Data Gates

Designing for Trust in the Internet of Things

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I describe ongoing work towards my PhD. I am developing a framework of trust for Internet of Things(IoT) data that extends Research through Design(RtD) and Speculative Design methods with Human Data Interaction(HDI) and postphenomenology. I put forward an interactive system that can provide ways for people to interact with IoT data in a performative way.

CCS CONCEPTS • Human-Computer Interaction(HCI) • Interaction Design • Ubiquitous and mobile computing

Additional Keywords and Phrases: Research through Design, Speculative Design, Design Fiction, Human Data Interaction, Internet of Things, Pervasive Computing, Postphenomenology, Trust

1 MOTIVATION AND RELATED WORK

The growing number of IoT devices and the rise of pervasive and ubiquitous computing is questioning how human beings interact with data [1]. Although GDPR and IoT device manufacturers put in place policies for citizens to engage with data practices, there are still few ways in which people can interact with and control personal data. This project builds upon RtD as a generative process [2, 3, 4], Design Fiction as world building [5,6,7,8], postphenomenological understandings of trust [9, 10, 11] and work in HCI and HDI that contribute towards designing interactive systems between people and data [12, 13, 14, 15, 16, 17, 18, 19, 20].

2 METHODS AND FINDINGS

5 participants from across the UK participated in Design ethnography, interviews and co-creation exercises, situated around provocative cultural probes [21, 22]. I detail one of the concepts that emerged from the RtD methods - Data Gates. The themes emerging from the research and concept development were extended to incorporate the tenets from HDI [1] as well as elements from postphenomenological notions of trust [9, 10, 11] to form a framework around designing for trust in the IoT.

Table 1: Designing for Trust in the IoT Framework

Design Principle	Description
Agency and Action	Agency extends to designing for action, allowing people to actively shape data trust relationships.
Interaction	The IoT must provide interactive methods for engaging with data.
Legibility	Data rights and regulations for IoT devices must be legible to people and machines.
Negotiability	People must be able to negotiate data choices beyond the binaries of yes and no.

Design Principle	Description
Confidence	Systems must encourage confidence by encouraging exploration.
Responsibility	People should be allowed to take responsibility for informed data choices.
Context	Systems must allow dynamic data interactions based on context.
Privacy as Performance	Privacy is related to the behaviour modification aspects and 'always-on' nature of IoT devices. We must design for the performative nature of Human-IoT interaction.

2.1 Participant Quotes

"I feel like the internet has become this hyper-capitalist place. People talk about re-wilding the internet and I think that kind of attitude might be helpful in having a broader market."

"I would have no issue having a little server box in my home where all the data is stored. Then, again, you've got that control of when the data is purged, what data is kept, what data isn't kept."

"If you're being watched, and you know you're being recorded, then it's obviously going to alter your mood, alter what you say, alter what you do."

2.2 Data Gates

Data Gates is a speculative design system for interacting with data collection in IoT devices, named after and inspired by the Boolean logic gates that control computers. This system allows users to practice agency, legibility, negotiability with IoT data in a performative way. People can experiment with combinations of RFID stickers to create personalized rules in their home, community or city. This concept will be prototyped using open-source technology. Photo and video will be used to explore design fiction futures in the next phase of research.

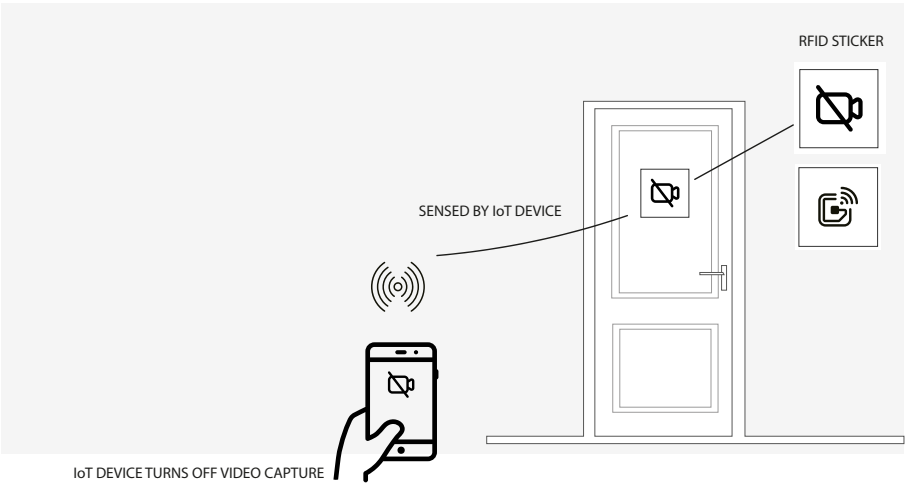

Figure 1: Working of Data Gates system. An IoT device recognizes a data gate RFID tag in a doorway and turns off video capture based on the tag instruction.

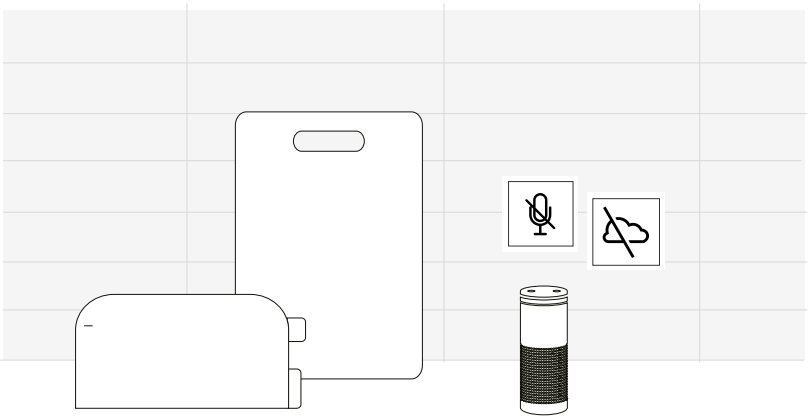

Figure 2: A smart speaker placed next to Data Gate RFID stickers turns off its microphone and stops uploading data to the cloud based on the Data Gate instructions.

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REFERENCES

[1] Richard Mortier, Hamed Haddadi, Tristan Henderson, Derek McAuley, and Jon Crowcroft. 2014. *Human-Data Interaction: The Human Face of the Data-Driven Society*. Social Science Research Network, Rochester, NY. DOI:https://doi.org/10.2139/ssrn.2508051

[2] William Gaver. 2012. What should we expect from research through design? In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '12), Association for Computing Machinery, New York, NY, USA, 937–946. DOI:https://doi.org/10.1145/2207676.2208538

[3] John Zimmerman, Jodi Forlizzi, and Shelley Evenson. 2007. Research through design as a method for interaction design research in HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '07), Association for Computing Machinery, New York, NY, USA, 493–502. DOI:https://doi.org/10.1145/1240624.1240704

[4] Elisa Giaccardi. 2019. Histories and Futures of Research through Design: From Prototypes to Connected Things. *International Journal of Design* 13, 3 (December 2019), 139–155.

[5] Anthony Dunne and Fiona Raby. 2013. Speculative Everything: Design, Fiction, and Social Dreaming. MIT Press.

[6] Mark Blythe, Kristina Andersen, Rachel Clarke, and Peter Wright. 2016. Anti-Solutionist Strategies: Seriously Silly Design Fiction. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 4968–4978. Retrieved February 19, 2021 from https://doi.org/10.1145/2858036.2858482

[7] Paul Coulton, Joseph Galen Lindley, Miriam Sturdee, and Michael Stead. 2017. Design fiction as world building. In *Proceedings of Research through Design Conference 2017*. GBR, 0–0. Retrieved February 19, 2021 from https://doi.org/10.6084/m9.figshare.4746964

[8] Mark Blythe. 2014. Research through design fiction: narrative in real and imaginary abstracts. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '14), Association for Computing Machinery, New York, NY, USA, 703–712.

DOI:https://doi.org/10.1145/2556288.2557098

[9] Asle H. Kiran and Peter-Paul Verbeek. 2010. Trusting Our Selves to Technology. *Know Techn Pol* 23, 3–4 (2010), 409–427. DOI:https://doi.org/10.1007/s12130-010-9123-7

[10] Ori Freiman. 2014. Towards the Epistemology of the Internet of Things Techno-Epistemology and Ethical Considerations Through the Prism of Trust. *International Review of Information Ethics* 22, (2014), 6–22. DOI:https://doi.org/10.29173/irie124

[11] Esther Keymolen and Simone Van der Hof. 2019. Can I still trust you, my dear doll? A philosophical and legal exploration of smart toys and trust. *Journal of Cyber Policy* 4, 2 (May 2019), 143–159. DOI:https://doi.org/10.1080/23738871.2019.1586970

[12] Joseph Lindley, Haider Ali Akmal, Franziska Pilling, and Paul Coulton. 2020. Researching AI Legibility through Design. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20). Association for Computing Machinery, New York, NY, USA, 1–13. DOI:https://doi.org/10.1145/3313831.3376792

[13] Franziska Pilling, Haider Akmal, Paul Coulton, and Joseph Lindley. 2020. The Process of Gaining an AI Legibility Mark. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems* (CHI EA '20), Association for Computing Machinery, New York, NY, USA, 1–10. DOI:https://doi.org/10.1145/3334480.3381820

[14] Rhianne Jones, Neelima Sailaja, and Lianne Kerlin. 2017. Probing the Design Space of Usable Privacy Policies: A Qualitative Exploration of a Reimagined Privacy Policy. (July 2017). DOI:https://doi.org/10.14236/ewic/HCI2017.50

[15] Joseph Lindley, Paul Coulton, Haider Akmal, and Brandin Hanson Knowles. 2017. Anticipating GDPR in Smart Homes Through Fictional Conversational Objects.

[16] Bill Gaver and Heather Martin. 2000. Alternatives: exploring information appliances through conceptual design proposals. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (CHI '00), Association for Computing Machinery, New York, NY, USA, 209–216. DOI:https://doi.org/10.1145/332040.332433

[17] Chris Elsden, David Chatting, Abigail C. Durrant, Andrew Garbett, Bettina Nissen, John Vines, and David S. Kirk. 2017. On Speculative Enactments. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 5386–5399. Retrieved February 20, 2021 from https://doi.org/10.1145/3025453.3025503

[18] Stephen Purpura, Victoria Schwanda, Kaiton Williams, William Stubler, and Phoebe Sengers. 2011. Fit4life: the design of a persuasive technology promoting healthy behavior and ideal weight. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '11), Association for Computing Machinery, New York, NY, USA, 423–432. DOI:https://doi.org/10.1145/1978942.1979003

[19] Joseph Lindley and Paul Coulton. 2015. Game of Drones. In *Proceedings of the 2015 Annual Symposium on Computer-Human Interaction in Play* (CHI PLAY '15), Association for Computing Machinery, New York, NY, USA, 613–618. DOI:https://doi.org/10.1145/2793107.2810300

[20] Joseph Lindley, Paul Coulton, and Rachel Cooper. 2017. Why the Internet of Things needs Object Orientated Ontology. *The Design Journal* 20, sup1 (July 2017), S2846–S2857. DOI:https://doi.org/10.1080/14606925.2017.1352796

[21] William Gaver and Anthony Dunne. 1999. Projected realities: conceptual design for cultural effect. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (CHI '99), Association for Computing Machinery, New York, NY, USA, 600–607. DOI:https://doi.org/10.1145/302979.303168

[22] Kirsten Boehner, Janet Vertesi, Phoebe Sengers, and Paul Dourish. 2007. How HCI interprets the probes. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '07), Association for Computing Machinery, New York, NY, USA, 1077–1086. DOI:https://doi.org/10.1145/1240624.1240789

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