Introduction: Design for Tangible, Embedded and Networked Technologies

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tentSIG is concerned with design as it deals with networked and embedded technologies. It seeks to complement the work of the Human-Computer Interaction (HCI) and Interaction Design research communities from a broader space of design research; in doing so, it also harbours the ambition to ‘infect’ design research with important theories and practices in these fields. We asked for contributors’ critical reflections on new work concerned with perceptual qualities of networked and embedded technologies (in particular the tangible), with design methodologies for new materials and things (distributed, invisible, or emergent), and with a focus on the person at the centre of future networks (including implications for ethics in design and technology).

The special interest group was convened in early 2015, in conjunction with an international Arcintex research network workshop and symposium at Nottingham Trent University. DRS2016 is the SIG’s first appearance at a Design Research Society conference, and we are very pleased to welcome a broad range of excellent submissions, organised around two key themes of data (its value, modalities, and availability to different stakeholders), and design strategies (including participatory methods, Service Design and User-Centred Design).

Data: its value, modalities, and availability to different stakeholders

Speed and Oberlander introduce an ablative framework for designing from, with and by data. They make the case that Human-Computer Interaction has been superseded by Human-Data Interaction as a result of cloud computing, social computing practices, and the rise of the Internet of Things (IoT). As such, fewer of our interactions are with recognisable computational devices, and increasingly with familiar things that happen to be embedded with wireless technology and sensors, and of course, with other people, in interactions which collect and generate data. This means that we interact less with objects (computers)
and more with data flows, and that these interactions should now be the focus of design efforts. The ablative nature of the framework is drawn from the Latin grammatical structure that describes “an agent, instrument or source within a relationship”: designing from data resonates with the research for design relationship; design with data resonates with research through participatory design practices, in which end users consider their own use of data flowing to them; while design by data describes a highly emergent, non-anthropocentric scenario, in which large data sets gathered in use, are analysed to autonomously generate new products and systems: data researches into itself.

The framework provides a crucial overview, allowing designers to organise existing methods, anticipate emerging methods, and recognise the performativity of data at work in different networks; as such, it both responds to and highlights the changing nature of design’s role in “value constellations”. This paper is followed by Hogan and Hornecker, who focus on the representation modality of data in tangible interfaces. In line with the previous authors’ assertion that more devices and services are becoming data-centric, this research deals with users’ experiences with data regarding indoor air quality, situating the ‘design probes’ in social home and office contexts of use. The work contributes to the growing field of non-screen based data representation, and considers sonification and physicalisation as output modalities in non-ambient, portable handheld objects. Wooden cubes with sound and vibration outputs were compared with the use and experience of a cube with a visual LCD display. In this work, data informs the creation of value around social interaction and personal space. Hogan and Hornecker note that before taking part in the design probe experiment, participants had not been concerned with indoor air quality, but began to pay attention to it through playful use of the objects.

The notion of attention is then taken up by Gullick and Coulton, who discuss the delivery of hybrid physical/digital information in the context of gaming. Game objects are evolving to support interaction with screen-based environments, storing player history, character types and characteristics in the physical object rather than on a console. This paper introduces research on the extension of the physical game object’s potential to communicate information with the player during the game, and gives examples of the different possible interaction scenarios involving objects, screens and physical space. The authors introduce the concept of sensory ‘Information Bandwidth’ as a means to design according to how people perceive and interpret data through the whole body in interactive spaces. Gullick and Coulton take a craft-led participatory design approach to the generation of novel data representation objects, which include inflating balloons for in-game information, and moving antenna on character objects. Darzentas, Hazzard, Brown, Flintham and Benford discuss how digital data associated with the ongoing use of objects in the IoT can become rich and meaningful when situated within communities of practice. Their paper introduces ways in which data is gathered, and is narrativised through provenance and use. Through working with gaming and music communities, they illustrate that the “mappings between interactive decorated physical things and their records are complex, multi-purpose…and need to be dynamically tunable to different owners and contexts”. Questions of ownership are brought
up, and opportunities for fictional stories, as well as verifiable accounts of provenance, are introduced as ways to enhance different types of value, while the availability of data within situated contexts of use is shown to pose challenges to established norms of practice.

**Design strategies: participatory methods, Service Design and User-Centred Design**

Jason Germany identifies an emerging semantic issue as devices establish multiple wireless ad-hoc relationships with each other. Where wires once served to visually and physically map and define such relationships, new forms of non-screen based symbolic systems are now needed. He asks if users can develop such frameworks through the shared formal characteristics of tangible objects, and shifts standard psychological perception study techniques towards generative design, in which people actively create their own meaning. Relationships seem to be definable based on proximity and the orientation of forms towards one another, though Germany points to the need for more work grounded in perception theory. If Germany deals with spatial relations, Stead’s paper introduces the expanded embodied temporal potential of connected things through Sterling’s concept of the spime. He introduces the ‘toaster for life’ as an example of a design fiction that avoids the spectacle of the utopian or dystopian vision, seeking to establish sustainability as an everyday concern in the near technological future. He discusses how crafting the toaster as a design fiction necessitates a critical review of the design process itself, and emphasises that design outcomes such as this should not be seen as ‘solutions’ to ‘problems’, but a means for generating discussion around particular issues, in this case, sustainable design in a connected world. To achieve this, the material spime has to be believable, and thus designed as if it is indeed real, going through several iterations, and assessed according to such strategies as for Design-for-Dissassembly and Design-for-Recycling. In this way, the speculative process is blurred with current commercial design processes, while seeking to generative ongoing reflection on design, through design.

The focus of design is extended to the complex socio-cultural ecosystems of digital service development by Rytilahti, Rontti, Jylkäs, Alhonsuo, Vuontisjärvi and Laivamaa. Through the use of three service design methods, they examine the pragmatism of a service design mindset, and how this helps to create new knowledge for socio-cultural process management, in tandem with technological systems development. The classical idea of knowledge as static is contested, and a discursive, active and shared perspective is introduced through the service design work, as a way of overcoming specialist silos of knowledge. The authors find that participating teams’ commitment and motivation are noticeably increased through the tangibility and visibility of service design thinking processes, and that such tools offer not only classical research insights into customer values, but serve to make organisational structures and processes more transparent between internal teams. The playful aspects of design thinking are further developed by Frankel and Hriniwich in their study of ‘serious play’, as a creative strategy for generating wearable concepts. They propose aspects of serious play as ways to overcome the problems of
fixation in designing novel, near-future technologies such as wearables, where designers may be overly influenced by known or existing product features. The participant design teams were often shy to act out scenarios, but used gestures and humour in a variety of ways to facilitate their own group cohesiveness, and to manage the introduction of less conventional design concepts. As a result, Frankel and Hrinivich suggest that design students are taught gestural skills, and the development of ways to involve less confident team members in such performative processes. The final paper of the session is also concerned with the development of wearable and e-textile concepts, and revisits the tangibility of Rytilahti et al.’s pragmatic approach, and discusses making tangible in two directions. The first of these is concerned with making the visions of near future technologies more accessible to diverse communities of end-users to enable their entanglement in co-creating desirable technological futures, while the second is concerned with making end-users more tangible and present for design teams and developers. In this case, the end-users in question are people with lived experience of mental health issues, who are accessing a third sector mental health service. As so many wearable and e-textile concepts are oriented around health and mental wellbeing, making real individuals’ experiences more palpable (‘tangible’) is important, if we understand users to be configured at least in part by the design process. In common with some of the other papers in these strands, the research described by Kettley, Sadkowska and Lucas treats users as experts, rather than designers, and the paper situates this attitude within the theory of the Person-Centred Approach. The co-development of two service-design toolkits is described, and in contrast to Rytilahti et al.’s ‘silver set’, an ad-hoc approach to aesthetic and materiality was found to facilitate inclusion with this cohort of participants, and was even seen to support humour and spontaneity in the description of sometimes emotionally difficult scenarios. Fanciful scenarios were mixed with pragmatic ones by the participants in imagining future uses and experiences with e-textile things, and the formal characteristics of the textile props provided were found sometimes to directly inform interaction concepts and experiences. In working with mental health service users, the researchers found that such individuals’ voices were often overlooked or even actively mistrusted by the medical establishment, raising questions for service design and participatory design research practices, which normally try to enable transparency of the power relations between stakeholders. The authors found that different audiences were looking for different forms of ‘evidence’ from the research, and describe the making of three short films with participants, to present personal experiences as research outcomes, and make those individuals more visible (tangible) to research communities.

The themes that got away
These themes were not predefined, but were strongly suggested by the submissions we received. Demonstrating the breadth of possible approaches to design for tangible, embedded and networked technologies, a further three papers examine in detail User-Centred Design as it meets Service Design in the domain of wearables (Liao, Chou and Hung), the relationships between materiality and intuition in mixed reality systems (Desai, Blackler
and Popovic), and the challenges to materiality at the intersections of design and ubiquitous computing posed by nanotechnology (Paiva); if the themes of the SIG were rearranged, we could indeed frame submissions according to user communities and demographics (for example children), or (im)materiality and presence in hybrid systems. The richness and diversity of the papers here have led us to consider themes that would be interesting to foreground in future tentSIG events, and we welcome suggestions on our ideas around: visibility and the potential for things to be configured and ‘brought into play’ by users (in Latour’s terminology); different modalities of understanding and being-with technologies, for example, cognitive and experiential approaches within the design process; how we research users ‘in the wild’; and modalities of data, concepts, and relationships and associations between things. We thank all of our authors at DRS2016, and look forward to continuing such discussions with you into the future.