How to Know a Data Centre without Leaving your Cosmology at the Door?

An Augmented Reality Field Study

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1. Introduction

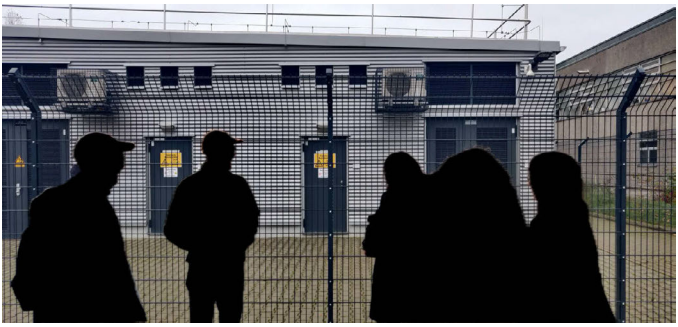
Data centres. Most people may have an idea of what they look like from the outside (cf. Fig. 1), perhaps also from the inside through stereotypical big tech PR photographs. Stories are told about them in the news when they are being built and when they cause trouble.[1] Yet, most of the time they are there, doing their job, usually unnoticed, and unknown by most. Such is generally the case with infrastructures.[2] This is particularly the case with cloud-technology, which is nothing more than IT running at a data centre. The cloud metaphor along with the uninterrupted availability of cloud services make end-users easily forget about the heavy CO_2 emissions, water and power consumption as well as the material extractions data centres, and thus the Internet, depend on. Popular media reports about how much tea water cooking is equivalent to a web search or an AI prompt may create some awareness of the electricity consumption of data centres, but they hardly help knowing data centres, even less care about their planetary relations. How can you know a data centre? How can you care? These are key questions of this chapter.

The distant relationship to data centres is related to the rational modes of knowing them. In the course of Modernity we have become more and more distanced from direct bodily experience of relations to the planet, leaving us with a distanced mode of knowing the plants and animals that are the basis of our nutrition, from the natural sources of heat and energy to our machines, and to the material foundation of the media by way of which we save our knowledge and process our data. This was entangled with the increased exploitation of plants and animals and the extraction of planetary minerals.

1 Cf. Starosielski, Nicole (2015): The Undersea Network, Durham, NC: Duke University Press.

2 Star, Susan Leigh (1999): »The Ethnography of Infrastructure«, in: American Behavioral Scientist 43:3, pp. 377–391.

Fig. 1: A university data centre, with some of the authors and other colleagues for scale



The standard story of rationalisation and exploitation is, however, further complicated by accounts establishing that bodily and experiential engagements have never completely vanished from the techno-science of Modernity.[3] Some analyses point to bodily engagement with the material foundation of data storage and data processing machines as caring modes of knowing computers which are accompanied by a sustainable relationship between humans, technologies, and the planet.[4] In the course of our ethnographic research on university data centres, scientists showed us their servers and pointed out their spinning sounds, their warm air flows and their flashing LED lights. »Listen«, one exclaimed during a visit, »someone just started a major computation task«. Like farmers caring for their animals[5] or car mechanics for their vehicles[6], scientists too use sensory clues to assess the wellbeing of servers if they are being pushed too hard or are running irregularly.

Such intimate, touching relationships with data centres, and such bodily knowledge of data centres are, however, reserved for the few. Data centres are bodily inaccessible to most. As large data fortresses they are carefully protected, and several

3 Cf. Knorr Cetina, Karin (1999): Epistemic Cultures. How the Sciences Make Knowledge, Cambridge, MA/London: Harvard University Press; Latour, Bruno (1993): We Have Never Been Modern, Cambridge, MA: Harvard University Press; Latour, Bruno/Woolgar, Steve (1979): Laboratory Life. The Construction of Scientific Facts, Beverly Hills/London: Sage Publications.

4 Maak, Niklas (2022): Servermanifest. Architektur der Aufklärung: Data Center als Politikmaschinen, Berlin: Hatje Cantz Verlag; Mauro-Flude, Nancy/Akama, Yoko (2022): »A feminist server stack: co-designing feminist web servers to reimagine Internet futures«, in: CoDesign 18:1, pp. 48–62.

5 Law, John (2010): »Care and killing. Tensions in veterinary practice«, in: Annemarie Mol/Ingunn Moser/Jeannette Pols (eds.), Care in Practice. On Tinkering in Clinics, Homes and Farms, Bielefeld: transcript, pp. 57–72.

6 Dant, Tim (2010): »The Work of Repair. Gesture, Emotion and Sensual Knowledge«, in: Sociological Research Online 15:3, pp. 97–118.

scholars report about being chased off the premises by guards when trying to take photos or in other ways getting closer to data centres.[7] Both scholars and other data centre users are kept non-knowing about what happens inside data centres.

Furthermore, like most state-of-the-art corporate data centres, the new university data centre which is the ethnographic source of the augmented reality data centre experience and which we discuss in this chapter, is operator-less. This makes any direct bodily and experiential knowing of a data centre even more unlikely. Servers are managed remotely, and only in exceptional cases is it possible for scientists to enter the university data centre, and only when accompanied by data centre staff. Software and dashboards provide all key indicators for monitoring server health, they state. It is technically no problem to maintain servers remotely—it is even beneficial, since one key risk to data security are humans. As one data centre staff told us, humans tend not to be able to keep their curious fingers to themselves, and often start touching things, although they have been told not to do so. This is when things tend to break. The tactile human mode of knowing servers is detrimental to their wellbeing. Bryan Cantrill's viral video »Shouting in the Datacenter« with Brendan Gregg of 2009 captures this idea in a humorous fashion.[8] Consequently, when scientists of that university start transferring their servers from their local server rooms to a new data centre in the course of data infrastructure centralisation, the scientists' intimate bodily relationships with their servers and their experiential knowledge of data centres will come to an end. Will their caring as well? Do experiential and bodily modes of knowing servers come along with a more sustainable relationship to data centres and to the planet; do they cultivate response-ability?[9]

Besides the bodily inaccessibility and non-knowing of data centres, we are also concerned with their cosmological inaccessibility. Who cares about data centres? Some engineers do, specialised computer scientists do, data centre managers and architects do, people training AI models do, and businesspeople selling data centres do. They care not simply because they have bodily access to data centres but because they have access to knowing data centres in specific ways. These are all highly specialised professional people with specialised knowledge of data centres. Other people do not care much about data centres, because they cannot care; the high degree of professional specialisation keeps non-specialised people afar from data centres. Engaging with data centres makes them feel incompetent, because they do not hold

7 E.g. Hogan, Mél (2015): »Data flows and water woes. The Utah Data Center«, in: Big Data and Society 2:2, pp. 1–12; Vonderau, Asta (2017): »Technologies of Imagination. Locating the Cloud in Sweden's North«, in: Imaginations 8:2, pp. 8–21.

8 Cantrill, Bryan/Gregg, Brendan (2009): »Shouting in the Datacenter«, in: YouTube.com (01.01.2009). Online: https://www.youtube.com/watch?v=tDacjrSCeq4 (last access: 11.11.2025).

9 Haraway, Donna (2016): Staying with the Trouble. Making Kin in the Chthulucene, Durham, NC: Duke University Press.

the specialised knowledge that has become the passage point for such engagements. Such non-knowledge makes them not care.[10] Yet, care we ~~should~~ must. Data centres are infrastructures which affect the data practices of societies, require a large share of the limited electric power available, extraction of earthly minerals, dependence on components fabricated under toxic and exploitative circumstances, and are built instead of building something else. So, *everybody* should care. Yet, how can you care for data centres when you do not hold the legitimate kind of specialist knowledge? Paraphrasing the Aboriginal scholar Tyson Yunkarporta who asks whether he must leave his cosmology at the door when entering Euro-Australian academic knowledge practices,[11] we ask *how to engage with data centres without leaving your non-specialist cosmology at the door?* In other words, *how can you care for data centres without becoming a data centre specialist, as non-knowers, or other-knowers?* This question became our leading question and put us on a track to look for ways to know data centres both bodily and as non-specialists.

This is a question about modes of knowing and about which representations evoke which modes of knowing. Contrary to the scientists' mode of knowing, the data centre is grounded on experiential and bodily engagements, knowing the data centre through indicators on a computer dashboard implies a representational, cognitive, and rational mode of knowing. Also, our own experiences of the data centre when visiting it during our ethnographic research were bodily and tangible. Yet our academic representations of data centres through descriptive analyses evoke a rational mode of knowing. How to discuss experiences of the data centre which exceed words? How to care for a data centre when the relation exceeds words?

In their studies of electric power, Watts et al. state that electricity is sensorially subtle,[12] which made them turn to the genre of graphic novels to transport the experience of this intangible matter. In the server room of a data centre, electricity is anything but subtle. There we felt the heat coming from the servers, the cooling pushed up from the double floor and through the racks, along with the continuous loud roar of the servers. The heat, the cooling and the noise are all energy *overflows* which human bodies relate to through experience. Which representation of a data centre can convey such experiences? This question motivated us to experiment with the development of an *augmented reality data centre experience* that allowed visitors to relate sensorily to representations of a data centre which we had experienced during

10 Cf. The Institute for Technology in the Interest of the People (2022): »Counter Cloud Action Plan«, in: titipi.org (2022). Online: https://titipi.org/pub/Counter_Cloud_Action_Plan.pdf (last access: 18.11.2025).

11 Yunkaporta, Tyson (2019): Sand Talk. How Indigenous Thinking Can Save the World, Melbourne: The Text Publishing Company.

12 Watts et al. (2021): »Unda: A Graphic Novel of Energy Encounters«, in: James Maguire/Laura Watts/Brit Ross Winthereik, Energy Worlds in Experiment, Manchester: Mattering Press, pp. 119–151.

our ethnographic research. As we will lay out below, an augmented reality data centre experience intervention with co-present performers provides us with the opportunity to experiment with affective encounters, bodily relations and spatial speculations. Screen based media representations like images, videos or PDFs do not adapt to bodily movement and cannot offer such spatial speculations.

Based on our interest in bodily care about and planetary relations to data centres, in modes of knowing data centres and in representations that evoke different modes of knowing, the chapter will entangle these matters rather than keeping them separate. This means that the accounts of this chapter meander seamlessly between the design of the augmented reality data centre experience as a representation, the university data centre that the augmented reality data centre experience represented, visitors' experiences of the augmented reality data centre experience and the modes of knowledge it evoked. It is part of the point of this chapter to emphasise that representations, design or technologies of representation, modes of knowing, and the experiences of representation are intimately entangled and mutually constitute each other.

The chapter is structured as follows: first, we briefly introduce to the technology of augmented reality. Second, we report from the ethnographic research which is the source material for the augmented reality data centre experience. After explaining the three versions of the augmented reality data centre experience we have set up we reach the main section of the chapter, which is a walkthrough of the third version of the augmented reality data centre experience. This walkthrough describes and analyses the beginning of the augmented reality data centre experience visit, the installation of the software, the visits to the so-called uninterrupted power system, the visit to the server space, and finally the exit from the augmented reality data centre experience. The walkthrough is followed by a discussion in the course of which we analyse modes of knowing of a data centre through an augmented reality data centre experience, after which the chapter closes with brief conclusion.

2. What is »augmented reality«?

What then is our augmented reality data centre experience? Bluntly put, it is a smartphone or tablet application for site-specific installations we host. Before going into our own construction below, a few general words for background:

Augmented reality (AR) is a notion and a set of design ideas for human-computer interaction (HCI) developed throughout the latter part of 20th century. It differs from virtual reality (VR) where users are audiovisually fully surrounded by computer generated content, typically using head-mounted display (HMD) goggles. In contrast, augmented reality—as the term implies—takes the ordinary perceived surrounding of a person as a starting point and augments it by adding computer gen-

erated elements. Undoubtedly, the most notorious and obnoxious commercial AR product (so far) has been the now fortunately cancelled Google Glass. If the added elements are visual—which is most often the case— users can see them through the camera display of a mobile device—looking as if they were located within the physical environment. The point of augmented reality is therefore not to temporarily replace ordinary reality and immerse users in an entirely virtual one but precisely to add on and augment the familiar environment with helpful, useful, fun or strange elements. Furthermore, we complicate any straightforward notions of reality and add on to the controversies about normative ideals of augmentation and enhancement in the course of the discussion below.

Contemporary smartphones have the advantage of being programmable, powerful, networked computing devices with cameras, and of course of being ubiquitous commodity items of consumer electronics. In comparison to VR through head mounted displays, AR on handheld devices offers possibilities to provoke relational encounters on many layers, because their interference with the more-than-human environment is more obvious.[13] Users see the physical and social space around them through the camera of the device and all around the device, so they can interact with their surrounding in the same ways as the surrounding affects their experience, forming a mutual »relational intervention«.[14]

We believe that such a reality-altering perception-technology has the potential to experiment with perceivable, relatable, and affective reality layers added to already reality augmenting technologies, such as data centres.

3. The assembling of an artificial augmented reality experience

We spent a few months on ideating, designing, prototyping and iterating the conceptual, material and performative elements of the augmented reality data centre experience. What we gradually developed was a smartphone app for Android and iOS devices and a scripted performance of a hosted visit to the data centre. The vertical, full-screen app displays a live preview of the camera viewfinder of the smartphone and overlays it with a three-dimensional computer-generated image model (Fig. 2). The performance script starts with an entry into the data centre and ends with checking out (the walkthrough describes how the script came to be performed).

13 Heemsbergen et al. (2021): »Conceptualising Augmented Reality. From virtual divides to mediated dynamics«, in: Convergence. The International Journal of Research into New Media Technologies 27:3, pp. 830–846.

14 Fehrenbacher, Jens (2024): »AR als Relationale Intervention. Dynamiken ästhetischer Aushandlung zwischen Medientechnologie, Nutzenden und Umwelten«, in: IMAGE. Zeitschrift für interdisziplinäre Bildwissenschaft 39, pp. 78–102. Translation by the authors.

Fig. 2: Augmented reality data centre experience app in use

The augmented reality data centre experience visitor holds their phone in their hand, pointing the camera around them, while redirecting their attention to the space they see via the screen. As the visitor moves their smartphone and themselves, the app recalculates and renders the virtual objects around them in a sometimes smooth, sometimes irritating way.

3.1 The ethnographical material

The assemblage of the augmented reality data centre experience was based on extended ethnographic research on the relation between scientific practices,[15] university data centres,[16] and the planetary matter that, through fabrication and supply chains, are brought to and built into servers that help produce scientific knowledge

15 Çelik, Leman/Sørensen, Estrid (2025): »Scientific engagements with data infrastructures and their planetary matter«, in: Zeitschrift für Empirische Kulturwissenschaft 121:3.

16 Sørensen, Estrid/Laser, Stefan (2023): »Towards Artful Sustainable Integration of IT Infrastructures. A Report from the Construction of a University Data Centre«, in: Patricia Jankowski/Anja Höfner/Marja Lena Hoffmann/Friederike Rohde/Rainer Rehak/Johanna Graf (eds.), Shaping Digital Transformation for a Sustainable Society. Contributions from Bits & Bäume, Berlin: Technische Universität Berlin, pp. 87–90.

at German universities. For the augmented reality data centre experience we particularly selected material from visits to one specific university data centre. This data centre is located at a German university. Prior to the data centre, the university had what they called a »machine hall« which hosted racks of servers set up by scientists across departments. When we visited it several years ago, its key operator excused the *mess* lying around. They hinted at some boxes with cables in the corner as well as tools and rack parts lying around. Even a few plastic figurines were placed on a shelf in the middle of the room. To the ethnographers, this *mess* was all traces of social engagements with the servers.[17] Now, the building hosting the machine hall was to be demolished due to asbestos, so a new solution for server hosting had to be found. This started a process that became strongly influenced by scientific and technological developments in the second decade of the 21st century: heavy increase in scientific knowledge generation through digital data processing, intensified competition between universities, trends towards centralisation and professional non-scientific management of computing facilities, among others. This led to the decision to build the university's own central, operator-less data centre, which came to be one of our ethnographic field sites. »Its really hot in here, everything seems to hum loudly. Tiny, coloured lights are doing their thing, blinking to their own rhythm«, one of us scribbled into their notebook during the visit. Although there were a few cautionary hints to not hit your head on sharp corners as well as warning tape on the floor that indicated human presence in the data centre, this new server farm was much more sterile than the no longer existing machine hall, and indeed a hostile place for human agency. Our visits to the university data centre resulted in a varied collection of audio and video recordings, photos, field notes, 3D scans, planning documents and memories. As is a general principle in ethnographic research, the collected material was not treated as isolated data to be analysed independently of the experience of the field. On the contrary, references to the field were kept alive and key to validating our interpretations. Regardless of whether we write a naturalistic representation of the data centre or develop an augmented reality data centre experience, the guiding principle for the interpretations and translations of the ethnographic observations is always to stay true to the heterogeneous experiences in and of the field. What Valentine says about SF—»science fiction/spookily familiar/strangely or strongly factual/so far«[18]—also applies to our augmented reality data centre experience: »SF worlds lie in the gap between real-world science and human […] exploration on the one hand, and futurist/utopian thinking and sociopolitical experimen-

17 Law, John (2004): After Method. Mess in social science research, London/New York: Routledge.

18 Valentine, David (2018): »Evidently SF«, in: culanth.org (18.12.2018). Online: https://www.culanth.org/fieldsights/evidently-sf (last access: 18.11.2025).

tation on the other«.[19] As discussed in the introduction, and as will be attended to in more detail in the walkthrough below, data centres are challenging ethnographic sites. They offer rich bodily and sensual experiences which are rarely conveyed in data centre literature and which are only poorly represented in the dominating analytical medium of ethnography, which is writing. This was the background for experimenting with augmented reality, which does, however, not compromise our commitment to the research's ethnographic reality.

3.2 Building process

We created three iterations of the augmented reality data centre experience for three different academic events (see below). The size of the three iterations ranged between 20 to 40 metres in diameter, each in different shapes depending on the location of the event. To respond to the differing local environments within which the augmented reality data centre experience spawned into appearance, it was necessary to get to know the respective sites. We scouted the locations, took photographs, inspected layout plans, measured and estimated, looked for nooks, crannies and other interesting physical features. Contrary to a virtual reality application, which is entirely computer generated and thus fairly independent of the place of use, an augmented reality needs to be situated and carefully adapted to the space of use. The virtual objects have to be placed within the four walls of a room, and physical objects have to be carefully worked around.

We built and collected three-dimensional models as virtual objects for the augmented reality data centre experience, and we experimented with their arrangements, lines of sight, feelings of space, interactions, and software code. We fervently hoped the presentation sites to be older campus buildings; walls which display the wear and tear of generations of students soon became our friends, because it is hard to convince the augmented reality data centre experience to perform at its best within a flawless environment. It slips away easily, as if refusing to stay in the same place.

The virtual objects of the augmented reality data centre experience were mainly generated from the digital material from the ethnographic visit to the data centre. In addition, we used some generic, prefabricated default objects. All objects and soundscapes of an engine and of wide spectrum noise were organised into a scene in the popular game development engine Unity. Some objects were in all three setups, others were included in only some of them. In later developments we employed data centre-based artificial intelligence to generate three dimensional objects from some of our photographs of the backup batteries and gas cylinders, as will be discussed below. In a way, we thus asked the data centre to describe itself. Designing

19 N.p.

the augmented reality data centre experience and adapting it to a specific environment needed tinkering. It also asked for constraint.

3.3 Three setups

We presented our augmented reality data centre experience three times: at the joint EASST/4S 2024 conference in Amsterdam, at the CRC 1567 *Virtual Lifeworlds* annual 2024 conference in Bochum, and at the STS-Hub 2025 conference in Berlin.

The first time, at EASST/4S 2024, it was staged as a curated intervention within a panel dedicated to planetary data infrastructures. Here, eight volunteering colleagues from the audience were invited to roam the front of the lecture hall, device in hand, as part of a staged and choreographed presentation—a kind of data theatre which foregrounded embodied engagement. Parallel, one of us gave a presentation analysing the planetary relation of the augmented reality data centre experience. The second installation of the augmented reality data centre experience featured as one of three stops on an »infrastructure walk« across the Ruhr University Bochum campus during the annual conference of the collaborative research centre *Virtual Lifeworlds*. Organised in rotating groups of twenty people each, the participants of the infrastructure walk encountered the augmented reality data centre experience while being themselves in transit—sometimes sharing a phone to access the data centre, sometimes using a single unit—as they passed through different scenes. Some were in a rush or restraint, some were rushed or restrained by us to keep the pace of the rolling format. This mode emphasised movement, circulation, and the partial, fragmented ways people interface with infrastructures. Finally, at STS-Hub 2025 in Berlin, the augmented reality data centre experience took on the form of an exhibition piece in a temporary exhibition space of the *Drift. Sink. Emerge. Repeat. Multimodal Submersion as Diffractive Practice* exhibition with many other works consisting of images,[20] installations, sculptures, and performances.[21] The augmented reality data centre experience was open to visits during a single two-hour time slot, though participation often hinged on serendipity—on luring in curious passers-by and prompting spontaneous engagement.

Across these modes—staged, in-motion, and ambient—the augmented reality data centre experience shifted in function and form. It offered insights into the device itself and its design as a representation of a real data centre, into the knowledge and non-knowledge related to the augmented reality data centre experience and

20 Online: https://sts-hub.de/25/exhibition.html (last access: 20.10.2025).

21 Le Calvé, Maxime/Beck, Petra/Stock, Robert (2025): Drift. Sink. Emerge. Repeat. Diffracting the Critical through Multimodal Submersion. A Catalogue to the STS HUB 2025 Exhibition (07.03.2025). Online: https://drift-sink-emerge-repeat.pubpub.org/pub/jt8j21yd/release/1?readingCollection=8775d7ad (last access: 18.11.2025).

what was evoked by it, and also into how infrastructures are experienced through situated practices of presentation and interaction in and through an augmented reality data centre experience.

4. A walkthrough of the STS-Hub 2025 augmented reality data centre experiences

In this section we present a walkthrough through the third setup of the augmented reality data centre experience at the STS-Hub 2025 in Berlin. *Walkthrough* is a video gaming term referring to a processual description of how the gamer may get through the game.[22] We find this method helpful to account for not only the design and design decisions of the augmented reality data centre experience but also for the experiences of the visitors and the representational references of the augmented reality data centre experience to the data centre we experienced during our ethnographic visits. As is typical for walkthroughs, ours starts from the entrance to the augmented reality data centre experience and ends with leaving the AR.

4.1 Passage into the data centre

As described before, the augmented reality data centre experience was set up in the space of the *Drift. Sink. Emerge. Repeat* exhibition at the STS-Hub 2025 conference in Berlin. In other words, the augmented reality shared its space with other exhibitions. This was in contrast to the *green fields* often referred to in data centre lingo when indicating a building site. It resonates the colonial idea of terra nullius—a space that is empty, where nothing exists—as justification for occupying and exploiting it. Situating the augmented reality data centre within the exhibition space intervened with this idea—a space is never empty, which also created challenges for visitors to the augmented reality data centre experience. That will become clear below.

The experience started with a sign-in procedure. Since an augmented reality application outside the device is just as unnoticeable as data centres are to most people in their daily lives, we designed a physical setup to draw people's attention to it. It consisted of a sign dangling above a neon-coloured high-visibility vest wearing team member at a desk in the exhibition room. On the desk two clipboards waited with lacklustre printed forms for people to sign-in.

The augmented reality data centre experience entry procedure was a reference to our own ethnographic visit to the data centre, which also started with signing our

22 Light, Ben/Burgess, Jean/Duguay, Stefanie (2016): »The walkthrough method: An approach to the study of apps«, in: New Media & Society 20:3, pp. 881–900.

names into the data sheet, additionally to the time of arrival. This security measure is required by the DIN EN 50600 Data Centre Norm. Access to data is closely regulated to protect the data. Upon our visit to one data centre, our guide and interlocutor shared an anecdote with us: When the technical supervisor came to examine the data centre for attaining the data centre protection class 3, the somewhat nervous data centre operator was quick to open the door to the server room for the supervisor to enter. The supervisor inquired discontent: »don't you sign in visitors here?« With a relieved laugh our data centre guide told us that this was when they almost lost the certificate even before the examination started. Of course, the supervisor was aware of the difficulty to perform a normal situation when it was indeed an examination and was happy to see the sign-in form ready next to the door of the data centre. Accordingly, we also asked visitors to the augmented reality data centre experience to sign in. This procedure indicates the exclusive place of the data centre—not everyone is allowed to enter, and only upon revealing their identity.

In the exhibition space of *Drift. Sink. Emerge. Repeat* at the STS-Hub we observed a similar display of trust regarding the registration process as we had experienced at the data centre. A vast majority of visitors entered their actual personal data. When one person hesitated, one team member pointed to the augmented reality of the experience and suggested to simply make up some data. This of course never happened during our visits to data centres. The suggestion was met with emphatic and ironic protest: »It's a form! I can't lie to a form!« At the other end of the spectrum one user inquired the whole set-up sceptically right from the start. After challenging the need to protect the data in the augmented reality data centre experience they commented: »Oh! And now you're collecting personal data?!« Marking our position as gatekeepers to the data centre, they hinted at the data paradox between legal obligations and daily practices of data protection which we met in real life during our own data centre visits as well.[23] The data the visitor form asked for are legally classified as personal, meaning that they require safe storage in accordance to specific norms for sensitive data. Yet, while signing in, visitors could glimpse completely unhindered at the personal information of former visitors.

After the signing-in process the visitors' attention was drawn to a metal stool and the cotton shopping bag from German supermarket discount chain *Netto* holding stocks of blue plastic shoe covers, or as we called them in the team: data protection. At our field visits to data centres we found these shoe covers next to the door to server rooms and were advised that servers are highly dust and dirt sensitive, making shoe covers mandatory. Importantly, they are there not to protect the shoes but to protect the data. Visitors were asked to wear these data protections during the entire visit of the augmented reality data centre experience.

23 Hoeyer, Klaus (2023): Data Paradoxes. The Politics of Intensified Data Sourcing in Contemporary Healthcare, Cambridge, MA/London: MIT Press.

The sign-in procedure brought on some curious observations. First of all, the hesitation to engage spontaneously might well be an indicator that people did not know (yet) how to engage with the augmented reality data centre experience that was at their disposal. In the explorative conversations, many appeared to look for ideas of what to expect, and maybe understandably so. A full-hearted decision in favour of a profoundly unknown endeavour is a courageous and sometimes dangerous step to take. In this situation of bafflement, a sign hanging from the ceiling was even instructing them to »Pay attention to how the data centre feels. You'll need it later!«

4.2 Installation

Having been subjected to the vigorous data protection procedures at the registration desk, the documented visitors were handed over to the colleague at an adjacent standing table to run through the technical preparation procedure.

With either an Android or an iOS device, visitors scanned a QR code to download the app. Given the prototype status of the application, this did not result in a smooth setup; instead, it offered a thematically fitting experience of the restrictions, barriers, and idiosyncrasies surrounding data storage, ownership, and access to computer resources. Entirely different processes had to be prepared and guided for installation on Android and iOS devices. The Android installation package was stored in a publicly accessible folder on Sciebo, a regional file-hosting university cloud service. To install this package, however, visitors first had to allow applications to be installed from what Google considers untrusted sources in the smartphone's settings. Trust has to be actively granted to all sources outside the Google's Play Store, which led to doubts on-site: »How do I know I can trust you and this application?«; »Do I want the application to access my camera?«.

On the other hand, Apple's iOS operating system does not provide an option for installing apps outside their own ecosystem. Here we had to upload the app to Apple's own data centre, where the file was (opaquely) checked and only released for beta testing on the second attempt.[24] The app was not publicly accessible via the App Store but only through TestFlight, yet another program designed solely for iOS beta tests, which also had to be installed on the visitors' smartphones. Furthermore, with both iOS and Android, the menu navigation varied depending on the device and operating system. For some we learnt workarounds during the event, for others we had to give up in frustration. At times we handed out our prepared tablet or even private phones if nothing else worked. Reframed as being productive, these troubles also led not only to communication and reflection on restrictions and platform politics, but

24 Cf. Nieborg, David/Poell, Thomas (2019): »The Platformization of Making Media«, in: Mirjam Prenger/Mark Deuze (eds.), Making Media. Production, Practices, and Professions, Amsterdam: Amsterdam University Press, pp. 85–96.

also to cooperation. Sometimes, when someone could not install the app, they spontaneously joined another person and their device and visited the augmented reality data centre together, which motivated more discussion and reflection.

4.3 Aligning

For the augmented reality data centre experience to start, it was crucial to align the app, the device, the users' bodies, and the physical space. Technically, this was necessary because the virtual objects were precisely adapted to the specific space of the exhibition. No room or object recognition were available to automatically align virtual and physical space. Users, therefore, had to start the app at a precise spot predefined by our design, facing a specific direction, to prevent the intended path to lead visitors through walls and for the objects to appear within the walls of the exhibition room. This technical necessity led to dynamics of aligning bodies with the technology.[25] Tape on the floor marked the starting point, and a photo of the data centre hanging from the ceiling indicated the orientation of the device. Instead of a seamless user experience at startup, this seamful interaction design created an experience of fragility: the virtual data centre required careful handling and meeting various requirements.[26] It demanded commitment from the users, turning them into participants of active experiences, different from a detached tourist gaze.

Upon launching the augmented reality data centre experience on the smartphone, the exhibition space—when watched through the display of the device—filled with virtual objects viewable from different angles and distances (Fig. 3). A purple line at floor level, roughly resembling a cable, guided users through the entire spatial and virtual arrangements and established a choreography for the walk.

The necessity of active contribution by the visitors underscores that the actualisation of virtuality includes the possibility of failure.[27] Contrary to smooth commercial applications, the augmented reality data centre experience included its technological infrastructure—and indeed the physical room—into the experience. If the app was started too early or in the wrong spot, the virtual objects could be placed behind a wall or outside a window—not matching the physical space—which made

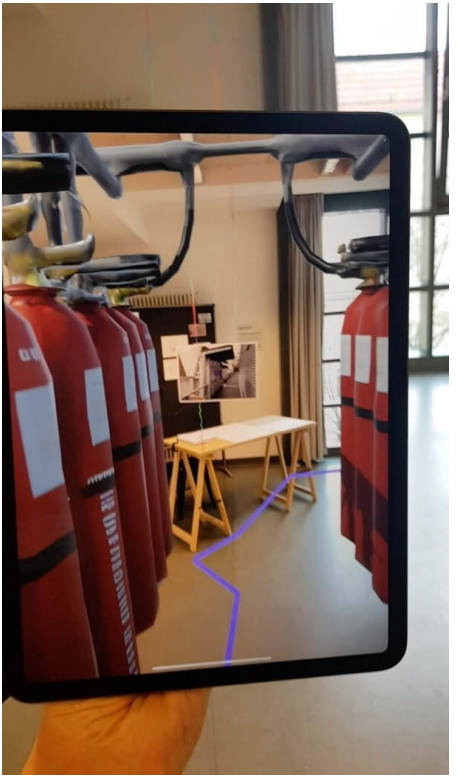
25 Friedrich, Kathrin (2021): »Imageability‹. Aligning bodies and imaging technologies«, in: Sara Hillnhuetter/Stefanie Klamm/Friedrich Tietjen (eds.), Hybrid Photography. Intermedial Practices in Science and Humanities, London/ New York: Routledge, pp. 71–78.

26 Chalmers, Matthew/Galani, Areti (2004): »Seamful Interweaving. Heterogeneity in the Theory and Design of Interactive Systems«, in: DIS2004. Proceedings of the 5th conference on Designing interactive systems: processes, practices, methods, and techniques, New York, NY: Association for Computing Machinery, pp. 243–252.

27 Stengers, Isabelle/Latour, Bruno (2015): »Die Sphinx des Werks«, in: Étienne Souriau, Die verschiedenen Modi der Existenz, Lüneburg: Meson Press, pp. 9–80.

objects inaccessible and required a restart. Alignment became an active, palpable engagement that demanded caution and came along with ongoing uncertainty.

Fig. 3: The start of the augmented reality data centre app: Exhibition room with virtual line, extinguishing gas cylinders and physical image hanging from the ceiling



4.4 Extinguishing gas

Even before visitors had become familiar with this strangely amalgamated scenery, they found themselves in the middle of a corridor of two-meter-high gas cylinders (Fig. 4). The purple cable showed the way beneath the photo pointing the way. Instead of walking around the photo and risking potentially moving through the virtual gas

cylinders, almost without exception participants ducked under the hanging photo. As it turned out, the virtual affordances possessed a decidedly urgent quality.[28]

The virtual gas cylinders mimicked one of the many emergency systems within the real data centre. In there, they were filled with a fire extinguishing gas which was automatically routed to any fire source via a pipe system. The specific gas, 3M's Perfluoro(2-methyl-3-pentanone) product Novec 1230, also known as »dry water«, was chosen because—in contrast to, for example, the familiar wet water—it does not harm servers, as our data centre guide explained during our ethnographic visit: another hint that data protection is a priority for data centre operators.

Aiming at evoking experiences of relating with data centres rather than offering naturalist representations, we did not create a naturalistic representation of the equipment. However, grounding the augmented data centre experience in the ethnographic material was crucial, and we took great care in relating to the phenomenology of the physical objects of the data centre via size, quantity or materiality. They can thus be regarded »speculative reconstructions« in the course of which the process of translation is not considered frictionless but influenced by more-than-human agencies.[29] Using a commercial generative AI service, we created the 3D models with photographs from our field visits as input prompts. The cylinder models—just like the battery and diesel engine models we will discuss below—were virtually distributed, grouped, and scaled in the space in accordance with the real data centre to create both a physical impression of their size and mass as well as evoke an affective closeness between structures. Such algorithmic renderings themselves operate within large datasets, photos, graphics, and models distributed across various servers and remixed into networked images by neural networks.[30] The generative AI service uses considerable data centre power, and we hope we did not cause any fire that, while rendering the cylinders, was extinguished with Novec 1230 gas.

On the wall in the physical space of the exhibition room and next to the renderings of the gas cylinders in the augmented reality data centre experience, visitors could see a large photographic poster of the gas cylinders from the real data centre

28 Breil, Patrizia/Kronberger, Alisa (2025): »Einleitung«, in: id. (eds.), Eigensinnige Objekte. Virtuelle Möglichkeitsräume zwischen Aufforderung und Entzug, Bielefeld: transcript Verlag, pp. 7–22; Alloa, Emmanuel (2019): »Undergoing an Experience. Sensing, Bodily Affordances, and the Institution of the Self«, in: id./Frank Chouraqui/Rajiv Kaushik (eds.), Merleau-Ponty and contemporary philosophy, Albany/ New York: SUNY Press, pp. 61–82.

29 Engemann et al. (2025): »Scalar Translation as a Method. Small Approaches to Scalability in Digital Cultures«, in: Digital Culture & Education, 15:1, pp. 92–111.

30 Dewdney, Andrew/Sluis, Katrina (2023): The Networked Image in Post-Digital Culture, London/New York: Routledge; Lee, Rosemary (2025): Algorithm Image Art, New York: Atropos Press.

which we had taken during our ethnographic visit. The difference between the rendered models in the augmented reality data centre experience and the ethnographic photos on the physical wall offered an estrangement effect. This way we hoped to evoke reflections on what the real data centre may be like and how it could be different. To push such imaginations, we added the text »standing reserve, for the case of fire« to the photo on the wall of the gas cylinders (Fig. 4). The gas cylinders reminded us of columns of soldiers and drew our attention to how the gas in the data centre is kept available, just like soldiers of the reserve, prepared and ready. We take inspiration from Marx's (1887) notion of a »reserve army of labour« to be called upon when necessary, and as disposable if not needed, as he theorised the socio-economic role of the unemployed.[31] Contrary to the reserve army of labour, the gas flasks do not push down salaries. It is however the case that the excess of data, chips, data centres, production sites etc. standing reserve for digital capitalism to keep prices for digital services and digital devices down. Many of them will never be activated, just standing there for the sake they could become of need for data flows and to pressure other data brokers, investors, countries, etc. to offer better deals.

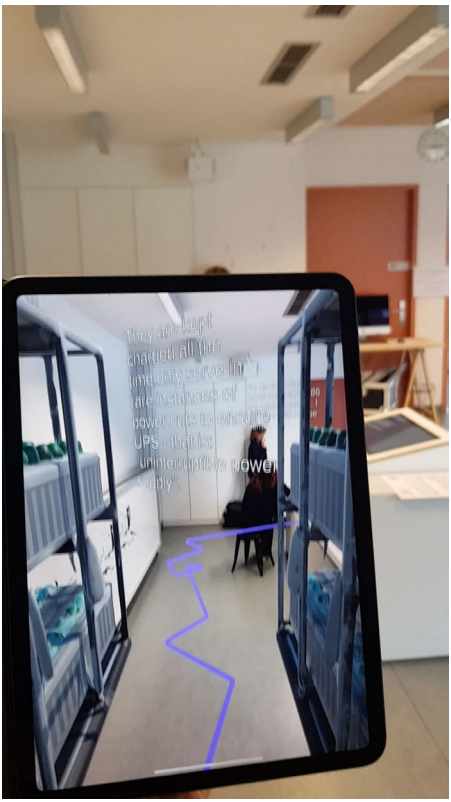
Fig. 4: The physical poster as part of the augmented reality data centre experience showing the gas cylinders from the university data centre »standing reserve, for the case of fire«

31 Marx, Karl (1887): Capital. A Critique of Political Economy, vol. 1, London: Sonnenschein, Chapter 25. Discussion of how reserves and stocks are crucial for digital economy result from conversation with Stefan Laser.

4.5 Batteries

Moving on along the purple line from the extinguishing gas onwards, the visitors encountered sets of virtual deep metal shelves covering an entire narrow room from floor to ceiling. The shelves were stuffed with batteries that, to our non-trained eyes, looked like car batteries—86 of them (Fig. 5). Like the extinguishing gas cylinders, the batteries in the augmented reality data centre experience were AI generated from photographs taken at the ethnographic data centre visit.

Fig. 5: Virtual batteries displayed in-app on the screen of a mobile device



We were told at our visit that these batteries are kept charged continuously, although only in rare instances of power outage they are activated to ensure the so-called uninterrupted power supply, which in data centre lingo is abbreviated to UPS. It is key to data centres; it is what defines data centres as Tier 1, 2, 3 or 4,

a ranking developed by a company which, without irony, is called »Uptime Institute«. Tier 3 data centres hold the promise of 99,982% uptime, which corresponds to a maximum of 96 minutes interruption per year. This promise is central to the conception of data centres as *clouds*. It gives users an impression of a technology—social media, storage space, webpages, online software, and basically anything that is related to the Internet—as being permanently available, similar to air that is just there for you to breathe (although also this is not the case everywhere all the time, and increasingly less so), always and effortlessly.[32] We included the batteries into the augmented reality data centre experience because we wanted to draw attention to the fact that contemporary intense Internet use, which feels so unbearably light, is actually heavily loaded with lithium and other toxically mined metals, not just to run the Internet but to do so continuously and to create and serve demands of pause-less work and incessant consumption. The desire for continuous uptime comes along with a concentrated fear of losing data and interrupting computing processes, which is key to the data centre cosmology and to knowing a data centre like its operators do. This fear validates, performs, and concretises the technological unconscious of a data centre.[33] We placed a poster-sized photo of the batteries we took during our visit to the data centre on the wall in the exhibition room next to the 3D generated batteries in the augmented reality data centre experience (Fig. 6). It stated »a room full of fear«, emphasising the values and emotions that are folded into these seemingly sleek and innocent technologies. Fear and angst belong to a modern risk society preoccupied with anticipation of and preparation for failures to come, as analysed by authors of Modernity such as Anthony Giddens[34] and Ulrich Beck.[35] The advantage of batteries for calming this fear is that they can be kept loaded all the time and immediately take over the entire power load of the data centre in case of interruptions in the respective city's power grid (which in the city of the university data centre was the case for 6 minutes in the year 2023). Of course, this means that a lot of energy is consumed only to keep the batteries charged, to uphold the promise of uptime, and to keep the operators calm. The batteries can

32 Cf. Hu, Tung-Hui (2016): A Prehistory of the Cloud, Cambridge, MA/London: MIT Press.

33 Clough, Patricia Ticineto (2000): Autoaffection. Unconscious Thought in the Age of Teletechnology, Minneapolis, MN: University of Minnesota Press; Thrift, Nigel J. (2004). »Remembering the Technological Unconscious by Foregrounding Knowledges of Position«, in: Environment and Planning D: Society and Space, 22(1), 175–190. Online: https://doi.org/10.1068/d321t; Kitchin, Rob/Dodge, Martin (2014): Code/Space. Software and Everyday Life, Cambridge, MA/London: MIT Press.

34 Giddens, Anthony (1990): The Consequences of Modernity, Cambridge: Cambridge University Press.

35 Beck, Ulrich (1992): Risk Society. Towards a New Modernity, London/Newbury Park/New Delhi: SAGE.

power the data centre for 15 minutes. »It is a lot of battery for such a short time«, our interlocutor commented dryly during our visit to the real data centre.

Fig. 6: The physical poster which, as part of the augmented reality data centre experience, hung on the wall and showed a photo of the university data centre battery room as »a room full of fear«

Due to the sloppy alignment of the visitors' devices with the physical space of the exhibition room, several of the visitors to the data augmented reality data centre experience walked away from the batteries head-first, right through the delicate and beautiful work *Walking with the Verticality of Björkö—Im/Possible Maps* by Arba Bekteshi (2025) (Fig. 7). Their piece poses questions about how to walk, and about vertical affordances for movement on the island of Väddö in the Baltic Sea and offers a meditation on the relative vertical movement of the island's bedrock. With one hand holding their smartphone with the augmented reality data centre app, some visitors made their way with the other hand through the very fragile work of stones and other objects hanging on strings. This unintended material and conceptual diffraction between our work and Bekteshi's hinted at a data centre—just like Bekteshi's work—is interrelated with other spaces and landscapes. They even intervene with them, sometimes harmfully so.

Fig. 7: A visitor of the augmented reality data centre experience at the STS-Hub Berlin 2025 pondering when confronted with Arba Bekteshi's work

4.6 Diesel Engine

Following the purple line on the floor of the augmented reality data centre experience, the visitor encountered a new sensorial experience: The sound of an engine starting got louder and louder with every step, flooding the room with a mechanical beat. It was not the high pitch of a sewing machine or the snarling sound of a moped but a deep voluminous roar like that of a fishing trawler. The display soon revealed that the sound came from a massive diesel generator, taller than a human and as long as a small locomotive. It was difficult not to feel small amidst this overwhelming metal body. In the augmented reality data centre experience the diesel engine was not as pretty as the prior technologies. We had taken a generic pre-fabricated 3D model of a diesel engine from a 3D asset store, which interestingly looked quite a lot like the generator we had seen at the data centre.

Diesel engines are the headaches of data centre designers. They undermine the trend towards energy efficiency and ecological sustainability of the industry. Unlike batteries, which contaminate the environment somewhere else—at their place of production and at sites of mining for e.g. lithium—diesel engines pollute at the location of the data centre. Nonetheless, few data centre designers will abstain from including a diesel generator. These machines are needed to take over from the batteries when they run out of power after around 15 minutes and if the grid interruption lasts longer than that. The diesel generator can run the data centre for around 48 hours. Could not data centres at least skip the batteries? No, since it takes around 10

seconds for a diesel engine to start up, enough time for servers to suffer a so-called unclean shut down, which is likely to cause both software and hardware damages. The relative quick start of the diesel generator, however, is only possible if the engine is already warm. For this reason, the oil of the generator is constantly kept warm. Furthermore, the diesel generator is tested once a month, which is the main reason why data centres burn a considerable amount of fossil fuel. On the physical wall next to the virtual diesel generator there hung a poster-sized photograph of the real diesel engine of the university data centre. It was so large that it did not even fit into the image, which seemed crammed. »fossile planet data« we printed on the photograph, reminding of the connection between this planetary resource and the processing of data (Fig. 8).

Fig. 8: Poster as a physical object hanging on the wall as part of the augmented reality data centre experience, showing the diesel engine of the university »fossile planet data« centre

Above the diesel engine sentences were hovering mid-air in the augmented reality experience, such as »The car association makes me imagine cars ready to set off. I only hope I will not be overrun«. These were excerpts from field notes from the ethnographic visit to the data centre that commented on the data centre and invited further reflections.

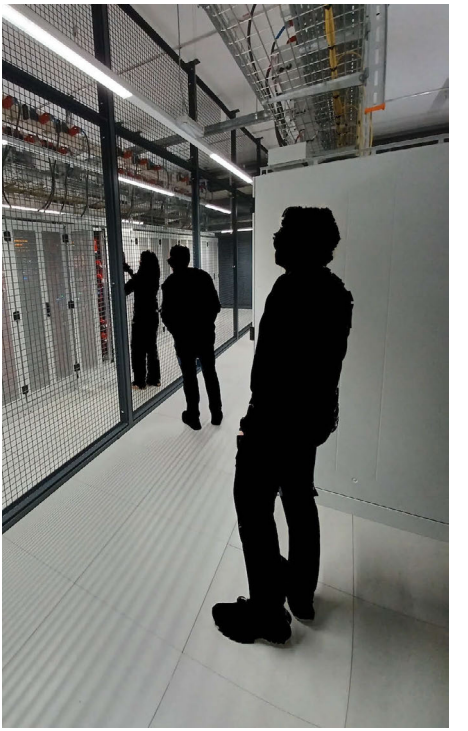
The visit to the augmented reality data centre experience began with extinguishing gas, batteries and the diesel generator, thus focussing on what the data centre operators call the »technology« in contrast to the »IT«. We decided to first confront the augmented reality data centre experience visitors with this industrial underbelly of plumbing, cylinders and engines, which is often not associated with data centres. We hoped that visitors would wonder »is this a data centre?« and that the augmented reality data centre experience would answer »yes«, thus intervening into the stereotypical idea of data centres as symmetric rows of blinking servers. All these technologies are dedicated *if* s. Just-in-cases. Standing-ins. Lumped together, and measuring taller than our bodies, they loom over us and demand human attention. Maintenance, for example. The technology furthermore requires labour and material effort. The equipment is continuously inspected, refilled, charged, and, if in doubt, replaced to be fully operational when needed. And they are all a burden to the planet. While the server rows merrily blink outside, performing daily compute operations, here among the »technology« we encounter the infrastructure that manifests a cosmology in which an outage, perhaps followed by a loss of data, constitutes an absolute catastrophe.

4.7 Server racks

Moving on along the purple line and leaving the UPS and emergency technology behind, the visitors were led out of the room of the *Drift. Sink. Emerge. Repeat.* exhibition space, across the lobby and down a corridor of the STS-Hub 2025 venue. There they encountered the core machineries of data centres running computing and storage services and which our data centre operator interlocutors call »the IT«: server racks.

The whole project of making an augmented reality data centre app had started with the rendering of the server racks. With the Scaniverse software running on an iPad, we spent considerable effort trying to scan the server racks (Fig. 9).

Fig. 9: Estrid Sørensen being observed by employees at a university data centre while trying to scan a server rack with the Scaniverse app

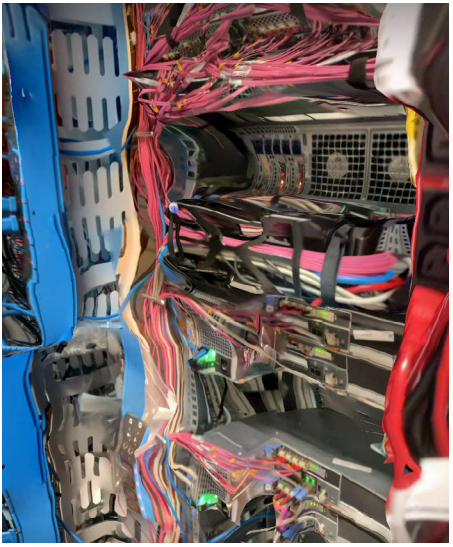


Scaniverse promises easy and perfectly naturalistic 3D scans. It worked well for kitchens, domestic objects and even our children during our trials. Scanning server racks was a different experience. The filigree pattern of server walls and rack doors, the many little sockets, cables and LED lights overburdened the software. Scans of tiny edges, of which there are many in a server rack, were often distorted, creating round and almost melting or organic looking corners (Fig. 10). They reflected how data centres are not contained within a closed space but spreading out. Dalí might have appreciated the liquefied looking server racks, confusing softness and hardness, fixity and ambiguity, which does indeed describe the paradoxical character of data.[36] As the scan is only a fragment of one open rack of servers' back panel, the fringes of the 3D-model were as obvious as they are dubious: a new virtual materiality which carried the traces of the scanning process. The rack model was not a solid technological entity but a spatial snapshot which might from one perspective

36 Cf. K. Hoeyer (2023): Data Paradoxes.

have realistic appeal and look glitchy from another, porous and just wrong. Being results of computing, the deformed models of the server racks could be speculated as a data centre's self-reflection, able of acknowledging clear surfaces but confused when it comes to juggling different levels of depth.

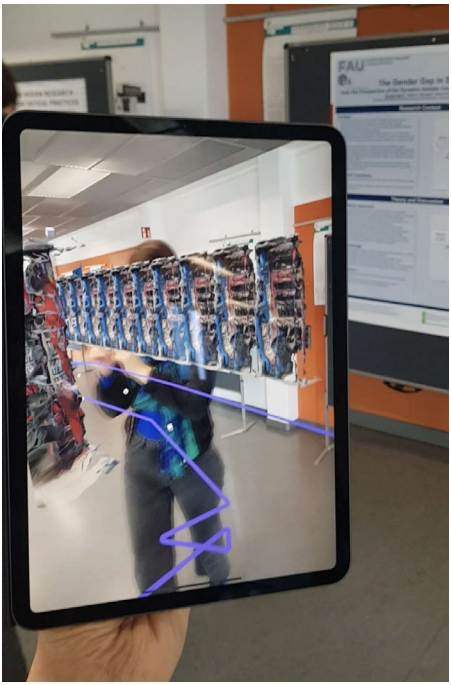
Fig. 10: Screenshot of a Scaniverse scan of a part of a server rack



With these reflections and speculations, the failed scans appeared to be particularly well-suited for an augmented reality experience that aims to evoke thoughts about how to know a data centre. A queer and surprising representation requires the spectators to think more intensively to understand it than does the iconic tidy and glossy photographs provided for the public by data industry's PR departments.

We copy-pasted a large number of copies of the one single scan model of a rack next to each other in a long narrow corridor in the augmented reality, not unlike in the iconic PR photographs of data centres, thus thematising the exchangeable and standardised nature of server hardware units at a data centre (Fig. 11). However, we multiplied the scanned rack in many (dis)orientations, in different sizes, and with different animations, thus highlighting that despite the idea of a standardised commodity unit a server is not stable and self-contained but always in relation to different environments all at once.

Fig. 11: Copy-pasted server racks



Visitors to the augmented reality data centre experience did not only see the racks. Many of them did hear them more than anything else. The server racks emitted a loud wide-spectrum noise we had recorded on site at the university data centre during our fieldwork. The extremely loud sound of the many servers strikes most people visiting data centres as one of their distinctive characteristics. The data centre we visited was no different. Our guide was shouting when he explained specificities of the racks, cooling system etc., and we were struggling to keep a polite intimacy distance to him, tending all the time to move up too closely to be able to hear his explanations. The noise brought its own message: it requires enormous amounts of energy for these little machines to produce so much sound. We versioned the fieldrecordings across hi-fi and lo-fi sound, exploring various settings of the MP3 audio format, and playing with the qualitative nature of the sounds we had recorded. Especially the obvious glitches and artefacts of extreme compression evoke the ghosts of data compression. These are usually masked by computational models such as MP3 encoders, which are based on psychoacoustics research and do their best to make the computation imperceivable to the faculties of the human sen-

sorium.[37] Retreating from human sensibility and knowability is a routine feature of computation. Beyond embodying values of their creators, as has meanwhile widely documented and pointed out to by critics, it is further conceptualised by post-humanist research that algorithmic and computational systems produce preferences and forms on their own. Setting this idea in motion blended the visitors to the augmented reality data centre experience into an ambisonic surround sound noise experience through their little smartphone speakers as they roamed through the augmented reality data centre experience's IT area around the racks. Although the sound was stronger from some racks than from others, which indicated that some were computing particularly much, the surround sound made it hard for visitors to figure out where the noise was coming from and where exactly data computation was taking place. It blurred between a screaming loudspeaker, a fluctuating field of resonance, merging with other sounds of the conference, out of tune with the situation of the data centre; posing the question of whether—or in what ways—this odd spatiality and temporality of data centres are ever in tune with everyday life outside of it.[38] To several of the visitors to the augmented data centre experience we talked to, the unusually repulsive harsh noise escaping their devices, else designed to please them, dominated their experience. »It's exhausting«, »Can't I turn it off?«, »With that noise, I can't really concentrate on the visuals« were among their reactions. Knowing data centres and other machines through their sound can indeed be harmful to human beings.[39] As mentioned in the introduction, scientists also use the sound of servers to sense their well-being. Server sounds are a source of knowing them and a foundation for caring for them.

4.8 Heat and cooling

We coloured some of the racks of the augmented reality data centre experience in a glowingly hot red to indicate the heat emitted from the hard-working servers. Server temperatures as well as the essential cooling air arising from under the floor tiles and circulating in cold aisles or blown through racks proved the limited representational ability of the audio-visually dominated digital devices through which the

37 Sterne, Jonathan (2012): MP3. The Meaning of a Format, Durham, NC: Duke University Press; Maguire, Ryan (2014): »The Ghost in the MP3«, in: Anastasia Georgaki/Georgios Kouroupetroglou (eds.), Music Technology Meets Philosophy. From digital echos to virtual ethos – Proceedings of the 40th International Computer Music Conference joint with the 11th Sound and Music Computing conference, Athen: National and Kapodistrian University of Athens, pp. 243–247.

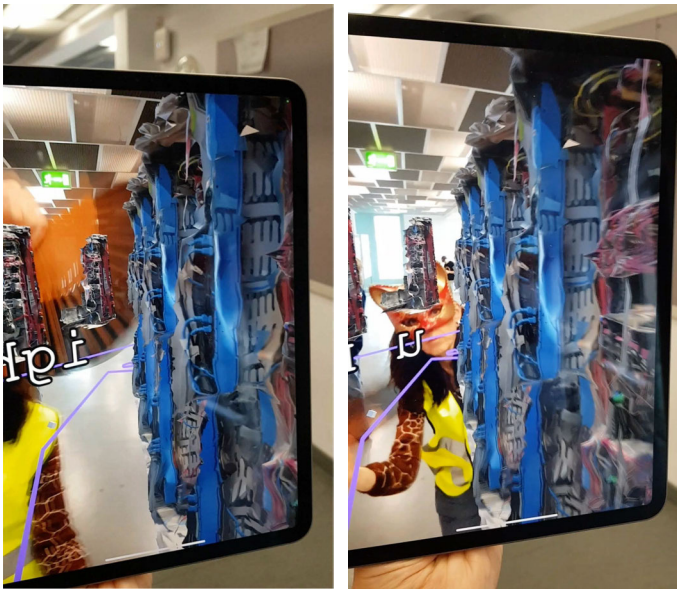
38 C.f. Trofimov et al. (2022): »Industrial Music, Noise, and the Sound of Machines«, in: Technology and Language 3:3, pp. 58–72.

39 Bijsterveld, Karin (2006): »Listening to Machines. Industrial Noise, Hearing Loss and the Cultural Meaning of Sound«, in: Interdisciplinary Science Reviews 31:4, pp. 323–337.

augmented reality data centre experience was accessed. It pointed to the non-knowledge of digital devices. Contemporary game engines like Unity allow for implementing original sound bites, but heat needs translation—a re-coding into a colour palette: blue indicating cooling, red and orange cues used to heat things up visually. While aiming to enable visitors to know data centres bodily through the senses, colour coding temperature failed to address the respective human senses. We found our means of expressing warmness by augmenting reality and blending virtuality with bodily impressions from our ethnographic fieldwork. A transgression of accessing the augmented reality data centre experiences through phones and tablets was needed. This resulted in visitors suddenly experiencing hot air blown into their faces or through their hair while walking through the aisles of server racks of the augmented reality data centre experiences, most often with their eyes fixed on the screens of their devices, not noticing a person coming up to them with the mundane coiffure instrument of a blow dryer. Directing the hot air at participants' faces absorbed both the participants' and the spectators' attention. One visitor to the augmented reality data centre experience at EASST/4S conference in Amsterdam commented being hit by the stream of hot air was a palpable astonishment as they were completely focused on the augmented reality data centre experience on the mobile screen in their hands. This is not just a metaphor but an apt analogy to academics and their ways of using data: Stuck in their usual virtual relation to data somewhere or nowhere, the augmented reality data centre experience grounded those data in a located, defined, bodily reality. Employing a blow dryer to convey the unexpectedly high air temperature corrupted academics' distanced relation to their data. It made them literally face the heat data processing is generating and thus involved senses which are rarely activated in the academia of the Humanities and Social Sciences.

What was true for hot air, was not less so for the cold air of the augmented reality data centre experience. One member of our team wearing a neon yellow high-visibility vest and a Venetian half-mask waggled two wooden fans at the visitors re-directing the surrounding air into a concerted cool stream towards them (Fig. 12). Some visitors smiled at the person—mostly somewhat shyly—, some frowned, and some were utterly disturbed. One visitor recounted afterwards: »I didn't even realise [the person's] presence until they were right beside me. When I looked up there was this bizarre figure I just couldn't make any sense of«. The visitor stated that their reaction was largely provoked by the Venetian half-mask the living, breathing human directly next to them was equipped with. Another visitor, struggling to comprehend this odd figure, kept asking »who are you, who are you?« until they finally answered the question themselves: »Oh, you are Gaia«. What a wonderful interpretation! Gaia, a Greek goddess and a controversial and ambiguous figure in modern science that connects life and the planet, the key issue the augmented reality data centre was developed to contemplate about.

Fig. 12: Team member dancing in a high-visibility vest with mask and fans



4.9 Passage out of the data centre

The purple line led the visitors though the adventurous experience of the IT area and back to the starting point. There they went through a small rite of passage to exit the augmented reality data centre and return to their less—or differently—augmented reality: Each visitor removed and gave back the shoe covers, resuming their ordinary bodily look and feel. They were asked to sign out in exchange for a postcard. They were also offered help to uninstall the app and re-establish the smartphone security settings, a step which only a few accepted. The sign-out procedure furthermore contained an invitation to reflect on the experience, being reminded of the sign to »Pay attention to how the data centre feels. You'll need it later!«

Many visitors did not need a prompt to give feedback. Some asked for more information about specific items and what they meant. As with the sign-in, those conversations covered the whole spectrum from having a friendly chat about a specific topic to fully enacted scene-plays on both sides. One returning visitor embraced the role of a terrified person, inquiring almost shyly about the ontic state of the monster right outside the door. Some people inquired about physical objects that were not part of the design of the augmented reality data centre experience. Such contingencies—one could say artefacts from the ongoing life around them outside the augmented reality data centre—suggest a heightened sensitivity in visitors towards their surroundings while struggling with the unusual way of knowing the

augmented reality data centre experience has brought upon them. Some expressed an experience of being overwhelmed: it was »too much« or »very loud«, the latter a familiar bourgeois reaction to all kinds of industrial noise.[40] Visitors expressed that knowing a data centre through the augmented reality of virtual and physical objects made them feel small and inside a system they did not fully grasp, that has its own agency and makes you feel like an intruder. There was a kind of joint insecurity among organisers and participants, blurring the boundary between those different relations to data centres. As the setup was very different depending on device and needed improvising/troubleshooting, some nagging questions persisted: Does it work? Is the AR correctly aligned? Do they find their way and not crash other installations? Is there something missing? Am I the one who is missing something? Does the design balance well the familiar and the strange? As some users struggled with this way of knowing the data centre, including finding their way, searching, and trying different routes, they engaged in conversations with others. Entangled with the multi-sensual augmented reality data centre experience, their mode of knowing involved testing different strategies to make sense of the embodied exploration of a data centre, just as we did when composing the augmented reality data centre experience and when adapting it to the specific contingencies of the place.

5. Discussion

We set up the augmented reality data centre experience in order to create an opportunity to know data centres in a different way than professional engineering and through what we know from business representations, which are often intimidating to non-professionals and thereby exclude them from engaging in debates and having a say about data centres. Such non-knowledge prevents people from developing even an interest in these ubiquitous technologies.[41]

Any representation is created out of materials and data or traces of the phenomenon it represents. This was no different with the augmented reality data centre experience, which was based on an ethnography of university data centres. However, taking another direction than the PDF-based written and printed representations usually seen in academia, the augmented reality data centre experience was non-naturalistic and held only-almost-naturalistic virtual objects such as gas cylinders, batteries, diesel engine and server racks. This character of the data centre and its objects drew attention not only to the installation and the objects but indeed to

40 Bijsterveld: Listening to Machines. Industrial Noise, Hearing Loss and the Cultural Meaning of Sound; Trofimov et al.: Industrial Music, Noise, and the Sound of Machines.

41 The Institute for Technology in the Interest of the People: Counter Cloud Action Plan.

how they were represented. Representationality was further emphasised by creating passages into and out of the augmented reality data centre experience, what theatre scholar Erika Fischer-Lichte calls a »change of roles« [*Rollenwechsel*].[42] The arrangement around the signing-in procedure, putting on shoe covers etc. initiated a theatrical situation and transformed conference participants into participants of a performed representation of a data centre, thereby augmenting the conference situation with a theatrical layer. The augmented reality data centre experience did not only mark an intervention into the conference space but also into logics of representating data centres: they are not only knowable through written and printed representations which primarily speak to the distanced and cognitive engagements with data centres. Through the augmented reality data centre experience data centres became knowable through bodily and sensorial engagements. It invited visitors to step into affective and bodily relations to data centres.

Through its only-almost-naturalistic and unfamiliar representational—or even non-representational—character the augmented reality data centre experience created opportunities for reflection.[43] The visitors seemed to engage intuitively in what Vinciane Despret (2005) calls *the virtue of politeness*:

> Despret's sort of politeness does the energetic work of holding open the possibility that surprises are in store, that something interesting is about to happen, but only if one cultivates the virtue of letting those one visits intra-actively shape what occurs. They are not who/what we expected to visit, and we are not who/what were anticipated either. Visiting is a subject- and object-making dance, and the choreographer is a trickster.[44]

Just like the jester at a royal court, the augmented reality data centre experience let its visitors know a data centre through emphasis or neglect, thus presenting an altered, succinct way of accessing and assessing. The augmented data centre was disturbing, unfitting, distorting, and challenging matters: spaces, people, and its local environment which were simultaneously its essence, inseparably folded into the concept of augmented reality. Different from professional engineering and business representations of data centres, the augmented reality data centre experience was very far from evoking a rational engagement, an engineering cosmology.

This was not only true for the visitors of the augmented reality data centre experience. Representing the data centre in an augmented reality app involved inquiring both the workings and the lures and flaws of the technologies we used, such as 3D-

42 Fischer-Lichte, Erika (2017): Ästhetik des Performativen, Frankfurt a.M.: Suhrkamp.

43 Thrift, Nigel J. (2008): Non-representational Theory. Space, Politics, Affect, London/New York: Routledge.

44 Haraway: Staying with the Trouble.

scanning, smartphone sensors, software development frameworks, the AI-rendering of objects and the standard objects offered by 3D asset stores. Assembling the augmented reality data centre experience as a (non-)representation was a process of playful and speculative pondering, arranging and testing, and at the same time remaining faithful to what we encountered empirically.

As discussed, building the augmented reality data centre experience furthermore required careful engagement with the space within which it was to be visited. While standard written and pictorial representations of data centres gain the agency of an *immutable mobile*[45] through the infrastructures of producing and circulating these representations, the learnt competencies of how to engage with them etc. this mobile immutability of modern scientific representations also contributes to generating a distance between the reader and the represented phenomenon. This resonates with the programme of modernism, making room and clarity for a work of art to stand on its own, in isolation, in the so-called *white cube* aesthetics. As a critique of this aesthetics—and the mode of knowing that accompanies it—the postmodernist concept of *site-specific art* emphasises that whatever exists before and besides the artwork is considered an essential part of the work and a resource to know it, to draw from and add on to.[46] Such works interact and are in conversation with the place and time where they are set up. In a similar gesture, our augmented reality data centre experience added a temporary reflective layer to the pre-existing space. This aligns well with the undoubtable fact that we are always-already inside the data centre—always being calculated and always calculating. This is one way of conceptualising the representational character and the knowing of data centres through the augmented reality data centre experience: it situated representations of data centres in a very specific place, and it situated visitors in visual, auditory, tactile and bodily relations to data centres, adding a media-technological layer to the notion of situated knowledge.[47]

Engaging with situated representation raises the question of how a data centre was in *this* place, at *this* time, and how we might imagine it *here*. To enable other conceptions of programs labelled AR/VR, Verhoeff and Drescher propose to think of »Crossed Realities«,[48] embracing interrelation instead of the separation of different realities:

45 Latour, Bruno (1983): »Give Me a Laboratory and I Will Move the World«, in: Karin Knorr Cetina/Michael Mulkay (eds.): Science Observed, London, UK: Sage, pp. 141–70.

46 Rebentisch, Juliane (2012): Aesthetics of Installation Art. London: Sternberg Press.

47 Haraway, Donna (1988): »Situated Knowledges. The Science Question in Feminism and the Privilege of Partial Perspective«, in: Feminist Studies 14:3, pp. 575–599.

48 Verhoeff, Nanna/Dresscher, Paulien (2020): »XR. Crossing and Interfering Artistic Media Spaces«, in: Larissa Hjorth/Adriana de Souza e Silva/Klare Lanson (eds.), The Routledge Companion to Mobile Media Art, London/New York: Routledge, pp. 482–492.

> »Working through and beyond understanding these confrontations as the crossing—or intersecting—of separable and fixed domains of ›physical‹ or ›virtual‹ realities, we approach their interrelation in XR from a perspective on their performative qualities as relational reinforcement«.

By translating the data centre into different socio-material sites and situations away from the social, architectural and epistemological data centre we confronted it with unforeseen social and material constellations: the sometimes orderly, sometimes chaotic interplay of bodies, the spaces and virtual objects which allowed for irritations to evoke new questions and a different re-situated knowing of data centres.

At the exit of the augmented reality data centre experience the visitors were given a postcard with an invitation to »reclaim the data centre«, to take it with them and place it elsewhere—on the beach, in the woods, at home—and to reflect on which new relations it generates elsewhere. This again emphasised the situated character and thus mutability of knowing the data centre. Przybylka describes that AR and VR often formulate an »Allverfügbarkeitsanspruch« [all-availability claim],[49] the promise to transport users to other times and other places, stepping into other perspectives, what Nakamura calls »toxic embodiment«.[50] By their design these applications tend to enact a *Euroamerican common sense realism* while presenting objects independently of observers and environments to be controlled via interfaces hiding the inherent relationality of user,[51] device and more-than-human environments.[52] Trying to represent a data centre naturalistically would fall into the same trap as describing a data centre as a merely technological entity. It would maintain a certain insularity of the data centre while leaving users with touristic impressions between entertainment and superficiality. The somewhat crooked and only-almost-naturalistic representations included into the augmented reality data centre experience, involving frictions within the mixture of virtual objects, physical space and physical objects, co-present people involved and not involved in the AR experience—all this was crucial to avoid the pitfall of toxic embodiment, and offering instead reflective bodily engagements—which were also disturbing and overwhelming.

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49 Przybylka, Nicola (2022): »Medienkulturwissenschaftliche Perspektiven auf Augmented und Virtual Reality in formalen Bildungskontexten«, in: MedienPädagogik. Zeitschrift für Theorie und Praxis der Medienbildung 47, pp. 331–354, here p. 348.

50 Nakamura, Lisa (2020): »Feeling good about feeling bad: virtuous virtual reality and the automation of racial empathy«, in: Journal of Visual Culture 19:1, pp. 47–64.

51 Law, John (2012): »Collateral realities«, in: Patrick Baert/Fernando Domínguez Rubio (eds.), The Politics of Knowledge, London/New York: Routledge, pp. 156–178.

52 Heemsbergen et al.: Conceptualising Augmented Reality; Fehrenbacher: AR als Relationale Intervention.

6. Conclusion

Refraining from offering visitors to know the data centre in rational and technical terms and instead translating it into an evocative experience, the augmented reality data centre generated new relations between the ethnographically experienced data centre, our inquiry, and the visitors we address by our research. Letting go of arguments about data centres, which are so central to critical humanities and social science, we instead initiated augmented, experiential, affective and exploratory engagements with data centres. This also meant giving up on the illusion of control that comes with writing—giving up the desire to build up arguments and monologues. An open-ended arrangement addressing body, affectivity and relationality can never be sure which feelings and relations emerge. Following the virtual cable, avoiding virtual gas cylinders and bumping into physically present people required constant switching between planes of knowing. Overwhelmed, frustrated, confused, curious, sad, nervous, shy, extravagant, bored visitors brought social experiences and affective knowledge of many kinds into play. Although it had been the initial idea, the augmented reality data centre experience only partially allowed people to bring their cosmologies into the data centre. As we have discussed above, the unusual representation rarely made visitors feel confident and familiar with the data centre, which would be a prerequisite for them to bring their cosmology into the augmented reality data centre experience. It did allow visitors to engage with data centres in bodily and experiential ways, which nonetheless enabled them partially to know the data centre. The estrangement effects of representations must be balanced between giving space for knowing through reflection and new experiences on the one hand and scaring them away and not knowing anything on the other.

Our hope was furthermore that the engagement with the augmented reality data centre experience would make visitors relate to the planetary relations of data centres. Most did at least get a strong idea of the heavy energy consumption of data centres, and a somewhat more detailed understanding of this compared to popular comparisons between the power consumption of data processing and of making cups of tea.

Knowing a data centre through one's own cosmology is a requisite of reclaiming data centres. We do not know whether visitors actually did, but we brought it with us and set it up in a park in Copenhagen where it was sniffed at and urinated on by dog companion Oscar (Fig. 13), to Halde Schöttelheide, a place which hides our industrial remains in a beautiful stockpile biotope landscape (Fig. 14), and Neanderthal where the traces of ancient humans are exhibited (Fig. 15). Wherever it is taken, the re-situated character of the augmented reality data centre experience opens up an experiential mode of knowing, poses different questions, offers new relations, tickles a shiver of wondering.

Fig. 13: Augmented reality data centre app re-opened during a dog walk with Oscar, one month later

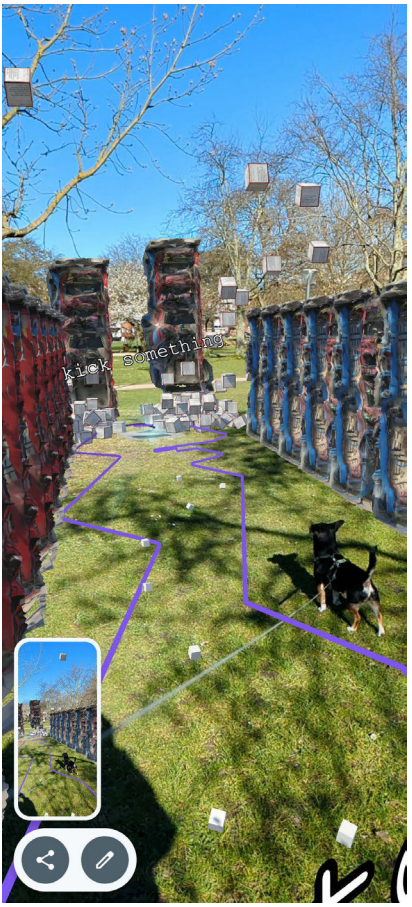

Fig. 14: Augmented reality data centre app re-opened while hiking in a stockpile biotope, one and a half months later

Fig. 15: Augmented reality data centre app re-opened in Neanderthal

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