Physical Sensemaking: Crafting For An Invisible World of Data

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Abstract

The potential of a 'data-driven life', together with the realization of Weiser's vision of 'the disappearing computer' have been embraced by many. However, the increasing invisibility, virtuality and complexity of data systems also come with a variety of concerns, such as issues of sensemaking, ownership, representation and control. Although data and technology is all around us, its virtual and invisible nature, thereby its lack of material and tangible forms has implications on the way data systems are (mis) used, understood, experienced and perceived. This paper presents craft-based approaches for physical sense making –widely ranging from physical artefacts to show and hide from monitoring, to crafting data physicalizations for critical thinking, communication and creativity. In doing so, this paper discusses how crafting physical forms can be used as a way to grasp and understand 'invisible' data systems.

Author Keywords

Craft; Monitoring; Hidden data systems; Disappearing computer; Millinery; Physical crafting; Monitoring; 21st century skills; Data physicalization; Physical models; Personal fabrication; Empowering physical design.

Figure 1: Interactive doll houses; scale models of apartments equipped with sensor networks for enabling discussion on the desired workings of hidden sensor data systems in the home (See also [8]).

Introduction

Societal developments and technological advancements –such as the miniaturization of computing devices, sensors that can be embedded in almost everything, the quantified self, and the mass-production, collection and deployment of (big) data– have contributed to a stream of data that appears to be increasingly invisible and complex. As a result, much of the technology and data that people come across and experience every day can go unnoticed. Although most have embraced Weiser's vision of the disappearing computer [14], some (e.g.[2]) have begun to critique this notion. Indeed, the invisibility in data collection and distribution has hidden yet profound implications, such as issues of ownership and understanding. To counterbalance the digital and mass-consumed world, there is a need for more physical, individually crafted experiences. Consequently, recent years have seen a growing interest in craft-based approaches within research in the design and use of interactive systems [3]. The questions brought about by the disappearing computer and the data-driven life need new physical examples and representations. To address this, the work presented focuses on crafted interactive pieces and physical crafting that uncover the hidden layers and implications of technology, abstract phenomena and data for critical debate.

Physical Craft For Sensemaking

The following described projects show a wide range of physical interactive projects for sensemaking. What these have in common is that these pieces have all been individually crafted for discussing its implications.

Interactive physical models for discussing technology
Physical interactive forms can help to explain and so uncover the desired use of technology, in a diverse set of ways (see also [9-11]). In particular, studies [7; 11] with physical interactive scale models (as shown in Figure 1 and 2) show that it can help stakeholders in discussing the desired and undesired forms of newly proposed technology. The (potential) workings of ambient and pervasive systems are not always clearly communicated to the user. The interactive scale models in Figure 1 and 2 are aimed at increasing public understanding of the existence, workings and potential of public screens (Fig. 1) and ambient sensor technology (Fig. 2) by physicalizing its potential.

Figure 2: This technology-enhanced scale model is a physical tool for co-designing and discussing public displays. The content of the embedded interactive screen is dependent on the monitored movement (see also [11]).

Physical monitoring: Craft against surveillance
Physical crafted pieces cannot only help to see how monitoring technology works, it can also be used to hide from monitoring.

Figure 3: Chapeau Privée: Flexible privacy.

Figure 4: Chapeau Privée: Mourning the death of privacy.

Figure 5: Chapeau Privée: Elegant hiding

Namely, Chapeau Privée explores how everyday citizens could potentially combat surveillance techniques using traditional millinery craft. It is a rather old-fashioned hat-wear collection, designed to protect oneself against CCTV surveillance. Hats (as shown in Figure 3, 4 and 5) are made out of glimmering camouflage and partly recycled material such as tin foil and voile-like techniques. The choice of materials was based on previous work [12] that explored the best surveillance and tracking camouflaging techniques. While it makes novel, surveillance techniques malfunction, it has been made in a traditional way using artisan millinery techniques. Although some facial camouflage techniques already exist (e.g. hoodies, caps [1] and paint [13]), Chapeau privée aims to move away from shady or 'nerdy' connotations and to not make one look overly stand-out in public. The idea of using recycled material in the collection is meant to strengthen its benevolent intent.

Physicalization of abstract phenomena
The previous exemplars demonstrated how physical and craft-based approaches could be used to better empower citizens. In this line, but using more modern fabrication techniques, *Bureau crazy* is a physical and verbal hand grenade against bureaucracy. It is an interactive physicalization of the Dutch saying van het kastje naar de muur (Literally: from Cabinet to wall, figuratively speaking: from Pillar to post). The project entails a wall and a cabinet with distance sensors that react in an endless loop by pointing and verbally directing you to either the wall or the cabinet. Its modular design is a physical way to fight against bureaucracy and is meant as an 'award' for people guilty of bureaucracy (see also [6]).
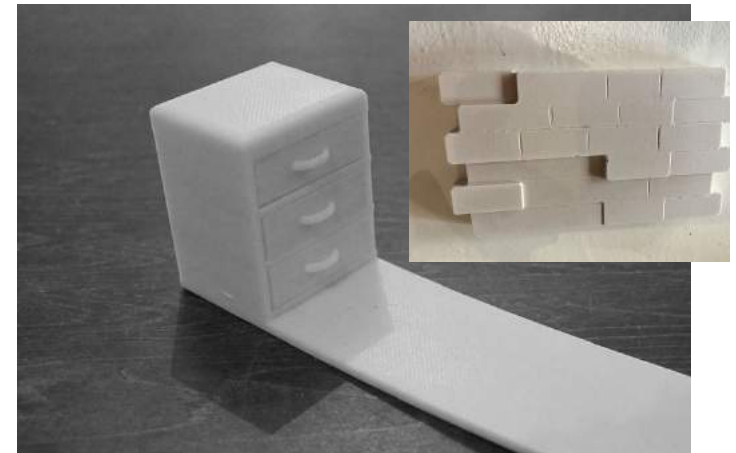

Figure 6: Bureau crazy, physicalization of the abstract concept of bureau crazy (encompassing an interactive installation and award), using a mixture of personal fabrication techniques.

Figure 8. Physicalization by children of the results to the question: How many best friends do you have? The visualization of the question itself was made with the vinyl cutter.

Figure 9. Data physicalization by children that used the Little Bits for an interactive count-down display. They physicalized how the new pupils felt about their new school.

Figure 10. Physicalization by children on the question whether they prefer to use the phone or WhatsApp. They used the Little Bits to enhance their design with interactive ringing sounds.

Data physicalization for 21st century skills
To explore how the process of making data physical can support sensemaking and other 21st-century skills, more than 130 primary school children were engaged in a series of workshops and teaching activities on data physicalization. The pedagogical format built on the work of others [4; 5] and the activities led to 47 highly diverse crafted artefacts in total. This included 90 primary school children who made their own collected data on the theme of friendships physical to experience data in a different way. Observational findings and learners reports (using a 5-point Likert scale, 1=highly disagree, 5=highly agree) indicated that the vast majority of the children *agreed* that the data physicalization teaching activity enabled them to better understand the data ("*I suddenly thought of things I would never had thought of*"), collaborate and communicate well ("*as I could explain it with the real stuff*") and become more creative ("*Because I had the material to make something beautiful*" and "*Nobody had created the same*"). The majority of the children also *highly agreed* on enjoying the data physicalization teaching activity and to have learned from it, such as "*how to craft things*" and that "*data is all around you*". In the end, the children and teachers were proud of the accomplished results, especially when integrating technology (such as in Fig. 10) that they had not thought to be able to make work at the beginning.

Blending analogue crafts with digital technology
With MaKey MaKeys and Little Bits, the children and adults got to add an extra interactive layer to their craftwork, such as illustrative lights or sound. One group got to use the vinyl cutter (Fig. 8), which they felt was more special than using the 3Doodler pens. Nonetheless, these were also popular (Fig. 11).
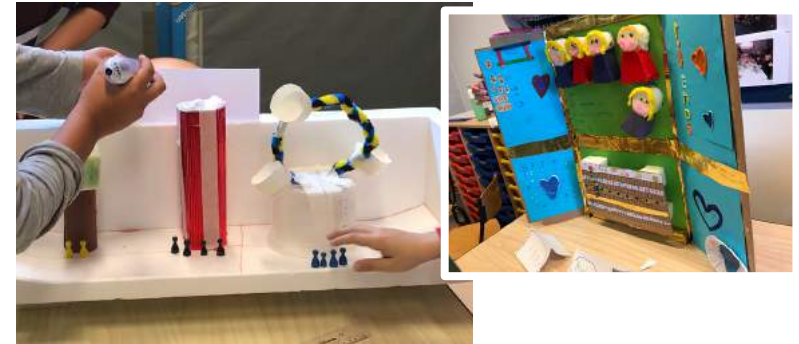

Figure 11. The children used the 3Doodler pen for decorating and annotating their data physicalizations.

Finally, the importance of physical crafting was stressed by one pupil stating: "*When you make something, you get more and more ideas on how to change it.*"

Discussion

The presented craft-based approaches, going from traditional millinery craft to digital fabrication, enable rethinking and reconfiguring of (monitoring) technology, abstract concepts and data. As such, these crafted pieces help making sense out of the digital world around us. Crafting and so uncovering and materialising invisible and data systems with physical techniques seem to be vital for democratically designing, using and critiquing a digital world in which data appears to be increasingly invisible. The work presented addressed new experiments and crafted forms for engaging with data and pervasive monitoring systems. Although there are different types of challenges and concerns needing further investigation, particularly the last study showed that the craft process of making physical and taking advantage of multimodal approaches can be a helpful approach in making sense out of a world with increasingly invisible data.

Acknowledgements

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