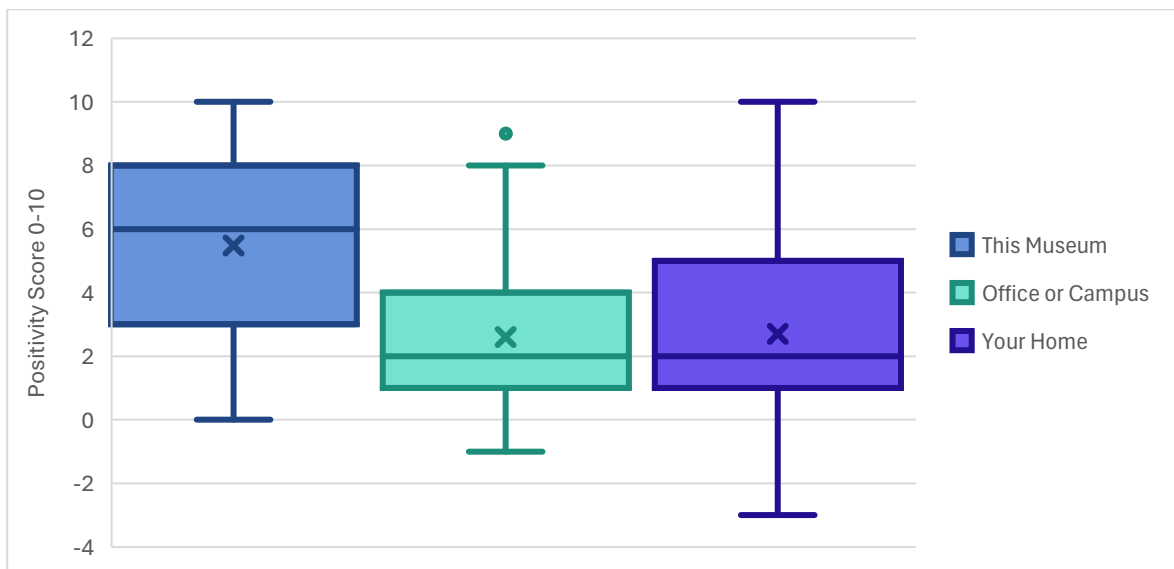
**Figure 13 Positivity Scores for RF Sensing Capabilities Across All Exhibits**

### 2.1.3. Person Object Detection

The findings suggest that Person Object Detection is perceived as a powerful but ambivalent technology whose acceptance depends strongly on how it is implemented, contextualized, and governed. **Figure 14** shows for each individual respondent (from the “perfect data”) their average disposition towards Person Object Detection in all contexts and its corresponding standard deviation (the extent to which their choices varied). Given that most standard deviations are above two, there is demonstrable evidence that context matters for *most* individuals regarding how and where RF-Person Object Detection is implemented. Simultaneously, there are clusters with consistent perspectives for the three contexts (low standard deviation), especially for those with a strong disfavor the technology. **Figure 14** is evidence of how independently driven perspectives are of the technology. A more general societal outlook is captured in **Figure 15**, which shows the overall combined results across exhibits –the museum setting was preferable to an office or campus as well as the home setting.



**Figure 14 Average Individual Person/Object Detection Positivity Score Across Three Contexts and their Standard Deviation for Each Exhibit**



**Figure 15 Positivity Towards Person/Object Detection in Three Scenarios from All Exhibits**

To better understand participant perspectives, we analyzed the Yes/No results, which asked whether or not Person/Object Detection would change society, why or why not. Participants recognize its potential to contribute to safety, efficiency, and new forms of insight, particularly in domains such as emergency response, security, and health related monitoring. At the same time, its reception is shaped by recurring concerns that point to important design and deployment conditions.

First, the technology is expected to influence behavior. The possibility of continuous or ambient detection can make individuals more cautious or self-aware in monitored environments. As one participant noted, “everyone would be more cautious if they were being observed.” Another respondent stated that “the feeling of being able to be monitored without seeing any technology behind it changes people’s behavior.” While some viewed this as potentially useful in contexts such

as public safety or risk prevention, others feared that everyday life would increasingly retreat into protected private spaces. These responses suggest that Person Object Detection requires clear contextual limitations and carefully defined spatial boundaries regarding where and under what conditions sensing is acceptable.

Second, participants express concerns about privacy and autonomy. Because RF-based detection can operate without line of sight and across walls, it extends sensing capabilities into spaces traditionally less accessible to monitoring technologies. This raises questions about consent, acceptable use, and the ability of individuals to meaningfully opt out. One participant described the technology as creating a “new way to be tracked,” while another remarked that “you are more ‘seen’ than you know.” At the same time, several respondents implicitly contrasted the technology with camera-based systems, suggesting that nonvisual sensing may be less invasive if carefully constrained. This indicates that privacy-preserving implementation strategies, local data processing, limited data retention, and explicit consent mechanisms could significantly shape public acceptance.

Third, transparency emerges as a key condition for acceptance. Participants were often less concerned with sensing itself than with uncertainty surrounding data flows, system control, and future uses of the technology. One respondent wrote: “you feel less secure when you can always be observed and do not know what is done with this information.” Others emphasized that the technology operates invisibly and “through walls,” making the scope of monitoring difficult to understand. Several participants therefore implicitly or explicitly called for clearer communication, stronger user control, and stricter limitations regarding access to and use of the data. These findings suggest that transparency must function not only as a legal requirement but also as an experiential feature of the system itself.

Fourth, respondents situate Person Object Detection within a broader landscape of existing surveillance technologies. Rather than being perceived as entirely novel, it is often understood as an extension or intensification of current monitoring practices. Several participants noted that surveillance already exists through smartphones, GPS, online platforms, and camera infrastructures. At the same time, respondents repeatedly warned against function creep and the normalization of mass surveillance. One participant wrote that “the biggest obstacle is useful processing, not more inputs,” warning that the technology could become substantially more intrusive as analytical capabilities improve. Another referred to the “panopticon effect,” while others raised concerns about increased policing, authoritarian misuse, or discrimination. Yet participants also proposed possible responses, including “more laws and regulations on surveillance tech,” clearer governance structures, and stricter limitations on where and how the technology may be deployed. These findings indicate that oversight, purpose limitation, and proportional deployment will be critical for ensuring socially legitimate use.

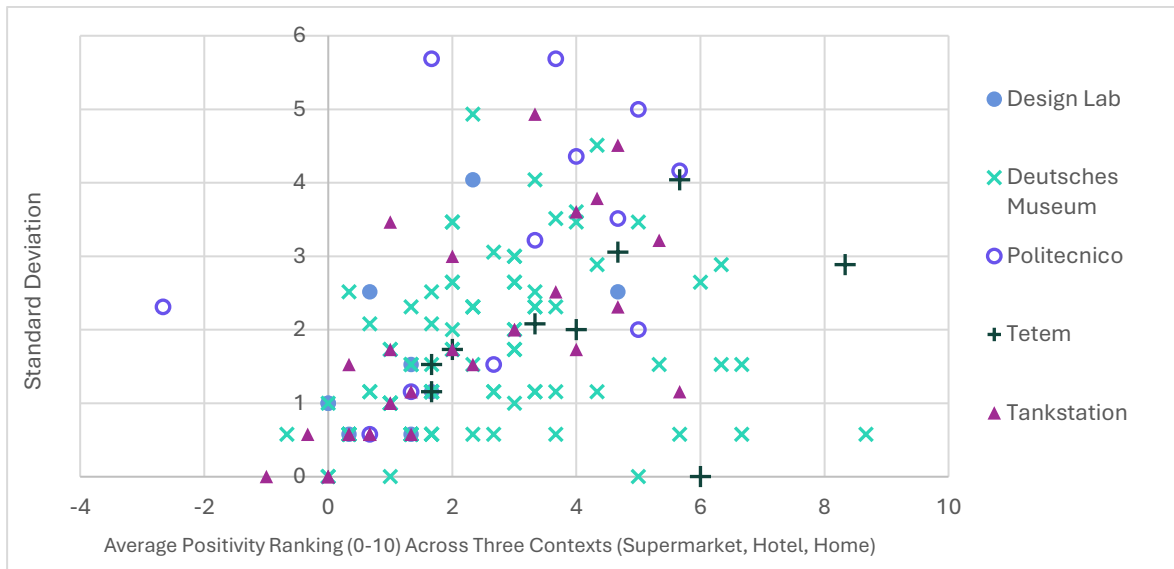
Finally, participants point to the open-ended and systemic nature of the technology’s societal impact. One participant asked, “Can we still go back if this path is not the right one?” while another warned that society may “trade freedom for security.” At the same time, some respondents acknowledged that the technology could be justified in high value contexts such as emergency response, military object detection, or healthcare related applications. These responses suggest that public acceptance depends not only on the technology itself, but on whether its use is

perceived as proportionate, necessary, and aligned with socially valuable goals. More broadly, participants recognized that the implications of the technology extend beyond individual applications and may gradually reshape social norms, institutional practices, and expectations surrounding monitoring and security.

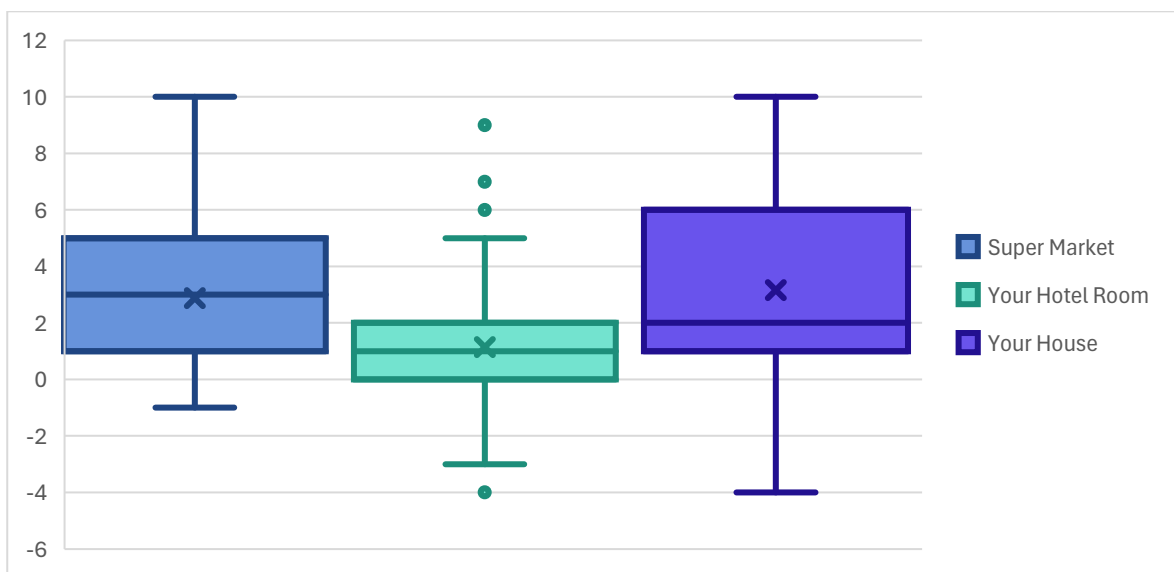
Taken together, the findings indicate that Person Object Detection can function as a valuable solution when it is narrowly and purposefully deployed in contexts where its capabilities address clearly defined needs. Applications related to safety, emergency detection, and health monitoring were more readily accepted, especially where the technology provides actionable insights without relying on intrusive visual surveillance. Its ability to operate without cameras can, under the right conditions, be perceived as a more privacy preserving alternative to existing systems. Participants particularly emphasized the importance of strict contextual boundaries, transparency regarding data use, regulatory oversight, and mechanisms that allow individuals to understand, contest, or opt out of detection. When these conditions are met, Person Object Detection is not merely seen as an extension of surveillance, but as a targeted and context sensitive tool that can address concrete societal needs while mitigating some limitations of current sensing technologies.

#### *2.1.4. Smart TV*

The data indicates that RF Smart TVs are perceived as a concerning and largely ambivalent technology, with responses skewing critical and acceptance appearing to hinge on questions of privacy, transparency, and personal autonomy. Although a minority of participants acknowledged potential benefits, most expressed apprehension about the convergence of media consumption, ambient sensing, and AI driven personalization within the home. **Figure 16** shows for each individual respondent (from the “perfect data”) their average disposition towards RF Smart TVs in the contexts of a supermarket, hotel room, and home with the corresponding standard deviation (the extent to which their choices varied). As with Person/Object Detection, *most* individuals changed their disposition towards the technology at least slightly based on the context of implementation yet there are clusters with consistent perspectives for the three contexts, again more for those who disfavor the technology. **Figure 17**, which shows the overall combined results across exhibits – individual preferences varied the most for whether they would want a RF Smart TV in their home but generally grouped for not wanting a Smart TV in their hotel room. In future research it would be worth examining the extent to which the framing of the technologies in the posters affects disposition – in the example provided someone was considering how much data an Airbnb host could gather about them from a RF Smart TV system (See **Appendix B** for poster panels).



**Figure 16 Average Individual Smart TV Positivity Score Across Three Contexts and their Standard Deviation for Each Exhibit**



**Figure 17 Positivity Towards RF Smart TVs in Three Scenarios from All Exhibits**

The most recurrent concern gathered from the Smart TV Yes/No data relates to privacy and data transparency. Many respondents framed the smart TV as a domestic surveillance device whose data flows remain opaque to users, raising questions about who has access to viewing and detection data and for what purposes. As one participant warned, "Transparent citizens and local surveillance: this could mean the end of value-based Western civilization." Such responses suggest that the social acceptability of the technology depends not only on what the device technically collects, but on whether its data practices are visible, intelligible, and contestable from the user's perspective.

A second cluster of concerns centers on autonomy and the sense of self. For several respondents, the gradual delegation of choice to an algorithmically driven system was experienced as an erosion of self-determination and even bodily awareness. One participant observed that "You lose more

and more of the sense for your own body and unlearn listening to and paying attention to your body's signals," while another stated: "The idea that the television decides is horrible. People are deprived of yet another ability of self-determination of their humanity." These responses point to a perceived risk that personalization shifts from supporting users to displacing their agency, and indicate that meaningful user control, rather than mere customization, is a central condition for acceptance.

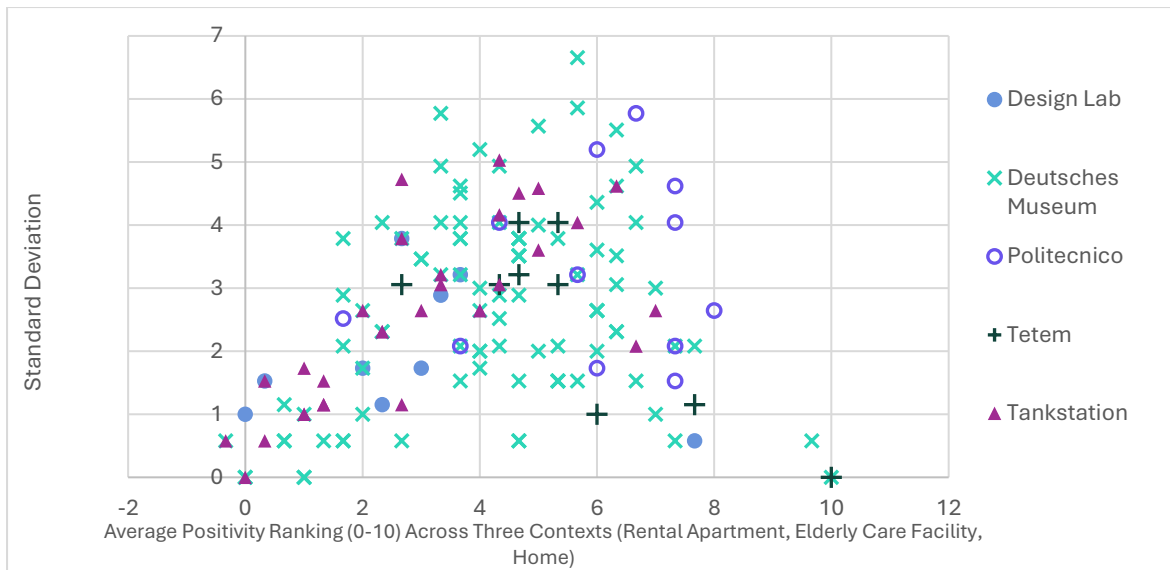
Beyond individual concerns, several participants situated smart TVs within broader cultural and societal trajectories. One comment connected the technology to a possible demographic decline driven by content saturation, arguing that "Smart RF TVs in combination with AI technologies lead to the drastic decrease in the fertility rate due to the loss of sexual drive due to the overload of media, video, games & augmented reality porn." Although idiosyncratic in its framing, this response reflects a more widely shared anxiety that immersive, algorithmically curated media may gradually reshape attention, intimacy, and everyday social life. The feeling of being constantly observed surfaced repeatedly across responses, suggesting that the home, traditionally understood as a protected private space, is increasingly perceived as a site of ambient monitoring. In response to these concerns, several participants emphasized the need for stronger regulation to prevent smart TVs from becoming a new layer of pervasive surveillance. Calls for clearer rules, oversight, and meaningful limits on data collection recurred across responses, indicating that legal and institutional safeguards are seen as a necessary complement to, rather than a substitute for, transparent design practices.

A minority of respondents adopted a more moderate stance, acknowledging potential benefits of the technology, such as accessibility features and support for people with cognitive impairments. These voices, however, remained the exception. There is a tendency to view the smart TV more positively when it is placed in a domestic setting, where users have greater direct control over it.

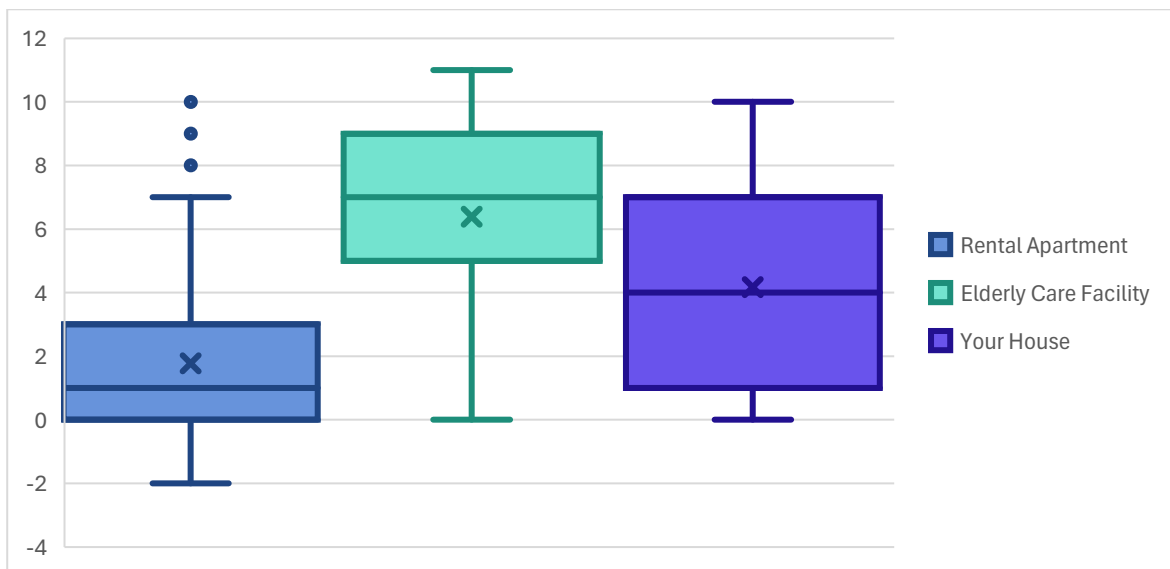
Taken together, the findings indicate that smart TV technology is currently perceived less as a neutral consumer product than as an emerging surveillance infrastructure embedded in the home, whose acceptance will depend on whether industry and regulators can credibly address concerns about transparency, autonomy, and proportionate use.

#### *2.1.5. Wi-Fi Care*

Wi-Fi Care generated the most data out of the three innovations due to it having the most interactions (the Sliders and Yes/No Boxes as both Person/Object Detection and Smart TV, but additionally Wi-Fi Care Forms and the multiple-choice data about how a resident of a care facility would feel about living with a Wi-Fi Care System). **Figure 18** shows for each individual respondent (from the "perfect data") their average disposition towards Wi-Fi Care in the contexts of a rental apartment, elderly care facility, and their home with the corresponding standard deviation (the extent to which their choices varied). Similar to the other innovations, context mattered when it came to the desirability of the technology. **Figure 19** shows the combined results across all exhibits for Wi-Fi Care preferences in each context. Rental apartments were the least favorable and elderly care apartments were the most. The home scenario had the largest range from lower to upper quartile.

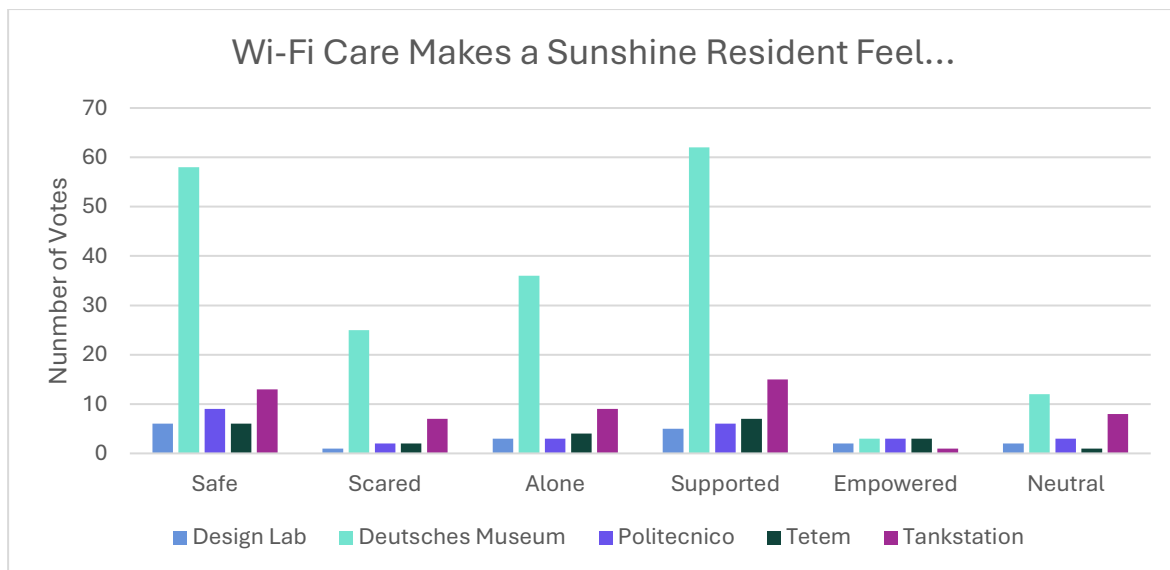


**Figure 18 Average Individual Wi-Fi Care Positivity Score Across Three Contexts and their Standard Deviation for Each Exhibit**



**Figure 19 Positivity Towards Wi-Fi Care in Three Scenarios from All Exhibits**

Our research gathered from the Wi-Fi Care NACE interactions has found that people recognize Wi-Fi Care as having the potential to improve healthcare for patients, while at the same time having the potential to reduce healthcare to data collection and management. Consequently, the benefit of Wi-Fi Care being able to, for example, reduce how much time healthcare professionals have to personally attend to patients is seen as both a gain and a loss. So, while people see Wi-Fi Care as possibly being able to improve the quality of care patients receive, people at the same time worry that it will reduce the quantity of care, leaving patients to feel more alienated and alone (See **Figure 20** for participant interpretations of how Wi-Fi Care would make an elderly care home resident feel).

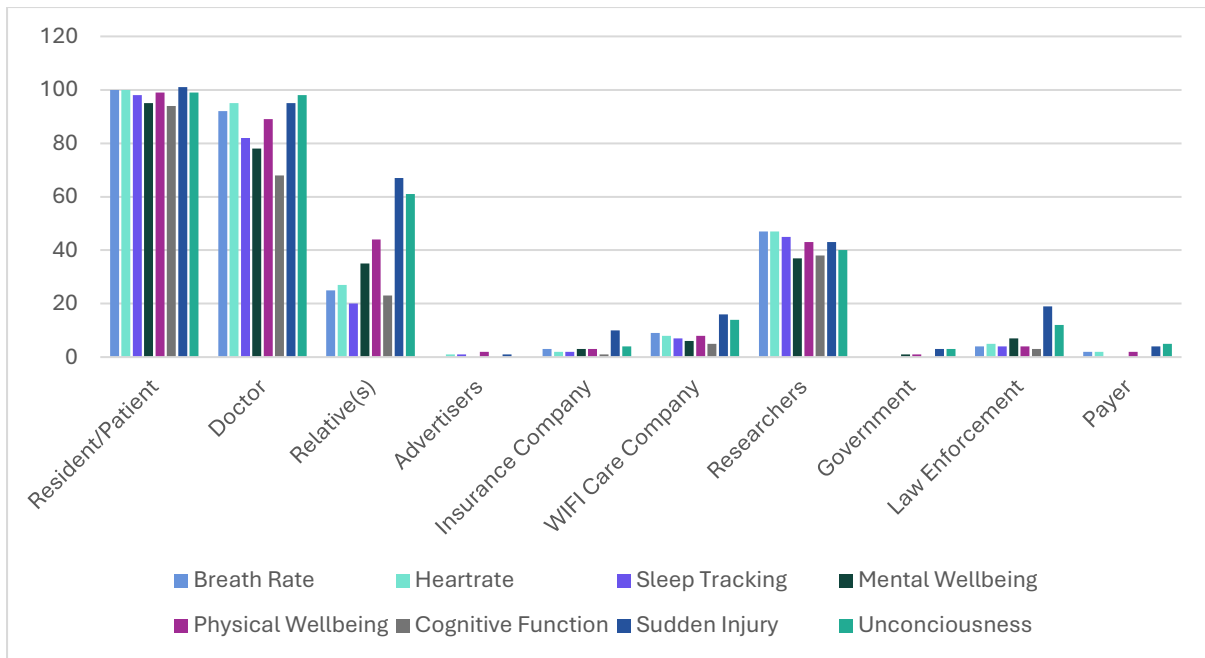


**Figure 20 Multiple Choice Votes: How Wi-Fi Care Would Make an Elderly Care Resident Feel**

On the positive side, people recognized ways in which Wi-Fi Care could be a benefit to medical research and practice, pointing out that it could produce “better health & research”; “better databases for medical treatments”; “better, more personalized care”; “faster response times”; “easily warning of diseases”; “reduced accidents”; and can make it easier for healthcare professionals to “track healthcare for vulnerable population.” Respondents also saw that Wi-Fi Care could improve safety and thereby even making families of patients feel better as a result. As one person put it, “As long as there is no dementia, the resident feels safe, and help can come in time. That maybe calms my conscience as a legal representative because I have placed my relative in the care home a little bit.” Similarly, another respondent noted that Wi-Fi Care allow families of patients to be more involved and “see what is really happening.”

Likewise, people responded that Wi-Fi Care could be a source of motivation for patients, as seeing their own healthcare data could have a feedback effect, leading patients to “live more healthily in order have good readings.” Another respondent pointed out that people without family members could also benefit as “if there are no relative, it is a good alternative for people in need of living alone (e.g., chronically ill, elderly, disabled) so that they do not have to move into a care home.”

On the more negative side, people were concerned about whether Wi-Fi Care would increase loneliness by leaving patients to be cared for by machines rather than people and would increase paranoia about who is collecting their data and what their data is being used for. At the same time there were concerns raised by a respondent who identified as a “nurse” that patients might simply not be able to understand the data as “people who currently live in care homes cannot do much with Wi-Fi”. Another major concern was whether Wi-Fi Care would end up raising the cost of healthcare and of insurance premiums. These concerns were reflected in the Wi-Fi Care forms, in which participants noted their data sharing preferences (**Figure 21**).



**Figure 21 Data Sharing Preferences for Wi-Fi Care Combined from All Exhibits**

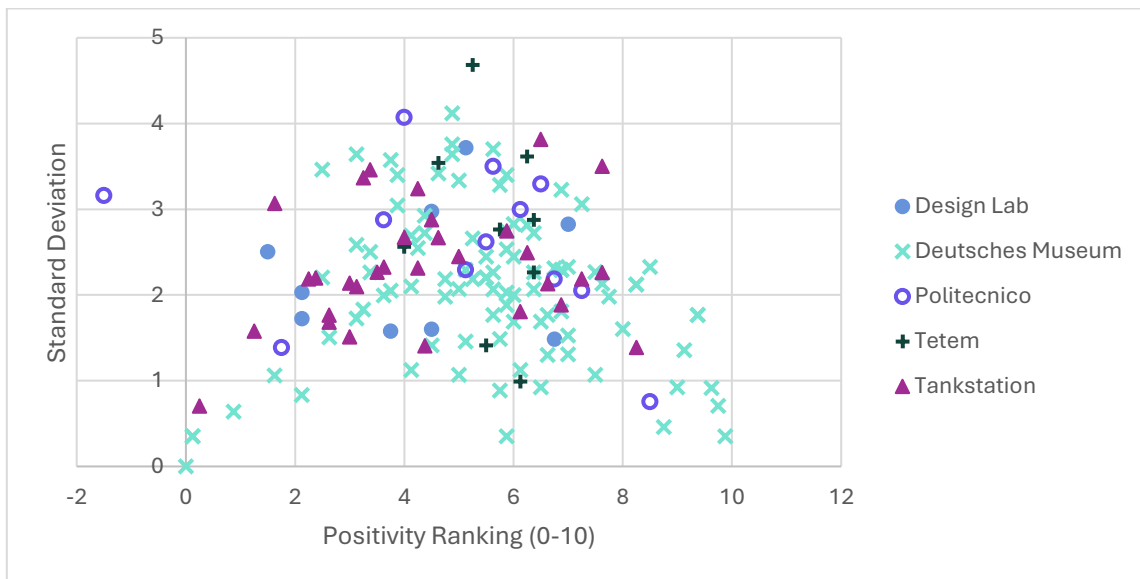
One respondent worried that “care will probably become worse” as a result of Wi-Fi Care, arguing “Care staff are overwhelmed by the amount of data or stop engaging with patients on an emotional level. Data are mainly misused by research companies and others to maximize profit. Good care would already be possible now.” Similarly, another respondent wrote: “Monitoring / control, the person becomes an ‘object’ that can be ‘conditioned’ through data like a machine. Humanity? Data protection? Personal rights? A false sense of security (my father is not visited but monitored). Errors / normal deviations in the data – who takes care of them? (staff) Fears are stirred up and reinforced.”

While concerns about how healthcare professionals and patients respond to Wi-Fi Care would be difficult for us to mitigate as they would be out of our control, there were concerns that are more directly related to the design of the technology, specifically regarding data protection, control, and access. Respondents feared that Wi-Fi Care could be a “major intrusion into privacy,” lead to “more surveillance in the surveillance state,” “data misuse,” selling of data to “advertisers” or “companies & research institutes.” There were also fears about government access to healthcare data, with one person worrying that “some regimes used as elderly home formed facilities to do cruel tests with the patients to measure extreme stress on bodies & how to trigger those with WiFi.” It is clear therefore that it is vital to find ways to reassure the public that data collected and used by Wi-Fi Care would be protected, anonymized whenever possible, and never used or sold without informed consent. Data must not only be under the control of patients but must also be made available to people in a way that they can understand.

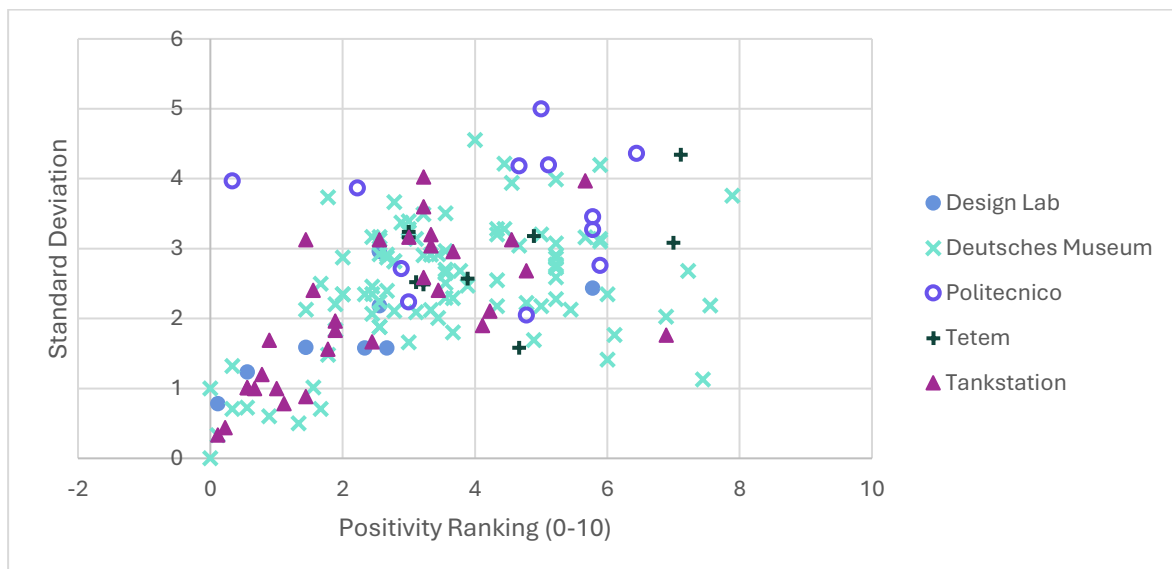
### 2.1.6. General Results Summary

Holistically, the appropriation study revealed some foundational insights. The study qualitatively shows that context matters for the majority of participants. This was true in all study locations and for each application. This can be seen by the relatively high standard deviation for each individual’s average rankings of RF sensing capabilities (See **Figure 22**) as well as each individual’s average

rankings for the three innovations across contexts (See **Figure 23**). Just because someone finds one capability of the technology cool does not mean that they support the technology holistically. Similarly, the technology being interesting and helpful in one context does not imply support of the technology in a different location or under different ownership.



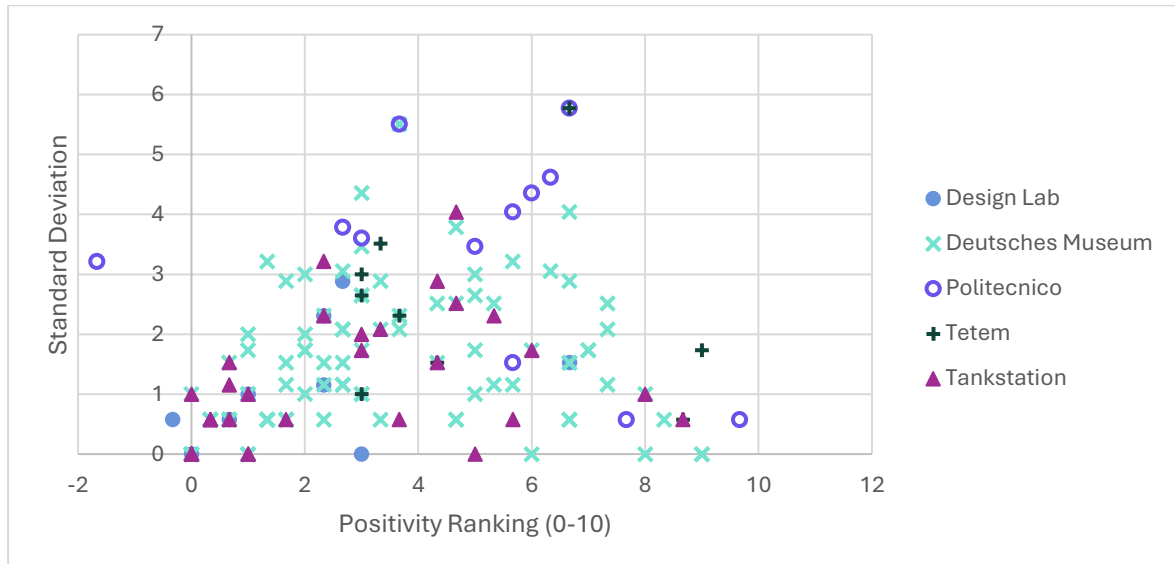
**Figure 22 Average Individual Positivity Score Across all RF Capabilities (Ex: Breath rate, Heartrate, Gesture Recognition etc.) and their Standard Deviation for Each Exhibit**



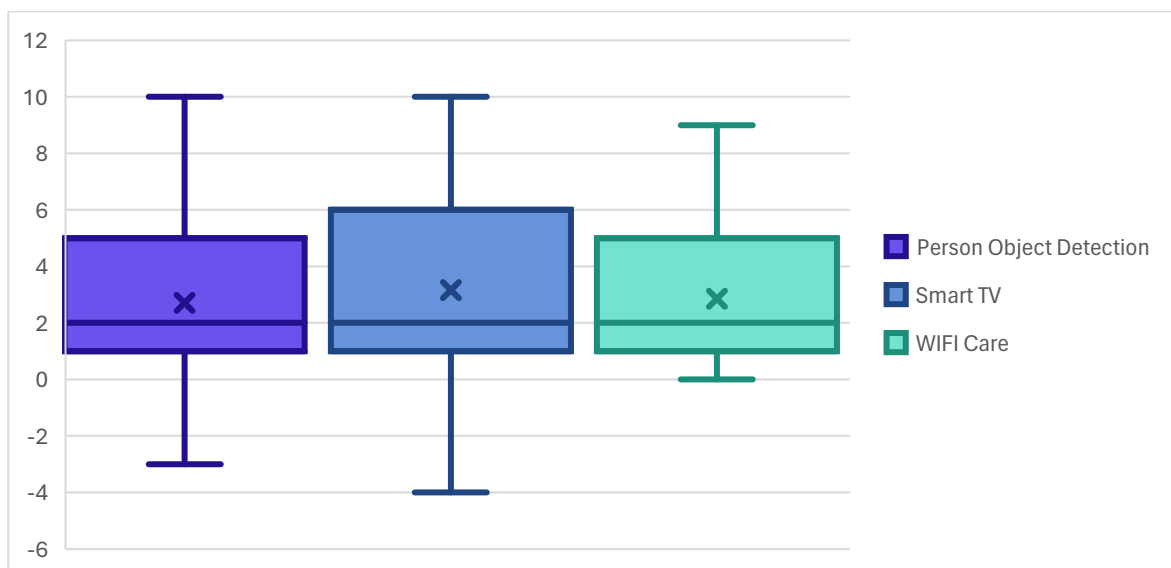
**Figure 23 Average Individual Positivity Score and Standard Deviation for P/O Detection, Smart TV, and Wi-Fi Care in All Scenarios**

For some participants it seemed that context was perhaps a more important factor on favorability than the innovation itself. Each innovation included a scenario where the technology was rated in the context of their home. The standard deviation of the average ranking of each individual's positivity scores of the three innovations in the home context were lower than that of any singular innovation across three contexts. More simply put, people were more likely to similarly rank their preference of Person Object Detection, Smart TV and Wi-Fi Care in their homes than any of those

applications in isolation in three different contexts (for example Smart TV in a grocery store, hotel, or their home). Interestingly, this is not because participants had similar preferences on the innovations in their home – individual views were more consistent but varied from person to person (see **Figure 24**). **Figure 25** directly compares all data from each exhibit for general preferences towards each use case in the home scenario not accounting for individual views.



**Figure 24 Average Individual Positivity Score and Standard Deviation for P/O Detection, Smart TV, and Wi-Fi Care in the Home Scenario**



**Figure 25 Positivity Towards All Three Use Cases in Own Home Setting from All Exhibits**

The study demonstrated that individuals were unique in their proclivity towards certain contexts and innovations. The home context makes this evident as some people were positive towards having the applications in their homes while others were adamantly opposed. A smaller study on a likeminded demographic, likely would have been unable to reveal the true societal disposition towards the technology. The NACE only ran in Western Europe, it would be helpful get feedback from individuals from other regions of the globe.

The importance of context was echoed in the responses from visitors who answered whether or not they thought that the innovations would change society. This suggests that the value of the technology shifts based on its appropriation and if the ends justify the means. The technology itself is not inherently valuable until it is effectively applied. Some applications might even have negative outcomes. What defines a negative or positive outcome may differ by individual. For example, multiple people were concerned about the technology being used to spy on them and encroaching on the private sphere, however those fears no longer mattered for some under threat of war or if the people being spied upon had, in their view, a more limited right to autonomy

*"I view the use of Wi-Fi in private areas as negative; in war zones and for military object detection, however, it may be necessary."*

*"Wi-Fi for everyone. Suggestions on the charts gladly for elderly people, sick people, people with disabilities and small children up to about 6 years old. Beyond that, surveillance is not acceptable. No independence and no private sphere."*

The importance of context leads to another essential finding: that moral values may be traded. In pursuit of increasing one essential value through the means of the technology it is possible that another is diminished. In the home scenario people can theoretically make their own choice about integrating a system into their space based on their own moral reasoning. (It is essential to note that most homes contain more than one individual, in the Smart TV case people viewed the home context more positively than the hotel context, meaning that the installer and controller will likely feel more comfortable than the other household members or guests who may not have a say in whether the device is installed). In the public sphere however decisions that affect society at large may be taken by the stakeholders with the means to produce, install, or approve of the technology, and not the general public.

*"Yes, people trade their freedom for "security"*

*"Negative cycle: Every functional device that brings us more security restricts our personal rights more and more. At the same time, we become increasingly anxious (someone is sneaking around in the garden: was it the cat or a person? False alarm?). Fear cycle."*

The exhibit also revealed that a portion of the participants understood or feared the unwieldiness of the technology. The complexity and interdependence of the technology allows for swift shifts in its capability, use and value. For example, a Person/Object Detection device alone would just contribute more data that could be analyzed for a specific purpose or in case of emergency, but once widespread and with increased processing power could become a mass surveillance device. Moreover, systems less related to surveillance could also shift slowly in function and be weaponized against users similarly to how many social media websites' main objective is to make money on advertisements by generalizing users and selling their data.

*"A little. An extension of mass surveillance. The biggest obstacle to them is useful processing, not more inputs. But once/if their processing ability improves, the more it will be a distinct worsening."*

*"No, technology should be used in a positive way, but there are also downsides, where it is easy [to be abused / to slip into something negative]."*

*"Yes. RF object detection has advanced various areas of research in health (social safety, personal tracking and surveillance (sadly))."*

Alongside those who felt that RF-sensing technology would make surveillance more ubiquitous and complex, several participants seemed to think that society has already reached a breaking point, and that the RF sensing would not add much new to invasive technology. Cited examples from participants included cellphones and cameras. Those who thought that technological surveillance is already the status quo were more likely to state that the technology would not significantly change society. This group also was more likely to observe that there are other innovations for Person Object Detection, Smart TV and Wi-Fi Care that do not use RF-sensing technology.

*"This can already be done today with cameras and is being done. The scenarios do not change because of RF."*

*"We are already in a surveillance world. Like it or not, our cell phones already can track us and can be used [...to] listen or see what we are doing. In 2035, it is just changing the way how things are done."*

*"Our location can already be determined with GPS/cell phones."*

*"Such surveillance is already possible through smartphones, which everyone carries with them (GPS, Bluetooth LE). It depends on regulation."*

*"They are just surveillance cameras."*

Lastly, many participants saw positives for the three innovations. For Person Object Detection people valued that it could be GDPR compliant by not capturing personally identifiable data, also that it may increase safety, especially if it was a less obtrusive way to sense or find dangerous objects (research still needs to be done to see if something like this would be possible). Smart TVs were seen as potentially helpful for those with disabilities or impairments as they could sign to the TV and the TV could adjust setting to their needs. The offloading of decisions to the TV was even a relief to one participant. Wi-Fi care had the most positive responses. It was seen as making healthcare more affordable, efficient, reliable, and evidence based. People saw the potential for residents to monitor and improve their health, predict illness and disease and be safer in emergency situations. Moreover, Wi-Fi Care was seen as a stress and guilt alleviator for friends and family of the patient.

### 3. Critical Issues and Resolutions by Innovation

Descriptive responses to each use case (Person Object Detection, Smart TV and Wi-Fi Care) were used to capture critical issues that should be resolved before final products are released on the market. Some of these issues are perceptual and might not actually be a concern, but still are worth addressing to decrease societal discomfort, while others may have a technical solution or require regulatory interventions. The issues addressed in this section are not exhaustive but represent the concerns of participants in NACE. To see the full unabbreviated table of the concerns and the corresponding quotations please see Appendix 2.

#### 3.1. Person Object Detection

Description	Origin	Severity	Mitigation Strategy	Status
People will <b>change their behavior</b> due to the feeling of being monitored and additionally not knowing the scope of the areas where they are being monitored. Especially in areas where cameras are typically not allowed such as bathrooms.	<u>PERCEIVED ISSUE</u> Due to awareness about invisible monitoring.	HIGH	Introduce strict legislation about where the technology is allowed to be installed. Adapt transparency system such as data register where people can find where system is installed, duration, how it is shared, and for what purpose. Options include an audio or visual indicator (similar to those for CCTV). There is also the possibility for passive tags (only those carrying tags will be detected or left undetected)	Open
New <b>wicked problems</b> will be created since we do not yet know the consequences of the technology.	<u>PERCEIVED ISSUE</u> Uncertainty and fear of unknown long-term societal impacts rather than a specific technical flaw.	MED-HIGH	Restrict deployment to small scale and context specific pilots before large scale rollout. Require mandatory ethical impact assessments and public consultation before approval of new applications. Establish periodic reviews to reassess societal effects, unintended consequences, and emerging risks as processing capabilities evolve. Continuously evaluate whether RF sensing remains demonstrably more privacy preserving and socially proportionate than alternative sensing technologies such as cameras.	Open
People will feel <b>increased anxiety</b> from feeling watched and not knowing who is controlling the information and what will be done with it.	<u>PERCEIVED ISSUE</u> Driven by lack of trust and awareness surrounding hidden sensing infrastructure	HIGH	Introduce clear notification systems, public information on ownership and data use, short retention periods, and restricted access. Communicate clearly that the system avoids capturing identifiable visual imagery unlike cameras	Partially Addressed
The technology might morph into something negative with <b>function creep</b>	<u>TECHNICAL ISSUE</u> RF sensing system can technically be repurposed for broader tracking and profiling beyond their original purpose.	HIGH	Legally bind systems to one explicitly approved function and prohibit repurposing without renewed approval and public review. Prohibit adding features that reconstruct identifiable visual representations or transform RF sensing into camera equivalent surveillance. Ban combining RF sensing data with facial recognition, smartphone tracking, or commercial profiling systems. Require external audits whenever software updates	Open

			significantly expand sensing or analytical capabilities.	
<b>Increased policing</b> due to added surveillance opportunities	<b>TECHNICAL ISSUE</b>  The infrastructure directly enables larger-scale monitoring and automated tracking capabilities.	HIGH	Prohibit continuous passive monitoring of public populations without judicial authorization. Restrict use to clearly defined high risk contexts such as emergency response, dangerous object detection, or disaster situations. Require independent oversight committees to review law enforcement deployments and publish annual transparency reports. Only deploy where RF sensing is less intrusive than cameras.	Open
<b>Lack of transparency</b> since it works in the dark and through walls	<b>TECHNICAL ISSUE</b>  RF sensing is inherently invisible and difficult for users to detect or understand	HIGH	Develop mandatory transparency by design features such as active indicators showing when sensing is operating and interactive public maps showing sensing coverage zones. Prohibit hidden deployment in spaces where individuals reasonably expect privacy, such as bathrooms, changing rooms, bedrooms, and private residences without explicit consent. Clarify that the system detects patterns and movement rather than capturing photographic images.	Partially Addressed
<b>Less functional than cameras</b> because it provides less information and requires more processing to understand an image	<b>TECHNICAL ISSUE</b>  This limitation arises from the sensing modality and processing requirements of RF systems	MED	Deploy RF sensing only in environments where camera systems are unsuitable due to darkness, smoke, occlusion, or privacy concerns. Emphasize that reduced visual detail is an intentional ethical trade off to minimize identifiable data collection compared to cameras. Combine RF sensing with narrowly limited contextual metadata rather than attempting full behavioral reconstruction. Reduced visual detail should be framed as an intentional ethical trade off compared to cameras.	Ongoing
<b>Loss of autonomy</b> due to constant surveillance especially if the state is more authoritarian or work wants to monitor you	<b>TECHNICAL ISSUE</b>  Continuous RF surveillance infrastructures can technically enable behavioral monitoring and control	HIGH	Ban workplace monitoring aimed at productivity scoring, behavioral analysis, or employee discipline. Require court authorization for state surveillance applications outside emergency situations. Provide legal rights for individuals to challenge, inspect, and appeal surveillance practices affecting them. Restrict use to cases where RF sensing reduces intrusiveness compared to visual surveillance.	Open
<b>Loss of privacy</b> due to being seen in more spaces especially if the technology is being used in more spaces due to being more privacy preserving than cameras	<b>TECHNICAL ISSUE</b>  The privacy issue emerges from the expanded deployment possibilities (e.g. multiple rooms)	HIGH	Introduce strict zoning rules limiting deployment to predefined spaces and purposes. Process data locally on device whenever possible and prohibit long term storage of movement or behavioral patterns. Require privacy impact assessments before installation in semiprivate or domestic environments. Do not use the technology to	Partially Addressed

			normalize surveillance in spaces where cameras would be unacceptable.	
<b>Irreversibility</b> from dependence on the system. Once it is installed it might not be possible socially or infrastructurally	<u>TECHNICAL ISSUE</u> Once infrastructure is integrated into institutions and environments it becomes difficult to remove	MED-HIGH	Require sunset clauses in deployment contracts that force periodic reevaluation and possible removal of systems. Maintain non technological alternatives for emergency detection and safety functions. Prevent infrastructural dependence by avoiding mandatory integration into broader smart city or policing ecosystems.	Open
<b>Mass surveillance</b> the technology will be applied ubiquitously meaning more surveillance overall which becomes an issue when processing power increases and more information can be uncovered	<u>TECHNICAL ISSUE</u> The scalability and passive nature of RF sensing technically support large-scale surveillance systems	HIGH	Prohibit centralized aggregation of RF sensing data across locations or institutions. Ban real time population scale tracking and long-term behavioral profiling. Introduce strict limits on cross platform integration with AI analytics, biometric systems, or predictive policing tools. Require independent audits of large-scale sensing infrastructures and publish public accountability reports.	Open
<b>Health risks</b> due to dense RF waves	<u>PERCEIVED ISSUE</u> Public concern exists regarding RF exposure, though most compliant systems operate within regulated limits.	LOW-MED	Inform users that the technology is not any more a risk to health than normal Wi-Fi. (Unless more Wi-Fi systems are out in place to improve the system, functionality.)	Open

### 3.2. Smart TV

Description	Origin	Severity	Mitigation Strategy	Status
Content personalization through <b>behavior analysis</b> leading to addiction and unfair economic advantage	<u>TECHNICAL AND BEHAVIORAL ISSUE</u> RF sensing combined with specific algorithms can continuously analyze gestures, presence, attention, and viewing behavior to maximize engagement and advertising value.	HIGH	Include clear limits on behavioral tracking used for recommendations, with opt-out options for personalized content. Designs should avoid addictive engagement patterns and provide user controls such as screen-time limits, neutral recommendations, and transparency about promoted content.  Reducing the level of detail needed to identify a specific person through obfuscation algorithms. High user flexibility in configuration modes (e.g. anonymous mode) in the TV menu or via App / User account.	Open
<b>Loss of privacy</b> in terms of ability to control and manage data capture as well as data being exposed to 3 <sup>rd</sup> parties	<u>TECHNICAL AND DATA GOVERNANCE ISSUE</u> Continuous RF sensing of user activities,	HIGH	Users should be able to easily view, manage, delete, and restrict the data collected by the Smart TV. Privacy settings should be simple, accessible during setup, and include clear consent for data sharing with third parties.	Open

	occupancy, gestures, and routines, with risks tied to storage, sharing, and monetization of behavioral data.			
Risk of <b>surveillance</b> from the Smart TV company or those who pay for and manage the system, this is <b>increased with larger networks of users</b>	<u>TECHNICAL AND SYSTEM GOVERNANCE ISSUE</u>  Enabled by persistent passive sensing and centralized collection of fine-grained behavioral data across large user populations.	HIGH	Minimize data collection, especially audio, video, and usage data, and disable unnecessary sensors by default. Strong encryption, independent audits, and strict access controls should be required, especially in large user networks where surveillance risks increase.	Open
Increased personalization <b>creates echo chambers and social division</b> even within family	<u>PERCEIVED ISSUE</u> Driven by algorithmic filtering and individualized content delivery informed by RF-derived behavioral profiles.	LOW	Offer shared-viewing modes that reduce individual profiling and encourage diverse, balanced recommendations. Users should be able to see why content is recommended and adjust personalization settings for household-wide fairness.	Open
Increased personalization and <b>addiction</b> lead to <b>lower creativity levels</b>	<u>PERCEIVED ISSUE</u> Behavioral and cognitive issue associated with passive consumption patterns reinforced by adaptive sensing-driven recommendation systems.	HIGH	Avoid endless recommendation loops and include prompts that encourage users to explore varied content or take breaks. Recommendation systems should include novelty, educational content, and user-led discovery instead of only optimizing for watch time.	Open
Increased personalization and <b>addiction</b> lead to <b>lower spontaneity and thus lower freedom</b>	<u>PERCEIVED ISSUE</u> Caused by predictive recommendation systems shaping user behavior and reducing exposure to unplanned or diverse experiences.	LOW	Users should be given easy access to non-personalized browsing, random discovery, and manual search options. The system should support user choice rather than automatically steering them toward predicted preferences.	Open
<b>Function Creep</b> especially with the ability to capture potentially <b>sensitive data</b> such as if one is sleeping	<u>TECHNICAL AND DATA GOVERNANCE ISSUE</u>  Where RF sensing capabilities extend beyond original entertainment purposes into health, presence, or intimate behavioral	HIGH	Collect only the data needed for core functions and clearly separate optional features from required services. Sensitive data, such as sleep patterns or presence detection, should require explicit consent and be easy to disable.	Open

	monitoring without explicit consent			
<b>Loss of autonomy</b> from TV addiction and the TV making decisions and recommendations for the user with the potential that these divisions are made intentionally (for example politically)	<u>PERCEIVED AND SYSTEM GOVERNANCE ISSUE</u>  Behavioral manipulation issue resulting from adaptive AI systems using RF sensing data to optimize influence over attention, preferences, and decision-making	HIGH	Provide limits on autoplay, binge-watching, and persuasive recommendation features. Users should be able to control or turn off algorithmic recommendations, especially where content could influence political or personal beliefs.	Open

### 3.3. Wi-Fi Care

Description	Origin	Severity	Mitigation Strategy	Status
<b>Increased loneliness</b> from replacing human caregiver with technological system	<u>PERCEIVED ISSUE</u>  Due to reliance on RF sensing systems rather than direct caregiving.	HIGH	Provide patients with the opportunity to decide with their caregivers how much, if at all, they want to be monitored by RF systems rather than by human caregivers. System might be useful to determine those in need of human care as well and what times are most beneficial.	Open
<b>Paranoia and stress</b> from feeling watched and examined constantly from system embedded in living environment	<u>PERCEIVED ISSUE</u>  Caused by invisibility of sensing technology	HIGH	Make visible to patients when they are being watched and when the system is off. Also make it possible for patients to choose when and where they want to be monitored.	Open
<b>Lack of Transparency</b> from user inability to understand the technology	Technical and perceptual issue caused by opaque RF sensing algorithms, unclear data processing, and invisible system operation	MED	Follow the principle of informed consent and make sure that patients have an adequate understanding of RF sensing technology and have consented to its use before implementing it.	Open
<b>Inauthentic data</b> from patient acting differently due to technology presence (This could also be positive to lead to healthier action)	Perceived behavioural issue (observer effect) where awareness of monitoring alters natural behaviour, reducing data validity	MED	Patients trying to behave in a healthier manner in order to have better data should be seen as a positive result of RF sensing and so should not be avoided.	Open
<b>Loss of autonomy and privacy</b> from not having access to data and being	Actual technical and governance issue involving data access control, ownership,	HIGH	The principles of respect for autonomy and informed consent must be strictly enforced to make sure that patients do not lose their autonomy or privacy. Patients must have	Open

unable to control it especially given sensitivity level	storage, and consent management within RF sensing infrastructure		control over their data and have access to their data as requested.	
<b>Inaccessibility</b> due to technology being a more expensive system of medical care	Actual socioeconomic and technical deployment issue caused by hardware, installation, and infrastructure costs of RF sensing systems	MED	The cost of RF sensing must be a way to reduce costs of healthcare rather than increase costs. This must be made clear to patients, so they understand that the aim is to use RF sensing to improve their treatment and thereby avoid unnecessary and costly medical treatment.	Open
Potential for <b>bad actor accessing and misusing data</b> this could even include insurance companies or government	Actual technical cybersecurity and governance issue involving unauthorized access, interception, misuse, or secondary sharing of RF-derived behavioural/health data	HIGH	Access to patient data must be restricted by law in the same way that patient data is currently restricted by hospital and healthcare professionals.	Open
<b>Dehumanization</b> due to prioritization of medical data over patient's lived experience leading to inaccuracies having disastrous effects (missing something important or over medicalizing)	Perceived and systemic issue resulting from overreliance on RF-generated quantitative data while undervaluing subjective patient experiences	HIGH	Just as patients must be able to decide if and when RF sensing is used in their treatment, patients must also be able to decide if and when they still want to be able to meet with healthcare professionals to discuss the data received from RF sensing.	Open
<b>Lack of autonomy</b> due to vulnerable populations being forced to use the system	Social/governance issue rather than a direct technical limitation; arises from institutional or caregiver pressure tied to dependence on RF monitoring systems	HIGH	By respecting the principle of autonomy through informed consent, vulnerabilities must be identified and taken into account when discussing with patients what RF sensing means and whether they should use it. In cases where informed consent cannot be provided by the patient, informed consent must be provided by a family member or other caregiver who has power of attorney. RF sensing must be treated as an opt in rather than an opt out service in order to avoid any potential manipulation or exploitation of vulnerable populations.	Open

## 4. Comparative Analysis of RF Sensing Innovations within Existing Technological Ecosystems

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The findings emerging from the appropriation study can be further contextualized through the competitive and market analyses conducted for the three targeted application scenarios: Object and People Detection, Wi-Fi Care, and Smart TV Interaction. While the appropriation study explored how participants socially and ethically perceived RF sensing technologies in everyday and institutional environments, the market analyses examined how these technologies position themselves within already existing ecosystems composed of competing sensing, monitoring, and interaction solutions. Bringing these analytical dimensions together is particularly important because the ethical concerns, privacy expectations, and mitigation strategies emerging from the appropriation study closely mirror the structural strengths and limitations already characterizing competing technologies currently deployed in the market.

The market analyses further demonstrate that RF sensing technologies enter environments already populated by multiple competing and complementary technological paradigms. These include CCTV and computer vision systems, radar and millimeter-wave systems, RFID tracking, wearable devices, smart home sensors, voice assistants, biometric access-control systems, and camera-based interaction technologies. Across all application domains, competing technologies exhibit recurring trade-offs between detection capability, operational effectiveness, privacy intrusiveness, infrastructure complexity, user burden, and societal acceptability. Importantly, many of the “perceived issues” identified during the appropriation study (including hidden surveillance, behavioral profiling, manipulation, lack of transparency, and excessive data collection) are not unique to RF sensing itself, but reflect broader societal tensions already associated with existing digital monitoring ecosystems. Conversely, several mitigation strategies proposed by participants, including edge AI, local processing, privacy-by-design architectures, transparency mechanisms, proportional deployment, and informed consent frameworks, consistently emerge across both the appropriation findings and the competitive landscape analyses.

In the case of the Object and People Detection innovation applied to security and surveillance environments, conventional solutions such as CCTV, biometrics, radar systems, and access-control infrastructures provide mature and highly effective monitoring capabilities but are frequently associated with significant ethical and operational limitations. Camera-based systems enable detailed situational awareness and AI-enhanced analytics but raise major concerns regarding visual surveillance, facial recognition, GDPR compliance, and continuous tracking of identifiable individuals. Radar and millimeter-wave systems partially mitigate visual privacy concerns while maintaining strong detection capabilities, yet they often require visible infrastructure, active RF emissions, and costly deployments. RFID and badge-based systems offer efficient asset and access management but depend on user cooperation and tagged objects, limiting their ability to detect concealed or unauthorized presence. Within this landscape, RF static holography occupies a differentiated position by enabling passive, non-line-of-sight sensing without requiring cameras, tags, or direct user participation. However, the appropriation study also revealed that precisely these characteristics (invisibility, hidden deployment, and passive sensing) simultaneously generate

new societal concerns regarding covert surveillance, lack of awareness, and potential misuse by institutional actors.

Within the Wi-Fi Care innovation and the broader Ambient Assisted Living ecosystem, the competitor landscape is similarly fragmented across wearable monitoring devices, environmental monitoring systems, passive health technologies, interactive voice assistants, and Wi-Fi sensing solutions. Wearables such as smartwatches and GPS trackers remain among the most widely adopted solutions but impose continuous user burden through charging, wearing, and active compliance, creating risks of abandonment or fatigue among elderly populations. Camera-based monitoring systems provide richer behavioral insights and fall-detection capabilities but are frequently perceived as highly intrusive because they visually transform private homes into monitored environments. Passive monitoring technologies such as smart furniture and fall detectors reduce intrusiveness but often remain functionally limited and fragmented. Interactive technologies including voice assistants improve accessibility but depend heavily on cloud infrastructures and raise concerns regarding passive listening and data collection. In contrast, Wi-Fi sensing and RF-based monitoring systems introduce a form of ambient intelligence capable of continuous contactless monitoring without requiring wearables, cameras, or active user interaction. The appropriation findings indicate that participants generally perceived this application scenario more positively than the others because the technology was associated with care, safety, autonomy preservation, and support for vulnerable individuals. Nevertheless, participants still emphasized concerns regarding data governance, hidden monitoring, behavioral profiling, and the long-term normalization of invisible sensing infrastructures inside private domestic spaces.

The Smart TV Interaction innovation reveals a third competitive environment characterized by interaction technologies such as smart remotes, voice assistants, camera-based gesture recognition, and wearable companion devices. Traditional remotes remain privacy-safe but lack contextual awareness and adaptive interaction capabilities. Voice assistants improve convenience and accessibility but rely on always-listening microphones and cloud-based natural language processing, generating concerns regarding unintended recording and behavioral monitoring. Camera-based gesture systems provide immersive interaction but face strong resistance due to continuous visual monitoring inside the home environment. Wearables and companion devices enable advanced immersive experiences but require continuous user participation and physical interaction. RF sensing-enabled interaction introduces a substantially different paradigm by enabling passive gesture recognition, presence detection, and ambient contextual interaction without cameras, microphones, or wearable devices. However, among all evaluated application scenarios, Smart TV applications triggered the strongest ethical resistance within the appropriation study. Participants frequently associated RF-enabled personalization and adaptive interaction with manipulation, behavioral prediction, addictive content optimization, and the erosion of personal autonomy inside domestic spaces. The findings therefore suggest that societal acceptance of RF sensing strongly depends not only on technical intrusiveness but also on the perceived intentions and economic incentives underlying the technology's deployment.

Overall, the competitive comparison demonstrates that RF sensing technologies derive their strategic differentiation from a combination of privacy-by-design potential, passive and non-cooperative sensing capability, hidden deployment, reduced user burden, and non-line-of-sight

environmental intelligence. At the same time, the appropriation study highlights that these same differentiating characteristics may also become sources of societal concern if insufficient transparency, governance, and accountability mechanisms are implemented. Participants repeatedly distinguished between “acceptable invisibility,” where technology discreetly supports legitimate societal goals, and “unacceptable invisibility,” where sensing becomes opaque, manipulative, or uncontrollable.

The competitor comparison therefore suggests that the future competitive advantage of RF sensing technologies will not depend exclusively on technical superiority over cameras, wearables, or radar systems. Rather, market legitimacy will increasingly depend on the ability to combine technological functionality with socially acceptable governance frameworks. This includes privacy-by-design architectures, local edge processing, transparent deployment policies, informed consent mechanisms, proportionality limitations, explainable AI, and clear institutional accountability structures. In this respect, RF sensing may emerge not simply as another sensing technology within the broader surveillance ecosystem, but as a test case for whether future ambient intelligence systems can remain aligned with democratic expectations surrounding privacy, autonomy, dignity, and societal trust.

The cross-domain comparison can be summarized through the following analytical frameworks, which synthesize the principal competing technologies, their ethical implications, and the strategic positioning of RF sensing across the three application scenarios.

<b>Application Domain</b>	<b>Application Domain</b>	<b>Main Competing Technologies</b>	<b>Main Ethical / Privacy Concerns</b>	<b>RF Sensing Strategic Differentiation</b>
People / Object Detection	Security & Restricted Areas	CCTV, Biometrics, Radar, RFID	Visual surveillance, facial recognition, hidden tracking	Passive sensing, non-line-of-sight detection, privacy-preserving monitoring
Wi-Fi Care	Elderly Care Monitoring	Wearables, Cameras, Voice Assistants	Intrusion into private life, dependency on user compliance, cloud health data	Contactless monitoring, ambient intelligence, reduced user burden
Smart TV	Smart TV & Home Interaction	Voice AI, Cameras, Wearables	Behavioral manipulation, personalization, always-listening systems	Frictionless interaction without cameras or microphones

**Figure 26 “Cross-Domain Competing Technologies”**

Technology	Privacy Protection	Transparency	User Cooperation Required	Hidden Deployment	Ambient Intelligence Capability	Main Ethical Risks
Cameras	Low	High visibility	None	Low	High	Visual surveillance and facial recognition
Wearables	Medium	High	High	None	Medium	Biometric data commercialization
Voice Assistants	Medium-Low	Medium	Medium	Medium	Medium-High	Passive listening and cloud profiling
RF Sensing	Potentially High	Potentially Low	None	High	High	Invisible monitoring and behavioral inference

**Figure 27 Ethical and Functional Comparison Between RF Sensing and Existing Technologies**

Strategic Differentiation Dimension	RF Sensing Contribution
Privacy-by-Design	Reduces collection of directly identifiable visual and audio data
Passive / Non-Cooperative Sensing	No active participation, wearables, or tags required
Hidden Deployment	Infrastructure can remain embedded and unobtrusive
Reduced User Burden	Eliminates continuous user interaction and maintenance requirements
Non-Line-of-Sight Environmental Intelligence	Enables sensing through obstacles and beyond direct visibility

**Figure 28 Strategic Differentiation Dimensions of RF Sensing**

## 5. Conclusion

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The appropriation study demonstrates that RF sensing technologies are not experienced as inherently positive or negative technologies. Rather, their acceptance depends strongly on context, proportionality, governance, and perceived purpose. Across all exhibit locations and applications, participants continuously evaluated the technologies in relation to where they were deployed, who controlled them, what goals they served, and whether the societal benefits outweighed the potential losses regarding privacy, autonomy, and freedom. Ethical acceptability therefore cannot be reduced to technical functionality alone but depends on the broader social and institutional environments in which these technologies become embedded.

The study furthermore shows that participants clearly distinguish between applications that address concrete societal problems and applications that are primarily experienced as expanding surveillance infrastructures. Wi-Fi Care generally received the most positive responses because participants associated it with safety, health, support, and care for vulnerable populations. Person Object Detection was perceived more ambivalently: acceptance increased in narrowly defined contexts such as emergency response, dangerous object detection, or health related monitoring, while broader or undefined surveillance applications generated substantial concern. Smart TV applications received the most critical responses, particularly due to fears surrounding personalization, addiction, manipulation, loss of autonomy, and the transformation of the home into a site of continuous monitoring. Across all applications, participants repeatedly emphasized the importance of transparency, purpose limitation, user control, and meaningful democratic oversight.

The comparative analysis of RF sensing innovations within existing technological ecosystems further demonstrates that many of the ethical tensions associated with RF sensing are not unique to the technology itself, but reflect broader structural dynamics already present within existing surveillance, monitoring, and smart-interaction infrastructures. Cameras, wearables, biometric systems, voice assistants, and AI-driven sensing platforms already expose society to significant tensions between functionality, convenience, automation, privacy, and individual autonomy. Within this broader ecosystem, RF sensing occupies a distinctive position because it enables passive, non-line-of-sight, and potentially privacy-preserving sensing without necessarily relying on visual imagery, wearable devices, or explicit user interaction. At the same time, the very characteristics that constitute its technological differentiation (invisibility, passive monitoring, and embedded deployment) may also generate new concerns regarding covert surveillance, behavioral inference, and loss of awareness if insufficient safeguards are implemented.

The exhibit further revealed that participants rarely evaluated RF sensing in isolation but instead compared it to already existing surveillance infrastructures such as cameras, smartphones, GPS tracking, and online data collection systems. Several participants recognized that RF sensing may, under clearly constrained conditions, provide a more privacy preserving alternative to camera-based monitoring because it does not necessarily capture directly identifiable visual imagery. However, participants also warned that this ethical advantage could quickly disappear if the technology evolves into broader systems of behavioral tracking, mass surveillance, or commercial

profiling. The ethical value of RF sensing therefore depends less on the technology itself than on whether its deployment remains limited, proportionate, and tied to clearly justified societal goals.

More broadly, the appropriation study demonstrates the importance of integrating public feedback early into the development of emerging sensing technologies. The exhibit revealed not only concrete concerns and mitigation strategies, but also broader societal tensions surrounding security, privacy, autonomy, and control. These findings suggest that the central challenge is not simply to develop technically effective RF sensing systems, but to ensure and keep ensuring that they remain socially legitimate and clearly distinguishable from the more invasive surveillance infrastructures they are often intended to replace.

# Appendix A. Critical Issue Evidence from Exhibit

## 5.1. Person Object Detection

Description	Evidence
<p>People will <b>change their behavior</b> due to the feeling of being monitored and additionally not knowing the scope of the areas where they are being monitored. Especially in areas where cameras are typically not allowed such as bathrooms.</p>	<p>Yes, because everyone would be more cautious if they were being observed." "Due to constant surveillance, free life will retreat into the private sphere." "The feeling of being able to be monitored without seeing any technology behind it changes people's behavior. (You feel watched even in the bathroom.)"</p>
<p>New <b>wicked problems</b> will be created since we do not yet know the consequences of the technology.</p>	<p>"We are solving problems that we created ourselves. Keep it 'simple.' Close to nature. We do not know the consequences yet!"</p>
<p>People will feel <b>increased anxiety</b> from feeling watched and not knowing who is controlling the information and what will be done with it.</p>	<p>"Yeah, because people are afraid" "Made up persona: My life hasn't been easy because of my anxiety disorder, but ever since they introduced RF person detection in 2025, I don't even feel safe at home anymore. People obey, are anxious, it helps others, strong polarization. Welcome to the Truman Show." "Yes, because you feel less secure when you can always be observed and do not know what is done with this information." "Yes, because everyone would be more cautious if they were being observed." "Due to constant surveillance, free life will retreat into the private sphere." " Yes, people feel monitored everywhere."</p>
<p>The technology might morph into something negative with <b>function creep</b></p>	<p>"No, technology should be used in a positive way, but there are also downsides, where it is easy [to be abused / to slip into something negative]."</p>
<p><b>Increased policing</b> due to added surveillance opportunities</p>	<p>"Citizen policing is on the rise, already by widespread use of cameras. I don't think this has benefitted society. With RF we will only get even more polarized"</p>
<p><b>Lack of transparency</b> since it works in the dark and through walls</p>	<p>"Yes, because you feel less secure when you can always be observed and do not know what is done with this information."</p>
<p><b>Less functional than cameras</b> because it provides less information and</p>	<p>"Yes, in my opinion the method could also be misused for criminal purposes. Because you can monitor through walls without line of sight, you have to feel constantly watched. In</p>

requires more processing to understand an image	my opinion, this method does not provide more security compared to cameras etc.”
<b>Loss of autonomy</b> due to constant surveillance especially if the state is more authoritarian or work wants to monitor you	“Yes, security would have changed with such technologies. Put in the wrong hands, it would be detrimental to the common person. Being spied on by your boss would be a way of pressuring workers. Capitalists who are profiting from people would love that.” "Citizen policing is on the rise, already by widespread use of cameras. I don't think this has benefitted society. With RF we will only get even more polarized" "people trade their freedom for 'security'" "it affects society in a negative way, people are more restless, what is it like when you speak out about politics or society legally?"
<b>Loss of privacy</b> due to being seen in more spaces especially if the technology is being used in more spaces due to being more privacy preserving than cameras	"New way to be tracked" "Without really knowing you are more “seen” than you know"
<b>Irreversibility</b> from dependence on the system. Once it is installed it might not be possible socially or infrastructurally	"Can we still go back if this path is not the right one? Too big a gamble if you ask me"
<b>Mass surveillance</b> the technology will be applied ubiquitously meaning more surveillance overall which becomes an issue when processing power increases and more information can be uncovered	"People fall under the panopticon effect (like the surveillance tower, the panopticon)" " A) Less visible ways for surveillance. B) And therefore, hopefully more laws and regulations on surveillance tech." " Since RF detection got used globally, regimes efficiently as never before monitored, oppressed, discriminated, kidnapped and murdered minorities and opponents. Start of the Genocentury, genocides wherever you lay your eyes." "1984" "An extension of mass surveillance. The biggest obstacle to them is useful processing, not more inputs. But once/if their processing ability improves, the more it will be a distinct worsening." "Yes. RF object detection has advanced various areas of research in health (social safety, personal tracking and surveillance (sadly))" "The possibilities for abuse (complete surveillance) are very high." "This technology enables systematic surveillance and spying. That has existed in Germany before, and other countries like China show where it leads."
<b>Health risks</b> due to dense RF waves	“No, how much can our body tolerate? Directly in front of it, it becomes warm, our molecules start to vibrate.”

## 5.2. Smart TV

Description	Evidence
Content personalization through <b>behavior analysis</b> leading to addiction and unfair economic advantage	"It would for the TV industry, because the companies that have the Smart RF TVs would instantly rule the TV industry." "Also, multibillion-dollar AI companies make movies every other second based on your personal emotional reaction to a show. The economic problem?"
<b>Loss of privacy</b> in terms of ability to control and manage data capture as well as data being exposed to 3 <sup>rd</sup> parties	"I have no problem with the technology as long as I am in control of the data. Is the data that the TV collects locally processed or is it just a server?" "Without regulation, the personalization of individuals increases. Surveillance becomes easily possible. Ownership of one's own data must become a fundamental right, like a human right." "I think people have a right to privacy. That's why I'm in favor of doing it at the supermarket; it's allowed, but you shouldn't do it at home." "Unnecessary additional function in my opinion. Not everything has to be further automated, nor do we always need to collect more data. Ethically, the fundamental question is where data are processed, how, and for what purpose." "Yes, here too things are being monitored again. It can recognize everything: zero privacy." "If you cannot keep this data locally, you feel constantly watched."
Risk of <b>surveillance</b> from the Smart TV company or those who pay for and manage the system, this is <b>increased with larger networks of users</b>	"But as soon as it is used for personal data collection and war/police, it's very scary, which outweighs potential benefits. Society will be changed drastically as with every big new technology, affection education, personal life and everything else." "Integration in network would allow more surveillance in homes. Without network integration, no (The blind should get bi-directing remotes that print)." "Such systems can help people with impairments, but they also simplify surveillance. I am not directly afraid of it, but there are certainly horror scenarios."
Increased personalization <b>creates echo chambers and social division</b> even within family	"People will lose connection because everybody watches their made to be perfect AI movie where everything is personalized." "People get glued to their TVs. Put them in every room!"
Increased personalization and <b>addiction</b> lead to <b>lower creativity levels</b>	"The more behavior is analyzed, the more we are guided – both as providers and as users. Creativity, individuality and willingness to experiment (and thus also innovation) suffer as a result."

Increased personalization and <b>addiction</b> lead to <b>lower spontaneity and thus lower freedom</b>	"Yes, because people now depend on the TV and can no longer regulate themselves as much." "Yes. No uncontrolled individuality anymore! No space for learning (learning from mistakes)."
<b>Function Creep</b> especially with the ability to capture potentially <b>sensitive data</b> such as if one is sleeping	If the technology is privately accessible to everyone, there is significant potential for misuse, e.g. stalking, surveillance, neighbors, etc.."
<b>Loss of autonomy</b> from TV addiction and the TV making decisions and recommendations for the user with the potential that these divisions are made intentionally (for example politically)	"THE GAP BETWEEN RICH & POOR HAS INCREASED WITH THE MEDIA CONTROLLING THE MINDS OF THE POOR EVEN MORE BY CREATING MORE CONTENT FOR PEOPLE TO CONSUME." "Yes, this would be a significant change to our way of living. As we are habitual "animals", this might infringe our autonomy." "Decisions and assessments are taken off your hands and made easier." "The idea that the television decides is horrible. People are deprived of yet another ability of self-determination of their humanity." "You lose more and more of the sense for your own body and unlearn listening to and paying attention to your body's signals."

### 5.3. Wi-Fi Care

Description	Evidence
<b>Increased loneliness</b> from replacing human caregiver with technological system	"It can make the residents life safer. There's also the potential that the life on an elderly person gets lonelier due to less personal care. Mentally, it's hard to predict if this is beneficial, it might depend on the health conditions of the individual. They might worry if they're not doing well more due to the tech." : "Advantage: faster response in favor of the person concerned; disadvantage: increased loneliness due to less staff."
<b>Paranoia and stress</b> from feeling watched and examined constantly from system embedded in living environment	"I myself am in burnout because I have too much control/insight into me. Sometimes just wing it, that's life. That's what separates humans from machines" "I'd tear it out/move houses. If I want such a device in my house, it will NOT be networked and fully in my control (software, hardware, source code). Increasing paranoia. Combative with staff. Fragment escape attempts. Sabotages any network technology. Spends more time away." "More anxiety possible people could talk less because it's all data"

	<p>which is good but like make sure to first talk and then data or if someone likes it idk. Sounds complicated" "If the person is anxious, it will exacerbate their anxiety. If the person is undereducated, it will be disregarded. If the person is a data nerd, they might actually use it. It will make a difference in an unexpected moment that is very hard to fathom at this moment"</p>
<p><b>Lack of Transparency</b> from user inability to understand the technology</p>	<p>"If the person is anxious, it will exacerbate their anxiety. If the person is undereducated, it will be disregarded. If the person is a data nerd, they might actually use it. It will make a difference in an unexpected moment that is very hard to fathom at this moment" "People who currently live in care homes cannot do much with Wi-Fi, are skeptical. For them it feels like surveillance. It must not replace human contact. (View of a nurse)"</p>
<p><b>Inauthentic data</b> from patient acting differently due to technology presence (This could also be positive to lead to healthier action)</p>	<p>"Could be reduced: accidents, fractures through changes in behavior." "You can feel monitored and therefore adjust your behavior ⇒ inauthentic data."</p>
<p><b>Loss of autonomy and privacy</b> from not having access to data and being unable to control it especially given sensitivity level</p>	<p>"Major intrusion into privacy; people in need of care have the same rights as everyone else." "The resident should be allowed to decide who may see which data in which situation. For research and quality assurance purposes, data should, where possible, be evaluated anonymously. Data should never be shared with advertisers; in my opinion, most people are also not aware of how they can protect their data."</p>
<p><b>Inaccessibility</b> due to technology being a more expensive system of medical care</p>	<p>"The hurdle to moving into a care home could become even higher. Access will become even more expensive and thus not accessible for everyone. Potential for clinical research and elderly care also outside of care homes."</p>
<p>Potential for <b>bad actor accessing and misusing data</b> this could even include insurance companies or government</p>	<p>"Could help when difficulties but isn't it really too much to know - like the government doesn't need to know everything" "More surveillance in the surveillance state" "Safety, but through monitoring and targeted advertising – regarding sleep and insurance – they could refuse you because you injure yourself often or something like that." "Data are mainly misused by research companies and others to maximize profit. Good care would already be possible now." "Humanity will likely not use it without data storage private usage."</p>

<p><b>Dehumanization</b> due to prioritization of medical data over patient's lived experience leading to inaccuracies having disastrous effects (missing something important or over medicalizing)</p>	<p>"Monitoring / control, the person becomes an 'object' that can be 'conditioned' through data like a machine. Humanity? Data protection? Personal rights? A false sense of security (my father is not visited but monitored). Errors / normal deviations in the data – who takes care of them? (staff) Fears are stirred up and reinforced." It feels less like a family environment, and you feel less important."          "Possible insecurity due to greater availability of information about one's own health, 'making a mountain out of a molehill' – worries about health problems that are actually not problems. Otherwise, positive, better overview of one's own health."</p>
<p><b>Lack of autonomy</b> due to vulnerable populations being forced to use the system</p>	<p>"Make this available to whoever wants it. Autonomy is important, wife care should not be pre-installed or forced, but I think this would be more non-invasive than existing monitoring systems and that the "human" diagnosis will fail more often than "smart" ones."</p>

# Appendix B. NACE Deutsches Museum



## Mit WLAN ohne Kamera sehen

### Wi-Fi – Seeing Without a Camera

**WLAN**, man kann es nicht sehen oder fühlen, aber es ist da. Es überträgt Daten von und zu Ihrem Telefon, Laptop und anderen Geräten. Es bewegt sich mit oder nahezu mit Lichtgeschwindigkeit durch Dunkelheit, Regen und Wände!

**Wussten Sie das?** Licht bewegt sich im Vakuum mit 300.000 km/s. Die Erde hat nur einen Durchmesser von 12.756 km. (Licht wird langsamer, wenn es sich durch Materialien wie Glas bewegt!)

Auch wenn wir WLAN nicht sehen können, kann es genutzt werden, um uns und unsere Umgebung zu beobachten.

(WLAN kann sogar zur Aktivitätserkennung sowie zur Messung von Atem- und Herzfrequenz verwendet werden!)

Erkunden Sie diese interaktive Ausstellung, um zu lernen, wie WLAN-Monitoring funktioniert, welche Anwendungen es gibt, und stimmen Sie darüber ab, was Sie von dieser Technologie halten.

Ihre anonymen Beiträge werden zu Forschungszwecken genutzt, um Ethikerinnen und Ethikern an der Universität Twente dabei zu helfen, Regeln und Designbeschränkungen für eine ethische RF-Holografie zu entwickeln. Wenn Sie nicht zur Forschung beitragen möchten, verzichten Sie einfach auf den interaktiven Teil der Ausstellung.



**Wi-Fi**, you cannot see it, or feel it, but it is there. It brings data to and from your phone, laptop, and other devices. It travels at or near the speed of light through darkness, rain, and walls!

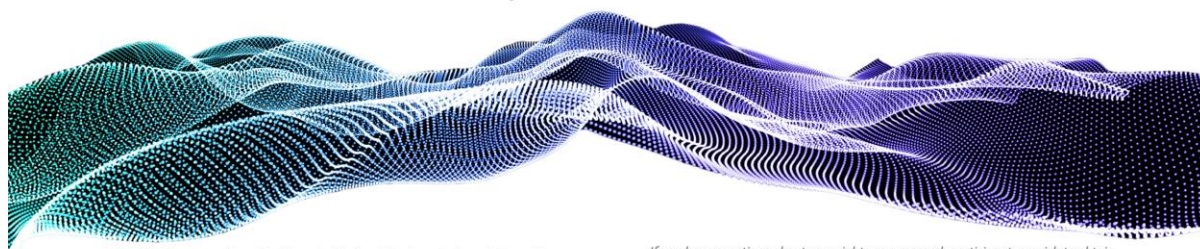
**Did you know?** Light travels at 300,000km/s in a vacuum? The earth is only 12,756km wide. (Light slows down when traveling through materials, such as glass!)

Although we cannot see Wi-Fi, Wi-Fi can be used to monitor us and our environment.

(Wi-Fi can even be used for activity recognition and to measure breath and heart rate!)

Explore this interactive exhibit to learn how Wi-Fi monitoring works, what applications are underway, and vote on what you think about this technology.

Your anonymous interactions will be used for research to help ethicists at the University of Twente form regulations and design constraints for ethical RF wave holography. If you do not want to contribute to the study, simply refrain from partaking in the interactions!



Wenn Sie Fragen zu Ihren Rechten als Studienteilnehmer haben, Informationen einholen, Fragen stellen oder Anliegen zu dieser Studie mit jemand anderem als den Forschenden besprechen möchten, wenden Sie sich bitte an die Geschäftsstelle der Ethikkommission/Bereich Geistes- und Sozialwissenschaften der Fakultät für Verhaltens-, Management- und Sozialwissenschaften der Universität Twente unter [ethicscommittee-hss@utwente.nl](mailto:ethicscommittee-hss@utwente.nl)

Gefördert durch die Europäische Union. Die geäußerten Ansichten und Meinungen liegen jedoch ausschließlich in der Verantwortung der Autorinnen und Autoren und spiegeln nicht notwendigerweise die der Europäischen Union oder der Exekutivagentur für den Europäischen Innovationsrat und für KMU (EISMEA) wider. Weder die Europäische Union noch die bewilligende Stelle können dafür verantwortlich gemacht werden. Bewilligungsnummer: 101099491 <https://holden-project.eu/>

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/domain Humanities & Social Sciences of the Faculty of Behavioural, Management and Social Sciences at the University of Twente via [ethicscommittee-hss@utwente.nl](mailto:ethicscommittee-hss@utwente.nl)

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# Diese Ausstellung ist interaktiv!

*This exhibit is interactive!*

*(Ja, wir möchten, dass Sie Aufkleber auf die Poster kleben.)*

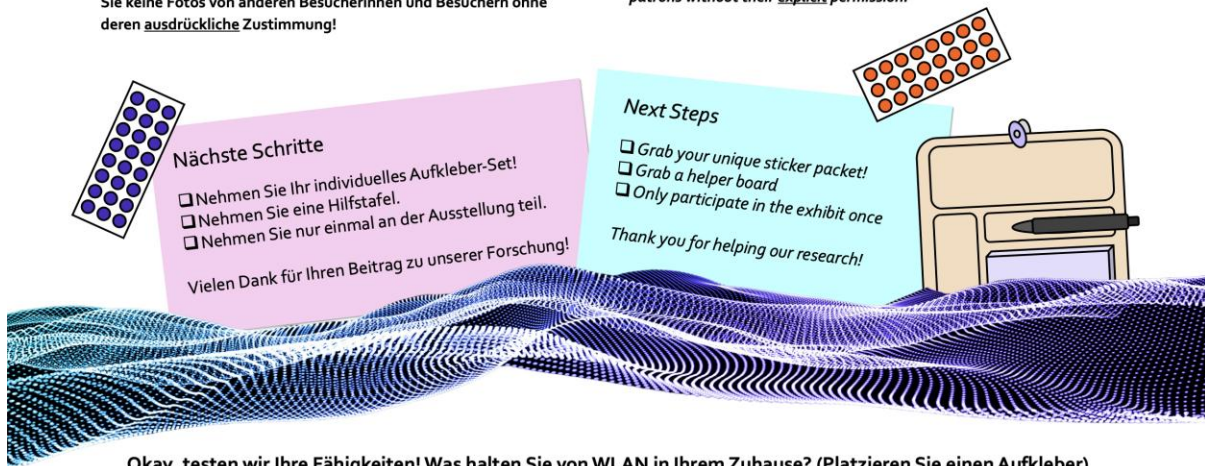
Durch Ihre Interaktion mit der Ausstellung tragen Sie zu einer Studie der Universität Twente zur öffentlichen Wahrnehmung und Verwendung von WLAN-Monitoring bei. Alle erhobenen Daten sind anonym und werden für weitere Forschung in diesem Bereich verwendet! Sie können die Ausstellung jederzeit verlassen.

Wir übernehmen keine Verantwortung, wenn Sie Ihre Beiträge in sozialen Medien teilen. Bitte seien Sie rücksichtsvoll und machen Sie keine Fotos von anderen Besucherinnen und Besuchern ohne deren ausdrückliche Zustimmung!

*(Yes, we want you to put stickers on the panels.)*

*By interacting with the exhibit, you will contribute to a University of Twente study on public perception and appropriation of Wi-Fi monitoring. All data collected will be anonymous and used to further research in this field! You can stop interacting with the exhibit at any time.*

*We are not responsible if you share your interactions on social media. Please be respectful of others by not photographing other patrons without their explicit permission!*



Okay, testen wir Ihre Fähigkeiten! Was halten Sie von WLAN in Ihrem Zuhause? (Platzieren Sie einen Aufkleber)  
*Okay, let's test your skills! How do you feel about Wi-Fi in your home? (Place a sticker)*



Wie stehen Sie zu 5G-Masten?  
*How do you feel about 5G towers?*



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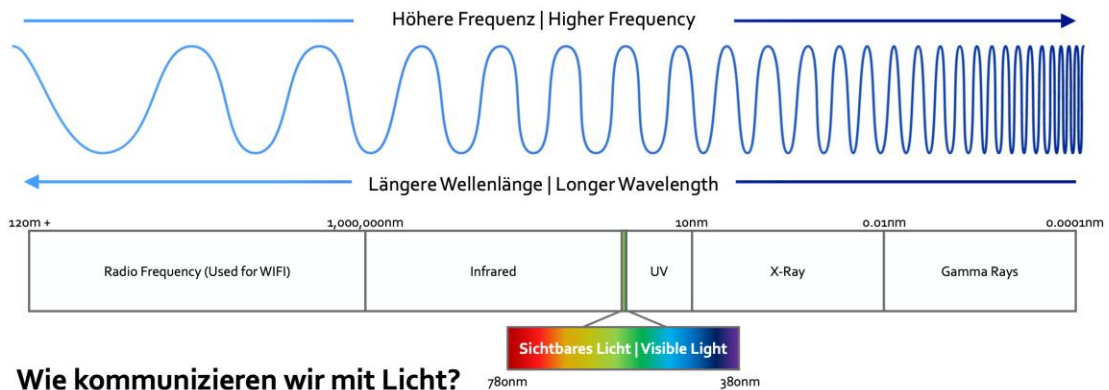
# Was ist WLAN?

## What is Wi-Fi?

WLAN ist ein System, das unsichtbare Strahlung nutzt, um Daten zu übertragen. Menschliche Augen können nur Strahlung (Licht) mit Wellenlängen zwischen 380nm und 780nm wahrnehmen. Die für WLAN genutzten Wellenlängen bei Radiofrequenzen (RF) sind 1000-mal länger. Die Wellenlänge von WLAN ermöglicht es, sich weit auszubreiten und Wände zu durchdringen! Die Wellenlänge bestimmt den Wellentyp (z. B. Radio, Infrarot, UV).

Wi-Fi is a system that uses invisible light to send data. Human eyes can only see light between 380nm and 780nm in length. Radio frequency (RF) waves used for Wi-Fi are over 1000x as long. Wi-Fi's wavelength helps it travel far and through walls! The wavelength determines the type of wave (ex: radio, infrared, UV).

### Das elektromagnetische (Licht-)Spektrum | The Light (Electromagnetic) Spectrum



### Wie kommunizieren wir mit Licht?

#### How do we communicate with light?

Digitale Informationen werden in Einsen und Nullen kodiert, die dann in RF-Wellen umgewandelt und über eine Antenne abgestrahlt werden. Empfänger erfassen diese Informationen, die anschließend wieder in Einsen und Nullen übersetzt werden.

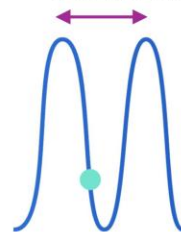
Digital information is encoded into 1s and 0s, which are transformed to RF waves that are sent out through antenna. Receivers capture that information which then is translated back to 1s and 0s.

Je nach Signal werden unterschiedliche Protokolle genutzt, um mehr Informationen schneller zu senden! Kürzere RF-Wellen breiten sich weniger weit aus, ermöglichen aber dank höherer Frequenz höhere Datenraten. Wellen können kombiniert werden, um mehr Informationen gleichzeitig zu übertragen, indem die **Amplitude** verändert oder die **Phase** verschoben wird.

Depending on the signal, different protocols are used to send more information faster! Shorter RF waves cannot travel as far but may deliver information quicker due to higher frequency. Waves can also be spliced up to share more information at once by adjusting the **amplitude** or shifting the **phase**.

Wellenlänge = Abstand von Gipfel zu Gipfel

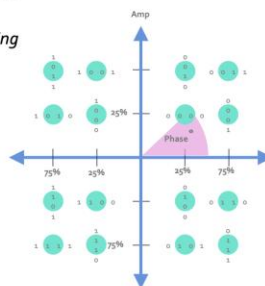
Wavelength = distance from crest to crest



Amplitude = Höhe der Welle  
Amplitude = height of the wave

Phase = Position innerhalb der Wellenlänge

Phase = Position within the wavelength



Licht kann mehrere Einsen und Nullen gleichzeitig übertragen, wie in dieser vereinfachten 16QAM-Konstellationsdiagramm.

Light can deliver multiple 1s and 0s at once as in this simplified 16QAM Constellation.

Amp 75% & Phase 45° = 0011  
Amp 25% & Phase 45° = 0011

IEEE 802.11 ist der weltweite Standard für drahtlose Netzwerke! Ohne Standards könnten wir WLAN-Daten nicht weltweit gleichermaßen senden und interpretieren.  
IEEE 802.11 is the worldwide standard for wireless networking! Without standards, we would not be able to send and interpret Wi-Fi data all over the world.



# Die smarte Welt

## The Smart World

Menschen lieben es, verbunden zu sein! Schätzungen zufolge verfügen 94% der EU-Haushalte über einen Internetzugang. Viele besitzen auch smarte Geräte, die sich mit dem WLAN verbinden, z.B. persönliche Assistenten wie Alexa, Siri oder Google Home, aber auch smarte Haushaltsgeräte oder andere Elektronik wie Lampen.

People love being connected! It is estimated that 94% of EU households have internet access. People also own "smart" devices that connect to Wi-Fi, such as personal assistants (Alexa, Siri, Google Home) and smart appliances and electronics such as lights.



**Die Messsysteme der Zukunft**  
The monitoring systems of the future

### Wie „sieht“ man mit WLAN? How to monitor using Wi-Fi?

WLAN verwendet Strahlung, um Informationen von einem Ort zum anderen zu übertragen. Strahlung (Licht) ist auch das, was wir zum Sehen nutzen! Licht interagiert mit der Umgebung mittels Reflexion, Absorption und weiterer Mechanismen. Die Umgebung beeinflusst daher die empfangenen Signale. Indem man rückwärts arbeitet, um zu berechnen, woher das Licht kommt (die Quellen bestimmt), kann man eine Vorstellung von der Umgebung und der enthaltenen Objekte bekommen.

*Wi-Fi uses light to transfer information from one location to another. Light is also what we primarily use to see! Light interacts with the environment reflecting, absorbing, transmitting and more. The environment therefore affects the signals received. By working backwards (reverse image source solving) to calculate where the light is coming from, one can get an idea of an environment and its contents.*

Eine Glühbirne beleuchtet ein Kätzchen. Das Licht wird in unsere Augen reflektiert und macht das Kätzchen sichtbar. Kein sichtbares Licht = kein Kätzchen in Sicht!

*A lightbulb illuminates a kitten, which reflects light into our eyes, making it visible. No visible light = no seeing the kitten!*

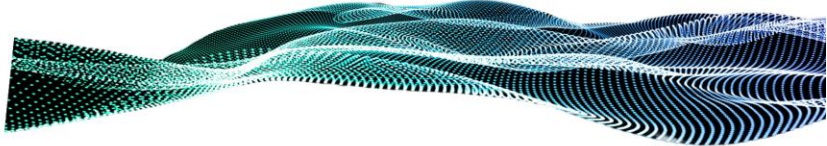
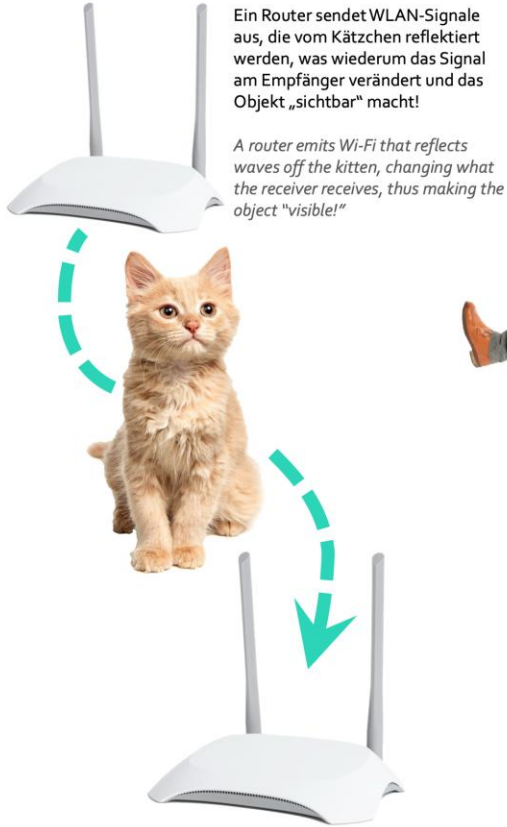
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# Wie „sieht“ man mit WLAN?

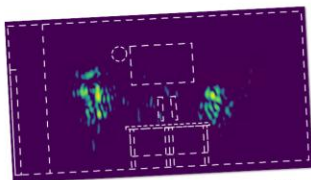
How to monitor using Wi-Fi?



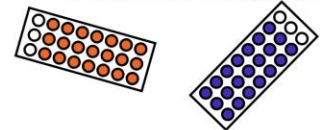
Das war eine Menge an Informationen. Wie viel wussten Sie davon bereits?  
*That was a LOT of information. How much of this did you already know?*

WLAN kann nicht so „sehen“ wie wir!  
 Manche behaupten, dadurch könnte die Privatsphäre besser geschützt werden.

*Wi-Fi cannot "see" the same way we see!  
 Some argue that this makes it more "privacy preserving."*



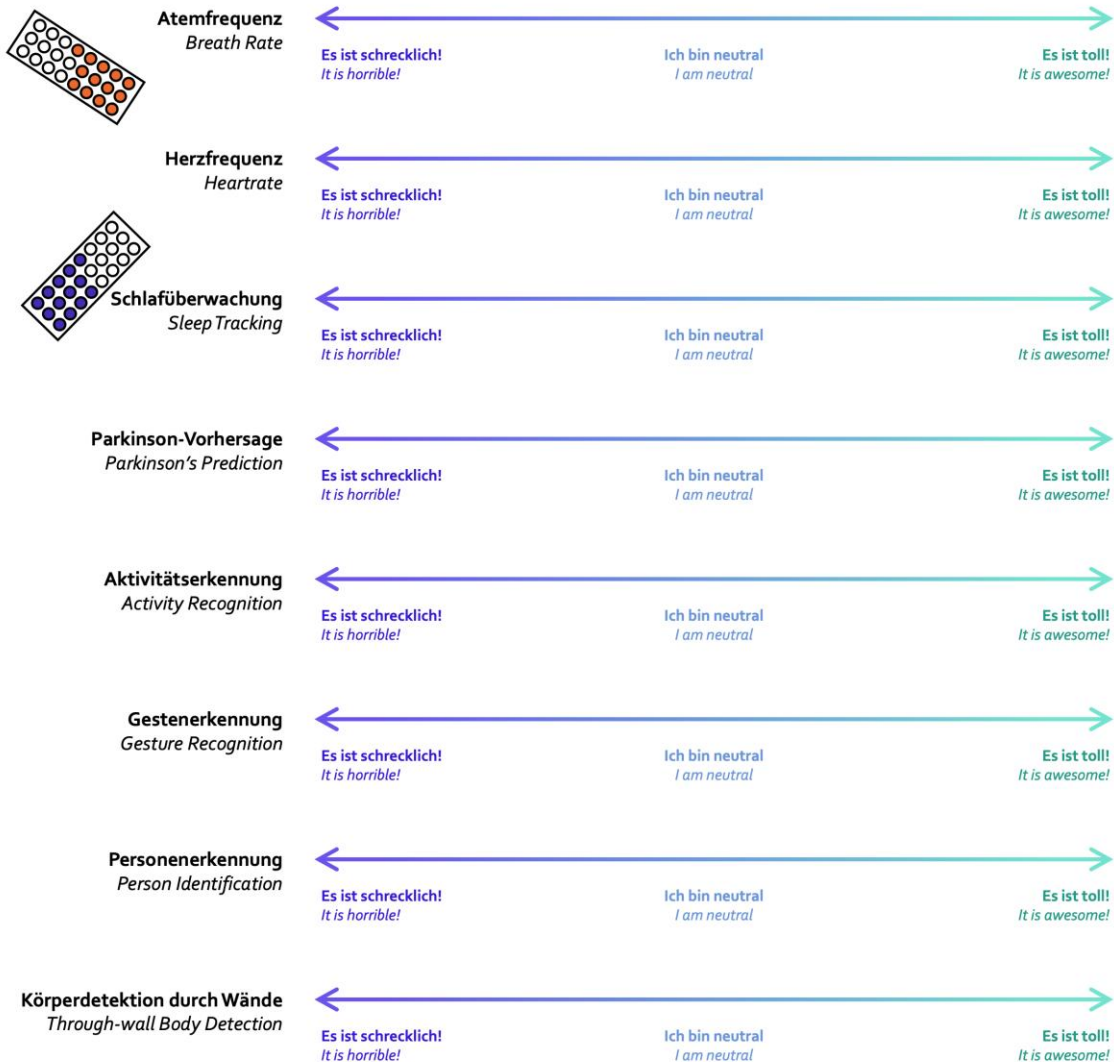
RF Imaging Credit: Technical University Munich



## Was kann man mit WLAN-Monitoring machen? What can you do with Wi-Fi monitoring?

WLAN-Wellen wurden schon für folgende Anwendungen genutzt! Was halten Sie davon? Stimmen Sie auf der „Gruselig-bis-Cool-Skala“ ab!

Wi-Fi waves have already been used for the following applications! Cast your vote on how it makes you feel on the "Creepy to Cool Meter."



# Willkommen in 2035

## *Welcome to 2035*

*Jetzt, wo Sie wissen, wie WLAN-Monitoring funktioniert, versetzen wir Sie nach 2035. Die Produkte, die Sie gleich sehen werden, sind bereits fast zehn Jahre auf dem Markt. Genau wie Mobiltelefone, Laptops und digitale Assistenten der 2020er Jahre wurden sie von der Gesellschaft übernommen und normalisiert.*

*Wir brauchen Ihre Hilfe, um herauszufinden, wie diese Tools Sie beeinflussen und ob sie die Gesellschaft verändert haben.*

### *Sind Sie bereit für die Mission?*

*Now that you have learned how Wi-Fi monitoring works, we are dropping you in 2035. The products you are about to view have been on the market for almost a decade. Just like the cellphones, laptops, and digital assistants of the 2020s, they have been adopted and normalized by society.*

*We need your help to know how these tools affect you and have shifted society.*

### *Are you up for the mission?*

**Diese Ausstellung nutzt kein WLAN-Monitoring, um Sie zu verfolgen.**

*This exhibit does not actually use Wi-Fi monitoring to track you.*

# Personen-/Objekterkennung

## Person/Object Detection

**Im Jahr 2035 nutzen die meisten Museen, wie auch dieses Museum, eine Kombination aus Überwachungsmethoden, darunter auch RF-Überwachung!**

Traditionelle Kameras benötigen klare Sichtlinien und Licht, was zu toten Winkeln führt! Bewegungsmelder haben Probleme mit statischen und langsam bewegten Objekten und sind anfällig für Fehlalarme durch Umweltfaktoren wie Temperaturschwankungen.

Die RF-Sensortechnologie ist jedoch eine nicht-invasive und zuverlässige Methode, um Personen oder Objekte zu identifizieren, selbst im Dunkeln, wenn sie aus dem Sichtfeld oder hinter Barrieren versteckt sind.

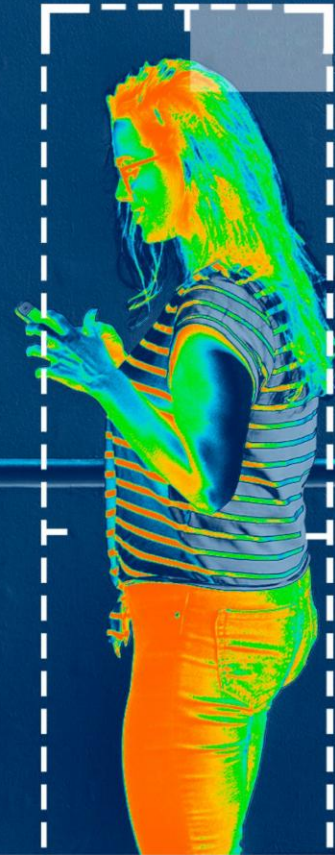
Außerdem kann die RF-Sensorfunktion nahtlos in bestehende Technologien wie Kameras, Präsenzsensoren und intelligente WLAN-Geräte integriert werden, sodass eigenständige Lösungen in vielen Fällen überflüssig werden.

**In 2035 most museums, such as this one, use a combination of surveillance methods, including RF monitoring!**

*Traditional cameras require clear lines of sight and light, which leaves blind spots! Motion detectors struggle with static and slow-moving entities and are prone to false triggers caused by environmental factors like temperature fluctuations.*

*RF sensing technology however is a non-invasive and reliable method for identifying people or objects even in the dark, when they are hidden from view or concealed behind barriers.*

*Moreover, RF sensing functionality can be seamlessly integrated into existing technologies, such as cameras, presence sensors, and smart Wi-Fi devices, eliminating the need for standalone solutions in many cases.*



## Bewertungen Reviews

"Meine Nachbarn haben dieses System installiert. Ich denke immer wieder, dass sie mich durch ihre Wände hindurch verfolgen können. Ich habe es auch, damit ich sie zurückverfolgen kann, falls nötig!"

*"My neighbor has this system installed. I keep thinking that they can track me through their walls. I got one too so I can track them back just in case!"*

"Wir haben die Verantwortung, unsere Besucher sicher zu halten. Metallgegenstände sind stark RF-reflektierend und mit dem System können wir sehen, ob jemand Waffen ins Museum bringt. Es ist auch einfach, mit unserem integrierten WLAN ein Überwachungssystem für das gesamte Museum zu erstellen. Wenn die Technologie schon vorhanden ist, kann man sie auch nutzen."

*"We have a responsibility to keep our patrons safe. Metal objects are highly RF reflective so we can see if people are bringing weapons into the museum. It is also easy to make a museum wide surveillance system using our integrated Wi-Fi. If the technology is there, you might as well use it."*

"Wir sparen sehr viel Energie in der Firma, indem wir verfolgen, wann die Räume genutzt werden oder leer sind! Ich kann auch sehen, was meine Mitarbeiter machen... oder zumindest, ob sie an ihrem Schreibtisch sitzen oder auf dem Flur plaudern! Es ist auch viel besser als Kameras, weil es weniger invasiv ist!"

*"We save so much energy at the company tracking when the rooms are used or empty! I can also see what my employees are up to...or at least if they are at their desk or in the hallway chatting! It's also so much better than cameras because it is less invasive!"*

"Nachts fühle ich mich viel sicherer, wenn ich weiß, ob unten etwas oder jemand herumschleicht. Das Beste ist, dass sie sich nicht verstecken können!"

*"I feel so much safer at night knowing whether something or someone is creeping around downstairs. The best part is that they cannot hide!"*

**Was halten Sie davon, wenn RF-Personen-/Objekterkennung an folgenden Orten installiert wird?**  
*How do you feel about RF Person/Object Detection being installed in the following locations?*

<b>Dieses Museum</b> <i>This museum</i>	←	<b>Es ist schrecklich!</b> <i>It is horrible!</i>	<b>Ich bin neutral</b> <i>I am neutral</i>	<b>Es ist großartig!</b> <i>It is awesome!</i>	→
<b>Ein Büro oder Campus</b> <i>An office or campus</i>	←	<b>Es ist schrecklich!</b> <i>It is horrible!</i>	<b>Ich bin neutral</b> <i>I am neutral</i>	<b>Es ist großartig!</b> <i>It is awesome!</i>	→
<b>Ihr Zuhause</b> <i>Your home</i>	←	<b>Es ist schrecklich!</b> <i>It is horrible!</i>	<b>Ich bin neutral</b> <i>I am neutral</i>	<b>Es ist großartig!</b> <i>It is awesome!</i>	→

**Hat die Gesellschaft sich durch RF-Personen-/Objekterkennung verändert?**

*Has society changed due to RF Person/Object Detection?*

Bitte schreiben Sie Ihre Meinung auf einen Notizzettel und geben Sie ihre Stimme in der passenden Box ab (ja oder nein)!

Ihre Meinung zählt! Ethiker von HOLDEN an der Universität Twente werden Ihre Antworten nutzen, um Anforderungen an ethische RF-Technologie zu formulieren.

Use a notecard to share your opinion and cast your vote in the box that fits your views (yes or no)!

Your thoughts matter! Ethicists in HOLDEN at the University of Twente will use your response to build requirements for ethical RF technology.

**Stimme ab: Ja oder Nein**  
**VOTE YES OR NO**



**(Wie, warum oder warum nicht?)**  
*(How so, why or why not)*



**"Klar, viele Wettbewerber haben RF-Wellen-Monitoring integriert, aber wir machen es am besten!"**  
*"Sure, lots of competitors have integrated RF wave monitoring technology, but we do it best!"*

# Smart (RF) TV

## Smart (RF) TV

### Benutzeridentifikation

*User Identification*



Jede Person ist einzigartig, und wir erkennen das. Speichern Sie bis zu sechs Benutzerprofile, und der Smart-TV wechselt automatisch zum richtigen Profil.

*Every person is unique, and we recognize that. Save up to six user profiles and Smart TV will go to the correct profile for individual watching.*

### Interaktives Fernsehen

*Interactive Watching*



Folgen Sie Workouts und erhalten Sie Techniktipps! Spielen Sie freihändig und entwickeln Sie Ihre eigenen Gesten- oder Bewegungssteuerungen!

*Follow workouts and get technique tips! Game hands-free and develop your own gesture or movement controls!*

### Gestenerkennung

*Gesture Recognition*



Unsere KI-Software bietet Gestenerkennung und sogar Gebärdenspracherkennung! Geben Sie einfache Befehle per Gebärdensprache und der Fernseher reagiert entsprechend.

*Our AI software offers gesture recognition and even sign language detection! Sign basic commands and the TV will respond accordingly.*

### Emotionserkennung

*Emotion Recognition*



Durch Messen von Herzschlag und Atmung können wir ein emotionales Profil erstellen, um Filme besser zu empfehlen (und zu produzieren).

*By measuring heart and breath rate we can develop an emotional profile to better recommend (and make) movies.*

### Aktivitätserkennung

*Activity Recognition*



Eingeschlafen beim Fernsehen? Der TV schaltet ab und merkt sich, wann Sie eingeschlafen sind. Raum verlassen? Kein Problem, der TV pausiert, bis Sie zurückkommen.

*Fell asleep while watching? The TV will shut off and note when you fell asleep. Left the room? Don't worry the TV will pause until you return.*

### Ständige Verbesserung

*Always Improving*



Unser System lernt kontinuierlich von Ihnen und Ihrer Familie. Die Genauigkeit verbessert sich mit der Zeit, während sich der TV an die neue Umgebung und Benutzer anpasst!

*Our system is constantly learning from you and your family. Accuracy improves over time as the TV adjusts to its new environment and users!*

# Wir vs. Andere Us vs. Others

	Wir / Us	Nicht wir / Not Us	Auch nicht wir / Also, Not Us
<b>Benutzeridentifikation</b> <i>User Identification</i>	90% genau   bis 6 Benutzer <i>90% Accurate   Up to 6 users</i>	80% genau   bis 4 Benutzer <i>80% Accurate   Up to 4 users</i>	X
<b>Gestenerkennung</b> <i>Gesture Recognition</i>	85% genau   30+ einzigartige Gesten <i>85% Accurate   30+ unique gestures</i>	80% genau   25 einzigartige Gesten <i>80% Accurate   25 unique gestures</i>	85% genau   10 einzigartige Gesten <i>85% Accurate   10 unique gestures</i>
<b>Schlafserkennung</b> <i>Sleep Detection</i>	95% genau <i>95% Accurate</i>	90% genau <i>90% Accurate</i>	90% genau <i>90% Accurate</i>
<b>Haltungserkennung</b> <i>Posture Recognition</i>	85% genau <i>85% Accurate</i>	X	X
<b>Emotionserkennung</b> <i>Emotion Recognition</i>	85% genau (Freude, Angst, Wut, Trauer) <i>85% Accurate: joy, fear, anger, sadness</i>	X	X

\*Genauigkeit basierend auf über 1000 Stunden Labortests  
\*Accuracy is determined by over 1000hrs of tests in our lab

## Kundenfeedback What our customers say

"Meine Tochter ist taub, und wir wollten, dass sie einen Smart-TV nutzen kann, der nicht auf Sprachsteuerung angewiesen ist. Für einfache Navigation und Anfragen funktioniert es großartig – sie hat gelernt, klar zu gestikulieren, damit der TV es versteht!"

"My daughter is deaf, and we wanted her to be able to use a smart TV that does not rely on voice controls. For basic navigation and requests it works great - she has figured out how to sign clearly for the TV to understand!"

"Mein Arzt sagt, ich verbringe zu viel Zeit sitzend. Es ist schön, dass der TV mich auffordert, zwischen Programmen aufzustehen, und mich warnt, wenn ich beim fernsehen einschlafe. Jetzt schaltet er ab, wenn ich müde werde, und schickt mich ins Bett."

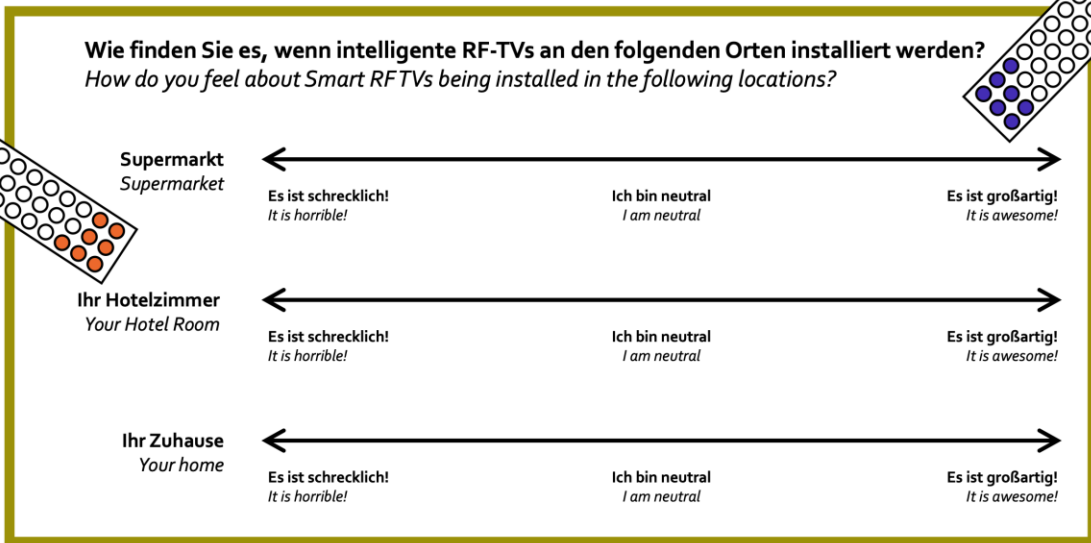
"My doctor says I spend too much time sitting. It is nice that the TV tells me to stand in between shows and has alerted me to my problem of falling asleep while watching TV. Now it shuts off when I am getting tired and tells me to go to bed."

"Unser Haushalt hat 7 Personen, sodass mein Jüngster kein Profil im System bekommt. Glücklicherweise ist er jetzt 3, also kein Problem, aber wir müssen etwas erfinden, wenn er älter wird. Vorläufig kann er Gastbenutzer sein, aber das fühlt sich in unserer Familie nicht ganz richtig an."

"Our household is 7 people, so my youngest does not get a profile in the system. Luckily, he is 3 now so that is not a problem, but we will have to figure something out when he gets older. For now, they can be a "Guest" user, but that does not fully sit right with the family."

"Ich habe letzten Monat sowas in einem Airbnb genutzt und habe mich gefragt, ob die Vermieter mich ausspionieren... als ob sie sehen können, was ich schaue und ob ich im Wohnzimmer bin, gruselig! Klar, es ist ihr Haus, aber es ist schon ein bisschen seltsam, oder?"

"I used one of these at an Airbnb last month and could not stop wondering if the hosts were spying on me...like they can see what I am watching and if I am in their living room or not, right?! I mean, I guess it does not matter, it's their home, but it's kind of weird, no?"



**Hat die Gesellschaft sich durch smarte RF-TVs verändert? (Wie, warum oder warum nicht)**  
*Has society changed due to Smart RF TVs? (How so, why or why not)*

Bitte schreiben Sie Ihre Meinung auf einen Notizzettel und geben Sie Ihre Stimme in der passenden Box ab (ja oder nein)! Ihre Meinung zählt! Ethiker von HOLDEN an der Universität Twente werden Ihre Antworten nutzen, um Anforderungen für ethische RF-Technologie zu formulieren.

*Use a notecard to share your opinion and cast your vote in the box that fits your views (yes or no)! Your thoughts matter! Ethicists in HOLDEN at the University of Twente will use your response to build requirements for ethical RF technology.*

# WLAN-Pflege

## Wi-Fi Care

### Was ist WLAN-Pflege?

WLAN-Pflege ist ein integriertes Wohnsystem, das nicht-invasive Einblicke und präventives Gesundheitswissen bietet. Durch kontinuierliche Datensammlung über tägliche Aktivitäten via WLAN-Monitoring bewerten wir Vitalität, Anfälligkeit für Krankheiten wie Parkinson, Schlafgesundheit und mentales Wohlbefinden. Unser System erkennt Probleme bevor Sie es tun!

### Datenaustausch

Dateneinstellungen variieren je nach Vertrag und Eigentumsmodell! Einstellungen bestimmen, welche Parteien Zugriff haben (beabsichtigter Benutzer, Pflgeeteam, Einrichtung, Versicherung, Familienmitglieder usw.). Zudem kann im Vertrag festgelegt werden, welche Daten gesammelt und welcher Partei gezeigt werden (Atemfrequenz, Herzschlag, Schlafscore, Vitalitätsmaß, Fortschritt chronischer Erkrankungen usw.).

Rabatte gibt es für vollständig offene Dateneinstellungen. Ihre Daten helfen der Forschung und Verbesserung der globalen Gesundheitsversorgung.

### Notfall-Einstellungen

Aus Sicherheitsgründen sind bestimmte Funktionen immer aktiv, wie Notfall-Sturzerkennung (Fälle, bei denen der Benutzer nicht aufsteht) und Bewusstlosigkeitsdetektion (wenn das System meint, der Benutzer atmet nicht mehr oder ist bewusstlos!).

### What is Wi-Fi Care?

*Wi-Fi Care is an integrated residential system providing non-intrusive insights and preemptive healthcare knowledge. By constantly collecting data on daily activity through WIFI monitoring, we assess vitality, vulnerability to diseases like Parkinson's, sleep health, and mental well being. Our system will recognize problems before you do!*

### Data Sharing

*Data settings differ by contract and ownership model! Settings determine what entities can access the data: intended user, healthcare team, care facility, insurance, family members, etc. Additionally, what data is collected and shown to each entity can be determined in the contract: breath rate, heartrate, sleep score, vitality measure, chronic disease progression, etc.*

*Discounts are available for those who choose fully open data settings. Your data will be helpful for research and to improve healthcare worldwide.*

### Emergency Settings

*Note: For safety reasons, certain features are always on such as "Emergency Fall Detection" (falls where the user does not get up) and "Unconsciousness Detection" (when the system believes the user has stopped breathing or rendered unconscious!)*



## Erfahren Sie, wie das Sunshine-Altersheim unsere Technologie nutzt

### Learn how Sunshine Elderly Home uses our tech



Das Sunshine Altersheim bietet Senioren seit über zehn Jahren WLAN-Pflege und würde Sie und Ihren Liebsten mit offenen Armen willkommen heißen!

Bei Sunshine glauben wir an nicht-invasive präventive Gesundheitsversorgung. Ihr smarterer Raum behält Sie im Auge, damit Sie und unser Personal sich keine Sorgen machen müssen. Unsere smarten Räume bieten frühe Parkinson-Erkennung, Atmungs- und Herzschlagdetektion, Vitalitätsbewertungen, Schlaftracking, Sturzerkennung, Stimmungsüberwachung und mehr.

*Sunshine Elderly Home has been empowering the elderly with Wi-Fi Care for over a decade, and we would love to welcome you and or your loved one into our warm shining doors!*

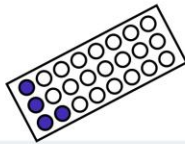
*At Sunshine we believe in non-invasive preemptive healthcare. Your smart room keeps an eye on you so that you and our staff do not need to worry. Our smart rooms offer early Parkinson's detection, breath and heartrate detection, vitality assessments, sleep tracking, fall detection, mood monitoring and more.*



## Kundenfeedback Customer Feedback

"Ich wohne allein und bin ein Biohacking-Nerd. Ich habe WLAN-Pflege zu Hause installiert, um sicherzustellen dass ich im Alter fit bleibe, ohne Wearables wie Smartwatches zu benötigen."

*"I live alone and am a biohacking nerd. I installed Wi-Fi Care in my home so I can make sure I stay fit as I age without the need for wearables like a smart watch."*



"Ich habe meinen Vater vor drei Jahren ins Sunshine gebracht und fühle mich beruhigt, dass ich seine Stimmung und Gesundheit prüfen kann, ohne ihn zu besuchen. Wenn sich sein Zustand verschlechtert, komme ich immer vorbei!"

*"I moved my father into Sunshine three years ago and feel comforted knowing that I can check his mood and health without visiting. When his condition worsens, I always come by!"*

"Ich wohne seit drei Jahren im Sunshine. Es hat weniger Personal und war günstiger als Alternativen, besonders mit dem „Verkaufen Sie Ihre Daten“-Plan. Ich konnte nicht mehr allein wohnen. Ich fühle mich sicherer, gemonitort zu werden. Man gewöhnt sich dran, wenn alle überwacht werden – wo ist das Problem?"

*"I have lived at Sunshine for three years now. It has slightly less staff than most homes and was more affordable than my other options especially with the "Sell Your Data" plan. I could not handle living alone anymore. I feel a bit safer knowing that I'm being monitored. Eventually, you just get over being surveilled, if everyone else is also being watched, then what is the big deal anyway?"*

"Vor einem Jahr kündigte der Eigentümer meines Gebäudes an, WLAN-Pflege in ALLEN UNSEREN WOHNUNGEN zu installieren?! Er hat gesagt, dass es nicht invasiv sei, da er unsere Gesichter nicht sieht, und das Internetunternehmen Rabatt biete. Es ist seltsam, aber bisher habe ich keinen Unterschied bemerkt...ich wüsste nicht mal, wo ich die Daten finden könnte."

*"A year ago, the owner of my building announced that he was installing Wi-Fi Care IN ALL OF OUR APARTMENTS?!? He said that it is not that invasive because he cannot see our faces, but that the internet company is offering it at a discount. I think it's a bit weird, but so far, I have not noticed anything different about my living situation...I would not even know where to go to find the data."*

### Was halten Sie von der Installation von WLAN-Pflege an folgenden Orten? How do you feel about Wi-Fi Care being installed in the following locations?

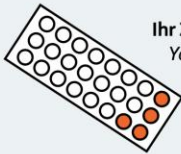
Mietwohnungen  
Rental Apartments



Altenpflegeeinrichtung  
Elderly Care Facility



Ihr Zuhause  
Your home



### Hat die Gesellschaft sich durch WLAN-Pflege verändert? (Wie, warum oder warum nicht) Has society changed due to Wi-Fi Care? (How so, why or why not)

Bitte schreiben Sie Ihre Meinung auf einen Notizzettel und geben Sie ihre Stimme in der passenden Box ab (ja oder nein)! Ihre Meinung zählt! Ethiker von HOLDEN an der Universität Twente werden Ihre Antworten nutzen, um Anforderungen für ethische RF-Technologie zu formulieren.

*Use a notecard to share your opinion and cast your vote in the box that fits your views (yes or no)! Your thoughts matter! Ethicists in HOLDEN at the University of Twente will use your response to build requirements for ethical RF technology.*



Sie sind in einem Sunshine-Studio mit WLAN-Pflege

An der Wand hängt ein Bildschirm mit den Daten des Bewohners.

Wie würden Sie die Daten nutzen?

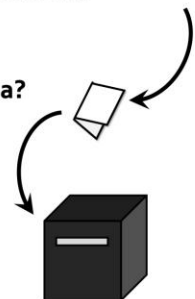
Füllen Sie das Formular aus!

You are in a Sunshine Studio with Wi-Fi Care

Above is a screen with data from the resident in this studio.

How would you use the data?

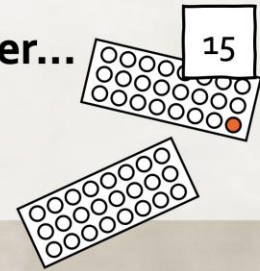
Fill out the form!



# Durch WLAN-Pflege fühlt sich ein Bewohner...

(kleben Sie einen Aufkleber auf alles, was Ihrer Meinung nach zutrifft)

*Wi-Fi Care makes a resident feel...(add a sticker for each you think applies)*



**Sicher** | *Safe*

**Ängstlich** | *Scared*

**Allein** | *Alone*

**Unterstützt** | *Supported*

**Ermächtigt** | *Empowered*

**Neutral** | *Neutral*

## Teilen Sie eigenen Ideen für Anwendungen mit RF-Monitoring

### Suggest your own RF monitoring application(s)



Bitte werfen Sie übrige Sticker weg und legen Sie die Hilfsbretter zurück, wenn Sie fertig sind.

When finished, throw out leftover stickers and return helper boards to the start.

Photo Attributions: 3D abstract modern techno background with flowing particles by kjaergeter - Freepik.com; LED Light Bulb Energy Efficient Illumination by sadartstudio - Freepik.com; Stunning Lake and Mountain View on Smartphone by tohamina - Freepik.com; White robot vacuum cleaner home electronics by rawpixel.com - Freepik.com; The red or white cat | on white studio by masters305 - Freepik.com; male looking surprised upwards pointing his finger at white studio wall by wayhomestudio - Freepik.com; Wireless router mockup 5G network device by rawpixel.com - Freepik.com; Full length portrait of a funny young bearded guy by drobotdean - Freepik.com; Mannequins at desk by Technical University Munich; RF Image of Mannequins at Desk by Technical University Munich; Composed of particles swirling abstract graphics, background of sense of science and technology by Iuzishan - Freepik.com; Body temperature during coronavirus pandemic thermal image by rawpixel.com - Freepik.com; Stunning Mountain Landscape Displayed on a Modern Smart TV by tohamina - Freepik.com; Vertical shot of happy dark skinned female with curly hair by wayhomestudio - Freepik.com; Lifestyle, people emotions and casual concept. Confident nice smiling Asian woman cross arms chest confident, ready to help, listening to coworkers, taking part conversation by benzoix - Freepik.com; Waist up portrait of handsome serious unshaven male keeps hands together, dressed in dark blue shirt, has talk with interlocutor, stands against white wall. Self confident man freelancer by wayhomestudio - Freepik.com; Happy man student with Afro hairdo shows white teeth, being in good mood after classes by wayhomestudio - Freepik.com; Close-up hand gesturing sign language by Freepik; Close-up hand gesturing sign language by Freepik; young woman relaxing on the couch by Freepik; Front view young male holding popcorn package and watching movie on the light-red wall male movie theater cinema film fun times by Kameerajydlow - Freepik.com; View of happy woman jumping in mid-air by Freepik; Brave armored knights with professional weapon fighting isolated on white studio background by masters305 - Freepik.com; Senior people confronting Alzheimer disease by Freepik; Full shot woman training with dumbbell by Freepik; Cute kid walking indoors with father by Freepik; Old patient suffering from Parkinson by Freepik; A woman wearing a white shirt to sleep by jcom - Freepik.com; showing surface bulletin painting sting by tirachard - Freepik.com; Medical infographic pack by pikisuperstar - Freepik.com; Old simple textured background design by rawpixel.com - Freepik.com. Lead Designer and Author: Dr. Sage Cammers-Goodwin Design Team: Daffa Kartika Paramitha & Blas Alonso Rodriguez

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