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Depth of Field

Discursive design research through film

Abstract

This article is about the role of film in interaction and product design research with technology, and the use of film in exploring and explaining emerging technologies in multiple contexts. We have engaged in a reflective design research process that uses graphical, audiovisual, and time-based media as a tool, a material and a communicative artefact that enables us to approach complex, obscure and often invisible emerging technologies. We give a discursive account of how film has played an intricate role in our design research practice, from revealing the materiality of invisible wireless technology, to explaining complex technical prototypes, to communicating to a public audience through online films that may fold broader social and cultural discourses back into our design research process. We conclude by elaborating on discursive design approaches to research that use film as a reflective and communicative medium that allows for design research to operate within a social and cultural frame.

Keywords: interaction design, product design, discursive design, emerging technologies, RFID, film, reflective, communication, mediation.

Introduction

In the last decade, interaction design has found itself in a rather unique position. As an interdisciplinary field, drawing upon many domains such as Human Computer Interaction (HCI), product and graphic design, informatics, art, engineering and critical practice, it has grown the potential to situate itself in a critical position between emerging technologies and culture. In particular, there are emerging modes of doing exploratory design research that result from the newfound relations between product, interaction and communications design.

In this article we discuss our design research activities that use film as a material for exploring, conceptualising and communicating with emerging technology. We analyse this through existing framings of audiovisual media in HCI, technology, and interaction design research. The central research question we address is how does audiovisual media enable new kinds of practice-based design research with emerging technology?

In posing this question several others also arise. How might designers use and shape audiovisual media to support processes of understanding and conceptualising with emerging technology as part of their practice? And what opportunities do audiovisual media open up for design in explanation and communication within a broader social and cultural context?

The article develops two main aspects: film as a material in communicating and conceptualising new technology and the role of film as a tool in the design research process. The concept of depth of field here opens up three things for us. First, we investigate the boundaries between the field of design research and the critical conceptualisation of technology. Secondly, in our design practice we use film to probe the depth and materiality of emerging and often invisible technologies. Third, depth of field is one of the cinematic qualities of film that is used here to both communicate about technology, and to help understand the role of audio-visual mediation in the design and development of technological products.

Film is a communication media that involves audiovisual representations that have immersive and experiential qualities, and that can be very selective in conveying and framing subject matter. By using film, we imply a mode of production and display that involves cinematic qualities such as genre, narrative and cinematography, not simply video as a tool

for documentation or analysis, but film as a purposeful, constructed, designed and directed experience.

Seven short films are included within this text. They have been produced over several years as an integrated part of our research. They are embedded in the article where they form topics and construct a path through the research as is argued for example in the field of visual rhetoric and through the genre of the visual essay or 'pictorial texts' (e.g. Mitchell, 1994).

The films are thus meant to be watched at critical points in the text where they act as both cases and arguments. We analyse these films through addressing their role in unpacking, conceptualising and visualising emerging technology, how the films themselves provide us with new design materials, and by looking at their role in communicating about technology on both an explanatory and experiential level.

Background

Research in interaction design builds knowledge around the concepts and practices involved in creating and using interfaces that mediate between people and computational systems. Interaction design research has drawn much from research in technology and informatics, but has expanded from its early technologically centred remit (e.g. Bagnara & Crampton-Smith, 2006) and developed approaches and theories such as those of critical design, user-centred design, reflective design and experience design. These are attempts to theorise around the rapid changes brought about by the emerging technological media in which design work takes place and in which designed interfaces are experienced (e.g. Redström, 2001). Today interaction design encompasses a broad set of approaches to technology and ubiquitous computing, user interfaces, tangible and embodied interaction, as well as media and communication design (e.g. Poggenpohl, 2006).

Our take on interaction design draws on a purposefully broad range of contexts and approaches from HCI, product, graphic design and visualisation, media, communication and also from particular approaches to prototyping and crafting with electronics and software. Our communicative design research methods are aimed at exploring emerging technologies that work from a design informed position with distinct qualities of hands-on making and form-giving, where tangible materials and prototypes are formed alongside visualisation and other mediating processes.

RFID and ubiquitous computing

This design research emerges from a project called Touch that investigated an emerging technology called Radio Frequency Identification (RFID). At its simplest RFID offers a wireless method for identifying objects at a distance, using small, battery-less RFID 'tags' that can be embedded inside products, objects and environments. RFID is rapidly emerging and is already implemented on a large scale in logistics and asset tracking, access control, security, and ticketing such as London's 'Oyster card'. The research discourse around RFID is often driven by powerful economic interests and focuses on utilitarian and industrial applications (eg. DeVries, 2008), the optimisation of tags, readers and infrastructures (eg. Dontharaju et al., 2009). Privacy and security are an important part of the public debate around RFID (e.g. Albrecht & McIntyre, 2005) and research is concerned with privacy and security policy (eg. Garfinkel & Rosenberg, 2005). The popular understanding of RFID is often coloured by fundamental misunderstandings largely created by mass-media representations that are very different from actual physical characteristics of the technology (Poole et al., 2008). The most common 'folk' theory about RFID is that tagged people or objects can be read from great distances, enabling governments and corporations to track people's everyday lives.

These dominant research and popular discourses around RFID rarely address the design of RFID interactions and products outside of utility and industrial contexts, or engage

with the public understanding of the technology. We position our research outside these dominant approaches to RFID. We do so in order to address a more nuanced view on the challenges and possibilities of RFID and this demands that we unpack the material of the technology, and that we re-frame it in a way that it can be designed, shaped and critiqued.

Already widely used in the world, it is important to understand how RFID is seen as a prototypical ubiquitous interface technology. It is located within a broader frame of research from 'ubiquitous computing' or ubicomp first developed by Mark Weiser at Xerox PARC in the late 1980s. Ubicomp describes a post-desktop computing paradigm where technologies 'weave themselves into the fabric of everyday life until they are indistinguishable from it' (Weiser, 1991: 1).

Contemporary ubicomp research includes alternative perspectives such as tangible and embodied interaction (Dourish, 2001), social and cultural issues (Galloway, 2004), user experience and society (Greenfield, 2006) and the concept of seamfulness which works towards active, engaged interaction rather than the dominant visions of seamless and ambient computing (Chalmers & Galani, 2004). An influential account of ubiquitous technology criticises the ever-shifting 'proximate future', where technologies are always 'just out of reach' despite the fact that many aspects of ubiquitous computing are already intertwined into society, culture and contemporary everyday practices (Bell & Dourish, 2007).

The dominant approach to ubicomp has been directed towards visions of a near-future of ambient, calm, invisible technology, with a discourse of miniaturisation, invisibility and 'disappearance' (Norman, 1999). Invisibility is a critically important issue for RFID, where it is not only conceptually obscure, but invisibly embedded inside products, and through interaction, generating obscure data in databases that are often outside user control. In our research, we address the issues of invisibility by focusing on visualising the tangible and spatial qualities of the technology itself and by contextualising it through embedding it in products and interactions where RFID offers opportunities for physical-world interaction embedded in everyday objects (Martinussen & Arnall, 2009). These multiple viewpoints reveal a complexity in the field and ubicomp represents an entirely new set of design materials, applications and implications that need to be explored.

Mediating technology

There is a need for design research to engage with emerging technologies like RFID in order to build knowledge that encompasses theoretical, critical, reflective and practical approaches to the technology. In addition, there is a need to understand the critical processes of translation between emerging technology and the popular cultural imagination. In a landscape dominated by powerful technology-push, is there a way for design to uncover and communicate the potential for human qualities, playfulness and sensitivity to materials and context?

Historically, film has been a central part of the communication of new technology with interfaces being mediated through film or video demonstrators. From televised events showing off household robotics at the 1939 New York World Fair to the invention of modern computing paradigms such as the mouse – in Engelbart's 'Mother of all demos' (Engelbart, 1968; Moggridge, 2007).

Products too are often initially experienced through cinematic forms, from lifestyle commercials for Sony televisions, to explanatory 'how to' informercials for the Apple iPhone, to user-generated 'unboxing' videos on YouTube. These forms include advertising and consumer marketing strategies, but also explanatory modes. The commercial film for the Polaroid SX-70 camera, directed by Charles and Ray Eames in 1972 (Eames Office, 2000), is a fine example from design practice of new technology explained to the masses through a product commercial, conveying technology and experience combined into one form. The

relations between scientific advance and cinema are extremely close. Kirby demonstrates how film establishes achievability of scientific and technical discourses, and 'cinematic depictions of future technologies demonstrate to large public audiences a technology's need, viability and benevolence' (Kirby, 2010: 41).

In the Touch project we have attempted to meet these challenges and opportunities for interaction design research via a broad socio-cultural approach to technology. This approach sees technologies as part of a wider social and culturally situated perspective and how they are taken up, adapted and adopted in contexts of design, testing, use and revision. Important here for design research that involves digital materials, processes and communication is the concept of mediation (Vygotsky, 1978). Mediation helps us to frame activities that involve designers in inquiry with a subject-matter that are directly and indirectly related through an artefact or a tool. In a socio-cultural perspective on design, interaction and communication, mediation allows us to get at the interplay of cultural codes and symbolic significations and the tools and technologies within which they are realised. However, this is a two way process. Tools and technologies also influence how we design, work and communicate so that finding out about their properties, affordances and constraints is also revealed through the activities of designing and the design of emerging products and services. The artefacts we design in the context of emerging digital technologies also convey their compositional and communicative character as mediating artefacts. Wartofsky sorts artefacts at three levels: primary artefacts are tools used directly in human activities (Wartofsky, 1979). Secondary artefacts are 'symbolic externalizations' or 'objectifications' of primary artefacts. Tertiary artefacts are abstracted from the function of secondary artefacts. At this third level, mediating artefacts are abstract and conceptual: they are no longer concerned with plain representationality but move into the realm of imagination. Here artefacts become powerful forces for transformation, embodying vision and potential. In the context of our research, we can discuss our design practices and research perspectives through artefacts like prototypes and products, and through representational artefacts like films that are both able to articulate concepts, potentials and visions for emerging technologies.

The films we include are examples of this as artefacts that mediate complex intersecting activities (Engeström, 2010) and various layers of design and communication. The films also 'speak' from several positions. These filmic artefacts are conceptualised and communicated at the level of artefact as tool and sign, but they are also artefacts of mediation. They encompass different disciplinary knowledge of RFID as technology, as interactive material and as culturally resonant media. At the level of articulation in discourse, they also interlace different conventions and stylistics that are realised though our own varied expertise in film, advertising, graphic, interaction and product design. In summary, following Hahn and Gregory (2007) mediating artefacts are constructed and invested with meaning in complex relationships among other objects by conceptualizing and reorganizing particulars. In this project we have reframed RFID technology through the tools of interaction design with a communicative intent, and explored the limits and edges of what the technology lets us do in design.

Frameworks

Within the discourses of emerging ubiquitous technology, we adopt a research by design approach that draws on a number of conceptual and theoretical frameworks in designing, analysing and reflecting. Below we go through some of the concepts we use and situate the filmmaking activity within practice-based design research. The contexts for this work are numerous and inherently multi-layered, so in order to discuss the films we must bring together a network of theories to provide frameworks for analysis. We define existing frameworks that are useful for analysing our practice-based design work, our material

approaches, the experiential and exploratory prototyping, and the propositional, discursive design artefacts themselves.

Critical design

In conducting research with emerging technologies the practices and approaches within critical design define an important set of design tools and analytical means. The term 'critical design' was introduced in Anthony Dunne's book Hertzian Tales (Dunne, 2005) and describes a design process that use speculative design proposals to challenge assumptions, preconditions and givens in technological systems (Dunne & Raby, 2007). Critical design can be defined as a form of design that uses the processes, tools and languages of product and interaction design to not solve or resolve problems, but to critically rethink the parameters of the problem area itself (Mazé & Redström, 2007). Critical design is currently being contextualised and developed with a focus on critical practice in design research where 'a pragmatic conception of reflection is extended as a critical modality - to question and transform rather than only describe and affirm' (ibid: 10). Critical design, therefore, provides an analytical stance and design approaches for exploring, conceptualising and communicating around emerging technologies. Mediation through photography and film is central in critical design practice. Dunne writes about 'the design object as prop':

> By abandoning the technical realism of the prototype and the visual realism of the traditional industrial design model, conceptual models in combination with other media, can refer to broader contexts of use and inhabitation. For instance, by using conceptual models as film props the viewer can be drawn into the conceptual space of the object in use rather than an appreciation of the thing in itself. (Dunne, 2005: 92).

Here we need to broaden the concept of 'design object' to include film props and other conceptual objects like traditional design models, working prototypes and technical probes, but also to consider the conceptual space of film as a design object in itself.

The concept of critical design is central to our process and position on technology and design research. Seago and Dunne describes the key methodological factor in critical design research as "using the process of invention as a mode of "discourse", a poetic invention that, by stretching established conventions, whether physical, social, or political, rather than simply affirming them, takes on a radical critical function, a material critical theory, or what Dunne terms a 'parafunctionality' (Seago & Dunne, 1999: 17). In the context of ubiquitous technology, this 'radical critical function' of design can be describes as "a critical medium for reflecting on the cultural, social, and ethical impact of technology" (Dunne, 2005: xii). Critical design in the field of RFID could address the conventions of the technology both on a instrumental and technical level by re-conceptualising the interactional and experiential possibilities of the technology, and on a social and cultural level by challenging and re-contextualising RFID in a broader public discourse. In this sense we have to see critical design in the bigger picture of technology, culture and media.

The research we report on takes place in the context of internet media where our work is mediated through online 'social' channels and connections (Shirky, 2008; Boyd, 2008). Much of the impetus for the research comes from the motivation to participate in public discourse, and the ability to use media as a way of conducting 'design probing' (Gaver et al. 1999) that uses various media forms to uncover and explore various latent perspectives and attitudes. This has been particularly important when working with a rapidly emerging technology as controversial and misunderstood as RFID. The dissemination of the research work through film has been part of the motivation for doing explorative design research in this area. When design research is mediated through online social media, online film can used as a 'boundary object' (Star & Griesemer, 1989) that can inscribe complex and difficult aspects of design research in a broad public discourse. Star and Griesemer (1989) introduced

the concept of boundary objects to describe objects that can be used to translate between fields or contexts and are 'both adaptable to different viewpoints and robust enough to maintain identity across them' (1989: 1). When designed media artefacts act in an online social media context, they are embedded into diverse mediational forms such as news, blogs and discussions forums, where they are used to support and discuss many perspectives and viewpoints.

Our overall approach uses film to mediate design artefacts and to build upon critical design approaches to problematise RFID. These films may then be put into a public domain to raise debate and with different participants/audiences. They have the potential to create and direct the discourses around emerging technology through the boundary objects of the films. These approaches from critical design contribute to a discursive mode of design research that connects to making and knowing, and to mediation and communication.

In our view, the mediating aspects of critical design are crucial, and must be explored beyond the art-centred forms of mediation that currently dominate critical design. We seek to do this by using film and online media as our central strategy in a discursive design take on research by design to communicate design research towards both technology and design communities, and a broader public. By emphasising the communicative activity of our design research, together with a reflective and explorative approaches of critical design, we seek to develop a practice of discursive design. This practice is also informed by reference to research into media and rhetorics of online discourse.

Research through interaction design

In interaction design the move towards computing that is embedded in everyday life has influenced new modes of embodied interaction that occupy a world of physical and social reality (Dourish, 2001:3). Interaction design has traditionally worked with situated forms such as wireframes, diagrams and screen-based prototypes (e.g. Landay & Myers, 2001), but when interfaces are ubiquitously spread across the physical world, we need new ways of sketching and visualising, that place greater emphasis on the body, time and space. Non-screen-based tangible interaction takes place outside of traditional confines of desktop computing and means that designers must work with complex networks of sensors, embedded computation and actuation (Igoe, 2007). In order to conduct these design explorations, we have needed to build knowledge around new technological materials, and develop new tools and techniques for practising design such as 'sketching in hardware' (Kuniavsky, 2006). However, design practice with tangible interactions is still relatively new, often requiring lengthy-development cycles that still rely heavily on technical knowledge of hardware and software that can be far removed from the design of user experiences (Klemmer et al., 2004). In order for designers to communicate about and through tangible interactions, there is a need for design research to develop new tools for sketching, rapid prototyping and visualisation that more fully account for the design of interactive experiences in these new contexts.

In our investigations into RFID, we situate ourselves in a process of research by design and practice through research as described by Sevaldson (2010). In research by design the design practice is a theory building activity: engaging ourselves as design practitioners in generative design activities where our 'investigations are conducted within a first person perspective combined with a reflexive mode making design knowledge explicit' (Sevaldson, 2010: 2). Here design engages in a research enquiry that opens up for generative, explorative and innovative approaches. This view draws upon both Schön in the formulation of reflection in action (Schön, 1983), and in the ability to generate knowledge in a bottom-up, explorative investigations of material and phenomena. In research by design we place ourselves as distinct from the kind of knowledge building found in 'traditional' sciences, in that our inquiry is not about hypotheses, problems and problem-solving. Instead, it is oriented

towards exploration and moves towards generative discovery, and towards desirable surprises (ibid). In practice through research we consider that our design practice - which is funded by research and has been practiced outside of commercial or client-based constraints - has been conducted in order to build abstracted or generalised knowledge of emerging technologies. This mode of knowledge building uses design activities to explore a particular domain, where the research is conducted through practical design experiments and explorations.

Design material

Design has a tradition of working closely with materials in shaping and constructing experiences. Schön (1983) describes design as a physical conversation with materials, and concentrates on the ways in which materials 'talk back' as part of this dialogue. But technology has introduced new complexity into this relationship, introducing time, multi-dimensional interactive relations and various highly complex and invisible components that are very hard to grasp for designers. Vallgårda and Redström (2007) see technology as a set of 'composite' digital materials that are likened to physical materials in architecture and design, pointing towards the often overlooked and pressing need to address the actual fundamental physical and spatial aspects of ubiquitous technologies. The spatial characteristics of sensing systems have a direct impact on the qualities of the interaction and the physical form of digitally augmented products (eg. Reeves et al. 2006). Nordby (2010) sees technological material as an important element of early phase conceptual design, where conceptual designs are often developed in tandem with new materials, and where designers need to understand materials in order to inspire new solutions. As well as treating RFID as a new material, the Touch project has also used the new opportunities and constraints offered by audiovisual media within its' design practice.

There is also a need to understand film as a design material, and reflect on the ways in which the material/medium of film operates within design research. At one level, film inscribes a mode of representation that involves time, audiovisual media, and a form that requires attentive and immersive engagement from an audience. To produce film requires literacy in cinematic form, such as formal narrative and nonnarrative construction, film style, editing and characterisation that are often developed and adapted from or contrasted with the classical Hollywood model (Bordwell & Thompson, 2007). At an instrumental level, film production can involve scripting, dialogue, visualisation, storyboarding, shooting, animation, editing, compositing, layering, motion graphics and special effects (Katz, 1991; McClean, 2008). Cinematic materials may include props, lighting, sets, sound, grading or colour balance, film stock or video format, shutter speed, frame rate, depth of field, sharpness and resolution. Here film offers a compositional space, where for instance we might shoot physical props and environments that define the space on the screen as 'real'. Special effects technologies may then be used to increase the expressive and manipulatable space of film, allowing for 'real' spaces and representations of 'physical' objects to be manipulated through software in what Manovich calls a 'metamedium' (Manovich, 2007). These are all part of the manipulatable 'materials' in the repertoire of moving image tools.

Film in interaction design

Film has lent itself to being used in multiple ways within design processes. This ranges from low-fidelity documentation and reflection (Ylirisku & Buur, 2007), enactment through video such as Sketch-a-move by Jain & Klinker (in Buxton, 2007: 321) to high-level experience prototyping of pervasive computing experiences (Halskov & Nielsen, 2006).

The use of film and video has been well documented from interaction design and HCI research, where video is used as part of an interaction design 'toolbox' to capture, document and communicate user-studies as part of a user-centred design process. Film is also well

understood as a prototyping tool, where the techniques for audiovisual, time-based representation are instrumentally important in communicating the spatial, social, tangible, embodied and time-constrained nature of interactive systems.

Ylirisku and Buur (2007) see video as a critical component in user-centred design and innovation processes. They depict video as a documentation tool to edit events, enactments, activities and social interactions as well as a way of facilitating collaboration and 'meaning making' processes in design. In 'design documentaries' (Raijmakers et. al. 2007) the focus is on observation and compilation of activities in everyday life in the 'discovery research' phase of a design process. Bonanni and Ishii (2009) use stop-motion animation to foster 'collaboration, legibility and rapid iterative design' when prototyping tangible interactions, and find that the medium inherently highlights the constraints of the body, space and materials. Halskov and Nielsen (2006) explore the use of video production in the design process that they call 'virtual video prototyping'. This involves both live-action filmmaking and the use of virtual 3D sets as tools for prototyping and enacting proposed interfaces. They see that 'the strongest argument for using this medium has been that it has been able to create an illusion of an idea without having to go into technical detail' (Halskov & Nielsen, 2006: 225). For these designer-researchers 'the communicative power stems from the high degree of realistic presentation of concrete situations in a story-driven rather than a technology-driven way' (Halskov & Nielsen. 2006: 226). They also highlight the problems of lengthy post-production processes as one of the limiting factors of video prototypes.

The films below demonstrate some of these approaches to film in discovery, prototyping, experimentation and evaluation. But for us there are many perspectives on film in interaction design that are not necessarily about empirical investigations or documentary representations. Within a research by design process, film may also reveal and articulate complex subjects, through multiple genres, and for multiple audiences. In a discursive design approach, we may be able to explore emerging technologies through still applying critical design approaches that involve play, invention, imitation, parody and irony, in ways that may be able to reveal and translate across many socio-cultural contexts.

Interaction design has developed methods of conceptualising and representing user experience, in practices such as 'experience prototyping' (Buchenau & Suri, 2000) and 'experience design' (Shedroff, 2001) allow for the tangible enactments and communication of experiences as part of a design activity. The audiovisual, time-based material of film opens up for experiential representations where objects, actors (or users) are typically situated in 'natural' sets or environments which reinforces the constraints of time, space and the body. In design research these experiential representations open up potential for the mediation of designed user-experiences in ways that may not be possible through other static visual, textual or verbal forms.

Graphic and information design offer tools and practices that can abstract complex systems and phenomena into knowable, visual artefacts. As shown in the rich graphic histories presented by Tufte (1997), there is a strong tradition in graphic design of making accessible visual representations of complex and multi-faceted information. The repertoire of graphic and information design have recently broadened to include time and motion, which can be seen in the 'motion graphics' that have become commonplace in broadcast news (Krasner, 2008). Film opens up for kinds of explanatory modes of communication within interaction design. Just as the Eames' were able to explain the radical change in photography brought about by Polaroid technology, we are able to use film to reveal and explain the intricacies of interactive and ubiquitous technologies. As increasingly complex and 'invisible' technologies emerge into the world, we see the need for a greater understanding of ways that the visual, cinematic qualities of film can be used to communicate experiential and explanatory perspectives on technology.

Research in many domains is beginning to accept the move towards a multi-media culture. Within studies of culture and technology, new media and digital art in a 'technology-engaged' world is being examined (Murphie & Potts, 2003), while studies of visual digital culture explore the relationships between digital technologies and media is with a focus on new forms of spectatorship within mass culture and new digital visual forms (Darley, 2000).

There is also a small but growing section of research that involves multi-mediational forms as part of their research dissemination, such as the refereed online journal Kairos. The dominant form of research, however, is still textually logocentric. We are having to tread new ground, even as interaction designers, to be able to use video as part of this research argumentation and scholarly publication.

Design activities

The Touch project has consisted of a small team of design researchers with a broad set of skills collaborating in conceptual and practical processes of developing concepts and detailed design outputs. We have approached technology as designers, in a collaborative design studio setting that allows for exploration, divergent paths and iterations. The team's talents and backgrounds include interaction and product design, programming, film, advertising and media. In this process we have valued hands on making and material explorations in developing a design literacy with material. This brings together a varied set of skills and design-tools such as creative methods, sketching, the detailed design and fabrication of product and prototypes, development of electronics and software, graphic design, motion-graphics and film-making.

The designed objects presented in the films emerged from an iterative process of conceptual and practical designing, making and testing that draw on product and interaction design methods, but these objects and products are also created with a focus on how they are going to be presented through audiovisual media. The process of production helps in the forming of conceptual frameworks, as complex ideas need to be tuned and refined in order to communicate them. The films were made with attention to communication, style and genres through a process of scripting, set-building, lighting, and post-production processes of editing, motion-graphics and special effects. Some of the films have a focus on presenting products that have already been designed, while others are generated from scripts to present specific concepts.

Many of the issues raised above as frameworks for the research were condensed into a set of design briefs that were used to guide the inquiry. These briefs set up areas and possibilities for design research that included: ‘properties of RFID as design material’, ‘playful RFID’ and ‘RFID in domestic contexts‘. Importantly, this means that the project has not worked towards given problem statements, but from the position of using design briefs to generate materials, to uncover opportunities and constraints, and to work towards desirable surprises. This again frames our research perspectives and foregrounds a discursive design approach with a focus on communication and conceptualisation of the technology.

Films from Touch

The following selection of films has been made as part of the Touch project over a period of three years within the design activities described above. These films have played various roles in inventing, mediating, articulating, and communicating within our practice-based research. The films have been published and distributed online using video sharing tools, and here they have become the boundary objects through which we discuss and communicate about RFID technology to broader audiences.

The first films show a research approach that explores the materiality of RFID in experimental and highly aestheticised ways. These films emerged out of probing at the

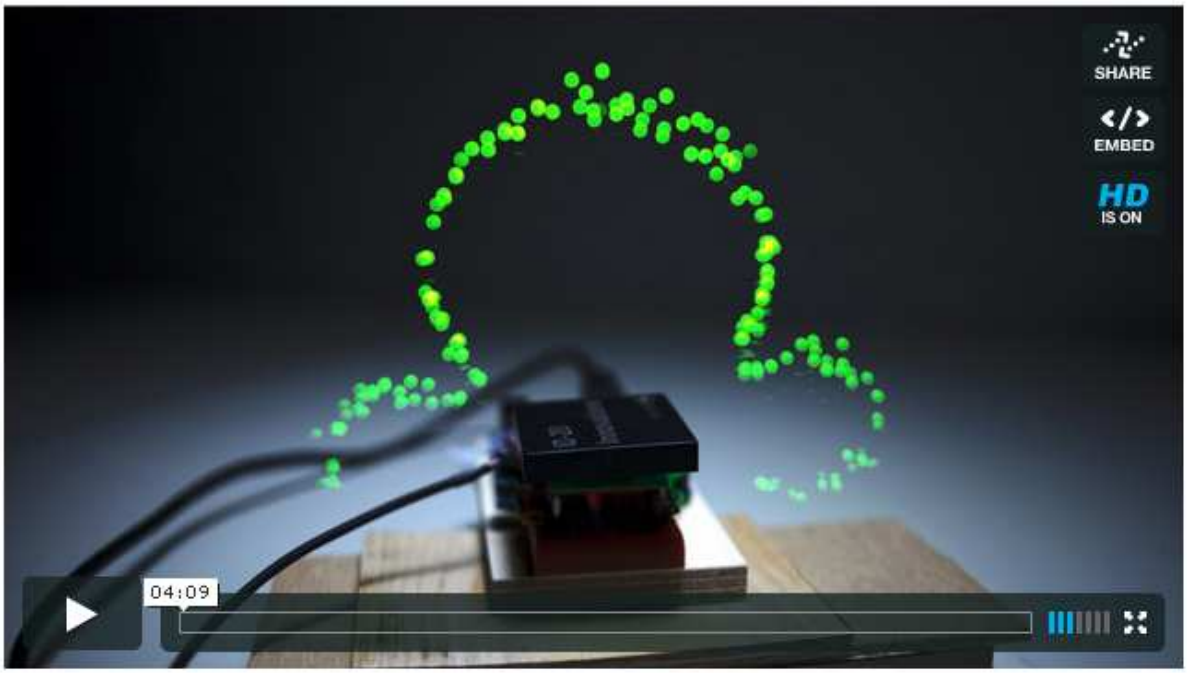
technology with the visual tools of photography and animation. Next, product-focused films articulate views on technology in context through specific experiential and explanatory moves, such as the use of motion diagrams. These films then set up a series of narrative 'vignettes' which convey experiences of actually using the technological products in specific contexts. In the latter films we embed critical framings of technology into culturally resonant forms which communicate to a broad audience, in what we are calling a discursive design approach.

Exploring materiality through film

As we have seen, RFID is a particularly immaterial technology, it is literally 'black boxed' into packaged components, and the qualities of its invisible radio fields are badly understood. The spatial and material aspects of RFID are important for design, in order to be able to create interactions and products that take advantage of the spatial and gestural properties of the technology.

These technological materials are in the first instance defined by engineers, scientists and researchers in domains very different from design, and often with different motivations. RFID for instance is framed as a technology that can track logistics in large infrastructural and economic systems. This means that the technology is often designed in a certain way, to support certain kinds of functions, contexts and activities. Designers must resort to manuals and data-sheets in order to understand the opportunities and constraints of the technology. Unfortunately, this translation of the ‘raw’ technology is more often than not biased towards particular kinds of application (such as scanning boxes of products on an RFID-enabled conveyor belt), often inaccurate in its’ measured and theoretical limitations, and occasionally wilfully misleading for marketing or sales purposes. Building on the manner in which Nordby (2010) models short-range RFID as a 'conceptual material for conceptual designing', there is a need to physically model it as a material for product design too.

The following two films emerged from an exploratory design process that investigated the spatial qualities of RFID fields using technical probes. Very early on in the Touch project we realised that we had to better understand RFID as a physical, manipulable material. We designed electronic probes that could help us understand the physical relations between various RFID components. We see the concept of audio-visual media being used as a design material in a design process, where experimentation with visual techniques such as long-exposure photography, compositing and stop-frame animation lead to material discoveries that are then carried through into new design work.

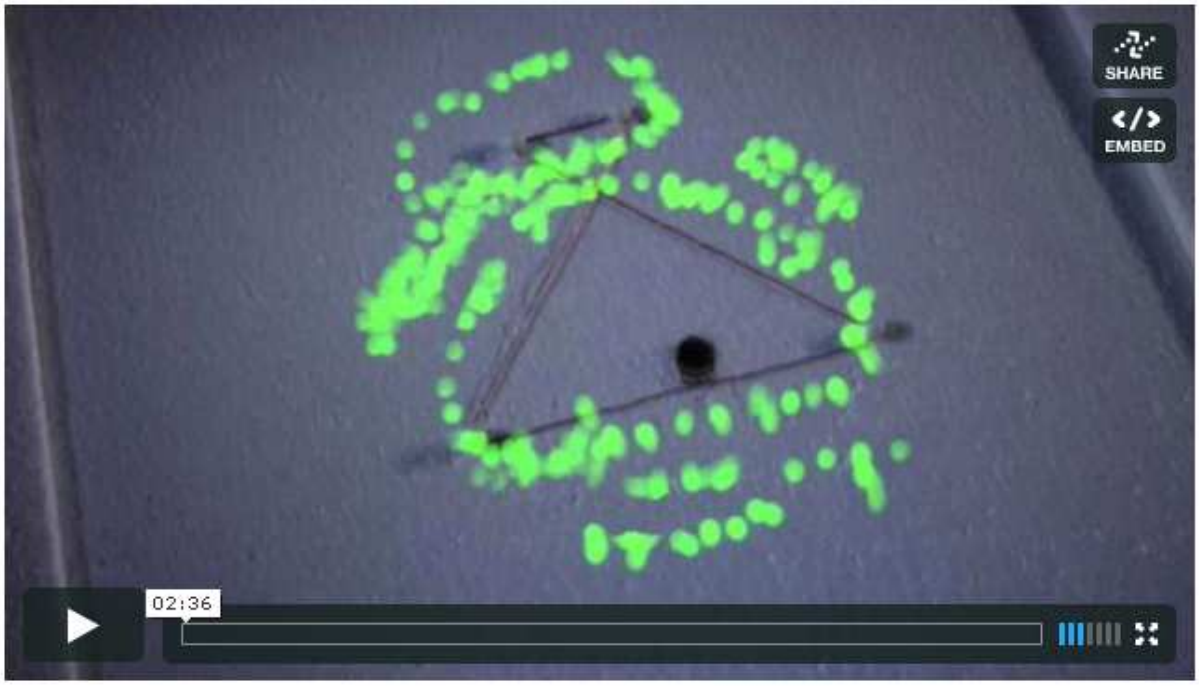


The resulting compositions - built out of many layers of imagery - accurately reflect the way in which RFID interactions inhabit physical space. The visualisation builds a detailed model of the spatial aspects of RFID, leading us to reflect on the tangible and embodied nature of the technology, where it almost feels like we could wave a hand through the field. Here we are making the invisible visible, constructing empirical evidence of the technology that then become foundational design materials in our practice. The materials here are more akin to physical materials of product design, not about digital behaviour, but about form, space, and surface quality. The visualisations reveal for us as designers how the spatial fields might be embedded inside products or environments, in order that they can be used gesturally.

These visualisations do not exist outside of the form of film, people can't go and experience our 'light fields' in an exhibition or through a demonstrator, the films are the only representational form. The use of layering over time through animation allows for particularly expressive modes of explanation, where the evidence can be laid out in sequences that don't overload one visual frame with information. This provides a visual and temporal layering that makes tangible, common sense: the visualisations occupy a 'real' space and are sequenced in a way that provides an immediately graspable view into the spatial qualities of RFID.

Communicatively, the visualisations are striking aesthetic artefacts that evoke connections to other forms of media like photographic lightpainting, holography and special effects. But they are presented in a documentary framing, including interviews intercut and overlaid with explanatory sequences that take the viewer through the process of constructing the visualisation itself. The simple narrative arc, introducing the problem of invisibility and then revealing the visualisations - when combined with the high production value of the visual material - resulted in the film being viewed and discussed widely online. We reflect on this online mediation below.

In this second immaterials film we go from revealing the boundaries of the 'readable volume' to exploring and manipulating the material substrate of RFID: the antenna.



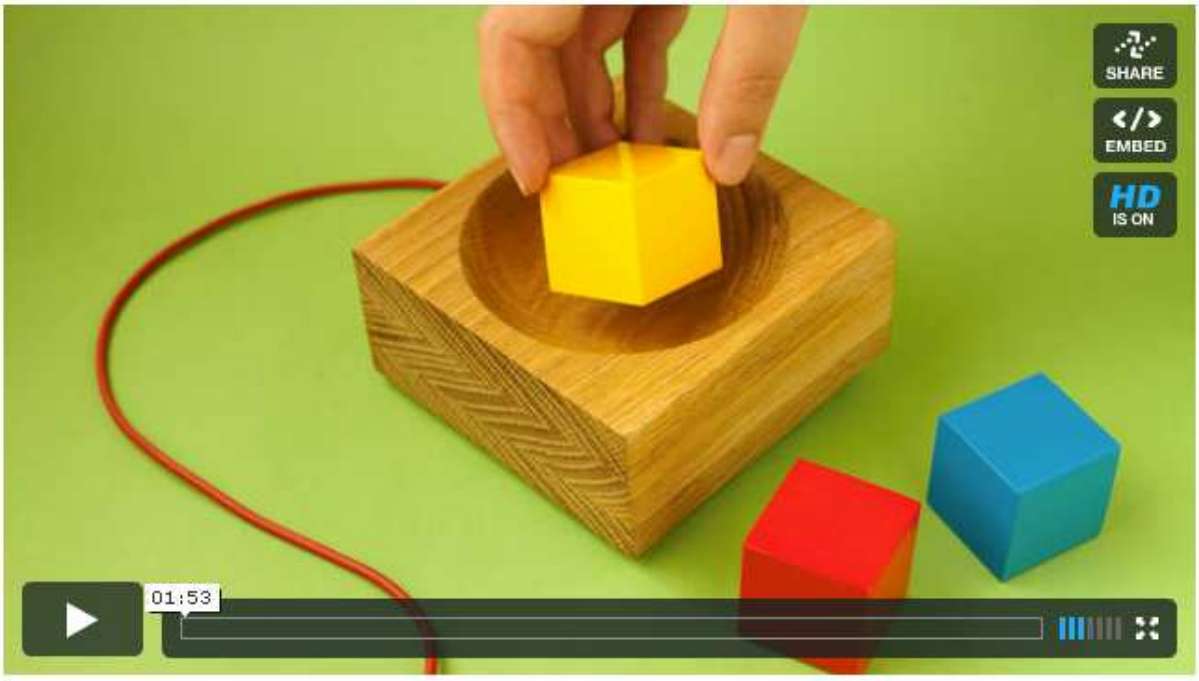
Here the same techniques of probing, long-exposure photography, animation and compositing are used to reveal the relationship between the RFID field and the shape of an antenna. A new level of understanding is built about the way in which RFID fields surround coiled antennas. But critically we are creating, shaping and experimenting with the material of radio, the added layer of expression–literally drawing with radio–evidences an even more nuanced visual model for how radio behaves. There is a creative dimension to the work, where we as designers - through our visualisations - show that the technology is not static and constant, and can be fundamentally shaped through design. When taken together, these films are intended to build material knowledge of RFID, but also through their form, show how designers might begin to take some control over the technical materials, for aesthetic, interactional or functional purposes.

In this design activity there is no separation (temporally, spatially or conceptually) between the filmmaking and the design process. These films can be seen as design processes that work within the material of film. Unlike post-process 'documentation', these filmmaking processes have taken place within a design activity, where the analysis, reflection and action emerged through the film visualisation process. We see that the use of film closely inter-relates the tool, the process and the outcomes. As they are formed the films act as mediating artefacts within this multi-disciplinary design activity. They evidence, expose and uncover otherwise unseen aspects of the technical materials in ways that reframe them for designers.

Conceptually this creative deconstruction of RFID through film points towards what might call a discursive design approach. Drawing on methods from critical design that unpack and re-conceptualise the technological material, combined with narrative and communicative approaches, we may begin to challenge some of the expectations and dominant understandings of RFID. In ways that are explored in more detail below, these films have also acted as boundary objects that work between design, technology and other communities. The consideration towards these communicative aspects may enable design research to be taken up broadly in public discussions.

Communicating products and prototypes through film

Here we explore RFID products and prototypes and the ways in which they are communicated through film. The main aim of these products has been to explore RFID technology in new contexts, and to engage with the opportunities and constraints of the technology in various uses. Here the design process has involved physical product design, designing with embedded electronics and systems, visual and filmmaking activities, and cinematic enactments with non-working props.



As a product, Skål (Norwegian for Bowl) explores RFID interactions in a domestic media context, where it broadens the activity of television-based media consumption towards playful, physical engagement. In this project film is being used to communicate a functioning product prototype, while at the same time bringing forward playful and tangible perspectives. The film is explicitly diagrammatic in its opening section, where it explains the interaction and function. It then shows the product in use without going deeply into the technical background, but focusing on experiential qualities.

Using these explanatory and experiential representations in film open up for communicative modes of research. The films achieve a high level of believability in the product qualities in order to reflect on the opportunities and constraints of RFID technology in products. Using a persuasive cinematic language to represent these product qualities might be critiqued as obscuring the critical aims of the project. But critical design discourse is already '...blurring the boundaries between the everydayness of industrial production and the fictional world of ideas" and suggests "a role for design objects as discourse where functionality can be used to criticize the limits that products impose on our actions' (Dunne, 2005: 43). In presenting the product in these ways we place emphasis on the discourse of the design object which lies in the playful and physical everyday activities in a domestic context.

Sniff tells a story about everyday experience with an RFID sniffing toy dog that was designed to explore tangible and social interaction through a children's toy. It presents the technology through a short moving diagram, where a layered compositional space explains the prototype through combinations of live-action footage, sound and motion graphics diagrams. We then introduce short sequences that show various activities around the product in use. To convey these experiences we invest meaning into the activities and contexts around the prototype being used, and offer the audience a glimpse of the daily lived experience.

In this film we see a specific quality of discursive design which involves the role of products and their presentations in re-conceptualising technology. In Sniff we see the potential for reframing technology through explanation and experiential representation of use and activities, and not by focusing on the technology itself. Here the use of cinematic qualities such as short depth-of-field and other stylistic devices such as quick-cut montages enable jumps in time and action that strongly reinforce the playful, exploratory perspectives on the technology.

The iPhone RFID film was created to engage with a critical mass of discourse around the iPhone and to provoke a subtle reframing of the discussion of RFID to include media, play and tangible manipulation. In this film, the iPhone RFID reader is a non-interactive prop that plays a sequence of clips that allowed us to enact a pre-prepared set of interactions between the phone and objects, which then seem to trigger media playback on the iPhone. This simulates the experience of using physical objects to play media and communicates a simple example of that experience. This rapid prototyping process through film allowed us to quickly experiment with product experiences without extensive technical development. The significant re-framing here was between the concept of an iPhone as a screen-centric device, and an iPhone that interacts directly with the physical world. The film is then a speculative object from which to see the possibilities for the rich, playful interaction between mobile devices and the world.

These three films offer experiential representations of RFID interaction that shift attention towards use and activity and away from technical specifications and features. Rather than the selection of relatively austere, gallery-based, and highly abstracted para-functional objects referenced by Dunne (2005: 50), these products are placed in everyday contexts, using highly communicative product presentations. However the intentions remain similar, to critique and reframe the discourse around technology through product design. Conceptually, they propose and speculate through cinematic enactments that tell stories about possible technological futures. They embody an activity of translation and re-framing, from a purely technical discourse towards design discourse that involves new contexts (domestic, media, entertainment), new users (children), new materials (natural materials, toys), and new activeties (playful and exploratory).

Conceptualising proximity

The next film embeds a particular view of RFID and proximity interaction into a short sequence that playfully resonates with a history of the 'chain reaction' film genre. It is designed to reach beyond a research or design community in order to provoke discussion and to increase awareness of the technological implications. It does this by parodying an existing popular cultural form in a way that inherently embeds the technology into the narrative.

In our overall attempt to shift the discourse around RFID away from the systemic and infrastructural viewpoint and towards tangible and playful concepts, it has been important to find new framings of the technology. Nearness or proximity is one of the key aspects of RFID interaction, the radio field of an RFID tag is small, and thus objects need to be close in order to interact. The film condenses the wide-reaching and complex research from the Touch project into a physical moving diagram, a poetic invention that involves objects, relationships and physical movement. We are taken through multiple enactments of nearness, field interactions and various other physical relationships that involve proximity such as light, magnetism and air pressure.

The film fondly references a history of popular cultural and popular science forms such as Fischli and Weiss, Tinguely, Pythagoras Switch (2001), Heath Robinson and Rube Goldberg. Fischli and Weiss' film The Way Things Go (1987) is arguably the best known of the chain reaction films, which involve tangible chain reactions where one physical kinetic or chemical reaction leads to another, often in impossibly long sequences. In Nearness nothing touches. With sensing technologies like RFID, mere proximity is enough to trigger a chain reaction. In this way the film takes a cultural form and re-appropriates it in a way that embeds the research as part of the mediation.

Both the Nearness and Immaterials films act as boundary objects where the intention is to translate and align discourse around proximity and the interactive qualities of RFID. These films are self-contained design objects in their own right that act as 'online probes' that are able to provoke and catalyse a discussion around the themes of the research. For example Nearness was featured in the London newspaper Metro which is distributed to over 1.3 million readers on the London Underground alongside the Oyster-card ticket gates. The film ended up being mass-mediated in the very contexts that the technology is used every day, showing the potential for discursive design research in a public context.

Analytically *Nearness* can be seen as an approach to critical design that has a discursive and communicative focus. As a discursive design artefact it takes a critical design stance that highlights the assumptions and preconditions of RFID, using the processes and tools from interaction and product design to rethink the opportunities and challenges of RFID. It articulates a subtle but fundamental aspect of RFID interaction that is already widely used

in the world, and in doing so sensitises us to the ways in which ubiquitous sensing and tracking works in the physical sense. In its para-functionality it 'attempts to go beyond conventional definitions of functionalism to include the poetic' (Dunne 2005: 43). In doing so it broadens RFID discourse from utilitarian, industrial and privacy issues towards playful, aesthetic and reflexive consideration of proximity interaction.

Behind the scenes: design and reflection in film

This film, produced for this article, is a compilation of experimental footage and sequences that show design explorations and processes.

Here many of the beginnings of audiovisual concepts for Nearness and Immaterials can be seen. Many of these sequences use visual layering techniques to diagram elements of virtual interaction into the physical space of live-action film. There is an aspect of invention in these explorations; the creation of spaces, objects, movements and audiovisual techniques that map and visualise the interactive phenomena of RFID. Rather than investing time in creating complex software and hardware prototypes, the interactive experience – with many of it's intricacies such as visual symbols, timing, sound and gestures – are quickly made inside film compositing applications. Objects are shown to change state, to connect to each other, to toggle back and forth in hierarchies, based on the interactions between fields. In a reflective activity of designing interactions, there is great value in having tools that offer efficient prototyping of interactions at an experiential level, that don't need to rely on complex electronics or physical design. There is also value in working within a medium that is not tied to a specific location or a unique demonstrator, and that is editable, reproducible and transmissible allowing it to be shared freely and widely amongst a research group.

Analytically film sequences have acted as mediating artefacts in our design process, particularly in the iterative loop between conceptual development and the practical making process. The film production process is highly reflective, where early experiments revealed new possibilities and led to new visualisations and material knowledge. A film sequence can gather and articulate a set of ideas in one place, providing a tangible outcome and further motivation for the design activity. In particular we see how audiovisual media may be used as an exploratory tool in design, where the processes of compositing and motion graphics

introduce yet more distance and consideration in communicating with and about emerging technology. The manipulated and composited space of the screen becomes a 'metamedium' from which to practice design approach.

Discussions

The overarching theme in our research is conceptualising, and re-conceptualising emerging technology through design. We have approached this through a discursive mode of interaction design research that draws on critical design approaches and uses film as a central part of its process and outcomes. As shown, film has been used as a tool and a medium to materialise and conceptualise with RFID technology. Specifically, we have addressed the role of film in exploring materiality, and the use of cinematic qualities in experiential and explanatory representations of the technology. Through this process we have reflected on the role of film in practice-based design research, and film in a broader public communication of RFID.

Film in the design research process

For practice-based design research, film offers a representational form that communicates about physical objects and their interactive, tangible behaviours over time. The time-based, audiovisual material of film can combine both the explanatory power of moving diagrams, with experiential and contextual sequences, and this opens up for complex objects and processes being externalised within a practice-based design research activity.

In our inquiry, film has been used for more than documentation of finished designed artefacts; the film-making process has been intricately woven into the designing and research activity. Film-making can be seen as a highly reflective activity: just as sketching has certain reflective and communicative qualities, film introduces new reflective and communicative properties into the design research process. It is a malleable metamedium that involves a highly reflective production process, and communicative outcomes. Film has enabled a loop of externalisation and internalisation that oscillates between practical and conceptual considerations within our internal design research process. However, unlike an experience prototype or demonstrator, films are unlikely to reveal usability issues or uncover new or unexpected user-behaviour outside of very constrained situations that are set up for the film-making process. Unless films are designed to elicit specific responses, they will generally not offer an audience the ability to experience the intricacies of interfaces, the knowledge that can only come from hands-on experience.

Film-making in design research can be seen as central in both reflection-in-action and reflection on action (Schön, 1983). Scripting and editing, in particular, allow for a highly granulated ‘reflective conversation with the situation’ (ibid: 76) where we reflect on both the situation of the concepts, contexts and applications of the technology, and on the designed objects and systems being created. In this, we shift stance from a hypothetical ‘what if’ to recognising implications, considerations of the total and moving from explorations towards proposals (ibid). However, in the process of film-making, we have also reflected back on our designs and the discourses around RFID. Through this we situate, articulate and discuss our own perspectives and the films become mediating artefacts with which to move our own practice and research forward, letting us collectively reflect on issues and technologies within our own inter-disciplinary design activities.

Conceptualising, contextualising and communicating

In conceptualising and communicating about technology we have approached the dominant discourses of RFID from a design informed position. The Touch project has attempted to weave its way through a broad set of complex and overlapping discourses of technology, design and culture. Film has played a key role in these activities: unpacking and visualising

the technology, reframing it, inventing with it, designing products and communicating about it to various audiences. Film has been used as a way of probing, externalising and unpacking conceptual frameworks about RFID technology within our own design research process. This is evident in the Immaterials films that were produced as a process of conceptually and practically unpacking RFID; the film acts as a tool for creating 'material evidence' of the technology. However, the films also act on a communicative level in creating models for thinking about the tangibility of radio fields. This proves to be useful both in the process of designing with RFID, but also in the broader discourse around RFID.

These films embody many kinds of concepts that attempt to reframe or rescript the dominant discourses around RFID. Nearness sets out to critique the dominant discourse of identification and shift the focus towards the tangible qualities of proximity. iPhone RFID shifts the focus away from logistics and tracking, to playful consumer-centric applications. Skål explores the opportunity for small, self-contained RFID products that work in domestic contexts, away from the privacy risks of RFID in public life. Sniff explores the experiential and playful aspects of RFID in everyday life. Immaterials uncovers and reveals the invisible materiality of RFID, and in doing so it offers a grounding for the discussion and debate of the controversial aspects of the technology. Immaterials also demonstrates a particular approach to technology shown by and through many of the films; this is an approach that does not take the technology as given, constant and pre-defined. Instead, it explores and uncovers the technology through probing, experimenting and re-contextualising in a way that offers new perspectives for design research and broader audiences.

The films – analysed as artefacts – might be described as design material, information visualisations, diagrams, mappings, models, explorations, explanations, arguments or articulations. Materialisation and visualisation are core concepts here. 'Immaterials' visualises the tangible, material and spatial qualities of RFID, and Nearness articulates the elegance and magic of proximity. By visualising these qualities of RFID in ways that are accessible to a wide audience, the films aim to help shape a wider understanding of the technology.

In addressing the discourse around RFID it has been important to contextualise RFID in ways that separate the technology from its use in utilitarian and industrial contexts. Film here has enabled ways of re-framing the technology through telling stories about products and applications that are both explanatory and experiential. With a wide range of narrative and explanatory styles, films can operate on multiple levels, and tell simple stories alongside explanations, visualisations and rich experiential framings. This is not a new form. The Eames' used a similar combination of aesthetic explanatory sequences alongside experiential narratives that mediated the Polaroid camera in use in rich contexts. Similarly, the process of re-contextualising RFID broadens the scope for discussion and further design with the technology. As an example, the Skål, iPhone RFID and Sniff films show visions of products in use in domestic contexts as part of family life. These films emphasise that the materiality and context of use strongly defines the character of the products and applications that can be built.

Through visualising and materialising the technology, showing potential use in everyday contexts, addressing the popular cultural imagination and proposing a gentle critique of the dominant discourses around RFID, we advocate for grounding the technology, and the visions of it, in the present. Bell and Dourish argue for 'developing an "ubicomp of the present" that takes the messiness of everyday life as a central theme' (2006:1). Our research advocates strongly for the role of design in shaping near-future perspectives on technology that is closely intertwined with the present, where detailed, considered artefacts relate to current practices and culture, and films can be the substrate through which these artefacts are mediated.

Discursive design and online mediation

These films were created for many audiences: this includes ourselves as a research team, for our project collaborators, for the design research community and for a wider online audience. Film sharing online has become simple and popular; sites like YouTube and Vimeo allow for distribution of films to a potential mass audience. The films articulated our own research perspectives by being embedding into articles on the Touch weblog (Arnall, 2009a) where they were contextualised by the media response and feedback. They were also embedded widely across the web, on news sites, in discussion forums, weblogs and specialist publications.

The dissemination of research online through media such as film is an important potential resource for discursive design research. In the cases presented here, the films have acted as highly communicative objects that are designed for specific and multiple audiences. The Immaterials film for instance has been embedded into a wide range of public discussions, from engineers and scientists discussing the accuracy of the 'empirical evidence', to privacy advocates critiquing it as an 'inappropriate model' for invisibility (Arnall 2009b). Similarly, with Nearness, the highly aestheticised visualisations have resonated with a wide audience that engaged in discussing tangible perspectives on RFID technology.

These early experiments in online mediation became the means for articulation of new concepts to a wide audience, and point towards the possibilities for using films as a means of probing the socio-cultural aspects of emerging technology. Critically, the level of cinematic detail and production quality has resulted in boundary objects that are both robust and adaptable enough to be interpreted in many contexts. These boundary objects can then provoke discussion and critique at the same time as revealing, explaining and translating complex technologies within the popular cultural imagination.

By combining the conversational aspects of film in online mediation with the speculative and provocative methods of critical design, discursive design may offer new ways of doing design research in a social and cultural context.

Conclusions

As we have shown through the films, the analysis of them and in the discussions above, there are a number of perspectives on the role that film can play in conceptualising and communicating about emerging technology. This has been shown as a process of film production and cinematic enactment that works in practice-based design research. We have also pointed towards the use of film in discursive design approaches that together with online mediation can broaden the context of public technology discourse and interaction design research with technology.

The multi-disciplinary activities within interaction design that involve a high level of agency over technological materials, combined with a tradition of visualisation and communication, may hold a potentially important role in the translation and interpretation of new emerging technology for public discourse and understanding. We have shown how practice-based design research has the ability to create representations and communicative artefacts, as opposed to technological development or mass production. A communicative approach to interaction design is central to this research. It embodies the idea that the communication of ideas, concepts and arguments through mediated design artefacts is essential to both creating effective interactive products, and to provoking discourse in and around technology-centric research. The form of film – that embodies both a highly reflective design activity and communicative qualities – is an ideal medium for interaction design research, where it can coalesce knowledge around practices and processes and project towards potential futures. Film allows for a degree of probing, explanation and reflexive

understanding of emerging technologies, but through its communicative qualities, also opens up for participation in broad social and cultural discourses around technology.

The core motivation behind this research is contextualising, conceptualising and communicating RFID towards a broader public discourse and the popular cultural imagination. We build on approaches and positions from critical design, but we do not argue that this process is necessarily provocative, subversive or 'critical' in the sense that critical design typically is. Our design proposals can just as easily be used to bolster and reinforce current practice as it can be used to critique it. The important similarity to critical design is the use of design artefacts to challenge the assumptions and preconditions of RFID, and using the processes and tools of interaction and product design to critically rethink the opportunities and challenges of the technology. In our research we have arrived at an approach to critical design that has a strong mediational focus and emphasises communication, and this strong focus makes up what we can call a 'discursive design'.

In this process, we have shown how we have increased our own 'depth of field' in design knowledge of emerging technology, and how we have developed cinematic modes of doing design research. We see the potentials for a kind of discursive design practice, where the object of design and analysis is the discourse that is catalysed by new artefacts, and the emphasis of design research is on communication. Through this we envisage the potential for extending the field of interaction design research to also include critical and discursive approaches, communication of emerging technologies and audiovisual media.

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