

Social Things: Design Research on Social Computing

Jun Hu^(✉)

Department of Industrial Design, Eindhoven University of Technology,
Eindhoven, The Netherlands
j.hu@tue.nl

Abstract. In the era of social networking and computing, things and people are more and more interconnected, giving rise to not only new opportunities but also new challenges in designing new products that are networked, and services that are adaptive to their human users and context aware in their physical and social environments. A research vision on social things is needed, that addresses both the technological and social aspects in design, and that requires a social approach to the Internet of Things.

Keywords: Social things · Internet of things · Social computing · Design research

1 Introduction

In the concept of Internet of Things, things start to communicate with other things, forming an “Internet of Social Things”, allowing things to have their own social networks, enabled by communication technologies that are both fixed and ad hoc, and both wired and wireless. These “Internet of Social things” are further in connection with their environments and users through sensors and actuators, communicating with the social networks of humans, interacting in social networks with humans and other objects, forming a “Social Internet of Things”. These two levels of social networks of things and humans give rise to not only new opportunities but also new challenges in designing new products (that are networked) and services (that are adaptive to their human users and context aware in their physical and social environments). Therefore, the design research to meet these new opportunities and challenges needs a social approach to the Internet of Things, which brings our attention to a research area, namely “social things”, that address both the technological and social aspects of the Internet of Things.

2 Social Things

2.1 Social Things for Data Driven and Service Centric Design

The merge of the social networks of people and the Internet of things leads to a shift from product or system oriented design to service centric design. Systems, products and the related services are more connected than ever. Products have become the terminals of the services and systems have become the platforms to deliver the services. Social computing started in late 1990’s and early 2000’s serving as platforms not only for

sharing online content and conversation, but also for processing the content of social interaction and feeding back into systems [1]. The difference is that the social interaction and feedback are tied to things, sensors, and information intertwined in the social channels. These channels create touch points between services and customers, and the feedback from the customers to the services has become quicker, driven by a more flattened and bottom-up social structure. Along with this development, products with embedded connectivity and identification technologies have become part of the Internet of Things, and with embedded sensing technology these products have been integrated into people's lives in a more adaptive and social manner, learning human activities and behavior from the big data in the networks of both humans and things. Figure 1 shows an in-flight entertainment system that collects not only the music preference of the passenger, social recommendations of the music, but also the heart rate to detect the stress level and to reduce it through adaptive music [2].



Fig. 1. Heart rate controlled music recommendation for low stress air travel [2]

With the facilitation of social things, service design can be carried out in an interactive and sustainable process. In this process data and input can be collected social interaction among the users; and the stakeholders and from the behavior of the users and the products, analyzed and quickly or directly fed back to the process. The quicker this feedback loop is, the more the design cost can be reduced. This research area needs to investigate how to tightly combine and coordinate these computational, physical and social elements to facilitate the service and the design process of it. Traditional new product design and development methods become insufficient when dealing with the shift towards service centric design, the power from the flattened and bottom-up social structure, and the complexity of the social systems of humans and things. Adaptivity of the intelligent systems and services has to be reinvestigated in the context of social things and social innovation in a larger scale eco-system in which the social networks of people and the Internet of things are intertwined.

2.2 Social Things for Social Innovation

The growth and development of distributed and pervasive computing, social networks and mobile technologies have dramatically increased the complexity of the systems, products and the related services, but also the complexity of the design itself. Social things that merge the social networks of humans and the Internet of things, on the other

hand, brings up new solutions against the complexity, towards social innovation, by harvesting the collective intelligence from the social networks of humans, including the designers, the users and the organizations, and the collective intelligence from the Internet of Things, in order to realize greater value from the interaction between people and things, which in turn, inventing innovative and hopefully also sustainable ways of living. In this context, design has become a social activity – design is a result of social innovation; design drives social innovation and leads social transformation.

In this context, the design research on social things aims at developing methods, tools and techniques to support design as social innovation and design for social innovation. In the case of design as social innovation, the research should investigate how social things can be used to support the collaborative design activities by the designers as well as other stakeholders including the end users and to enable collective creativity and intelligence in dealing with the complexity of the systems of today. In this case open source hardware and software are good examples of today (Fig. 2), but more can be expected to happen to other end user products and systems. In the case of design for social innovation, the research shall investigate how to use social things for design to trigger and support social innovation that leads to societal transformations, by introducing design perspectives and design intervention in a social context. The penetrating of social things to the society creates possibilities in creating collective awareness platforms for possible solutions that need collective efforts and shared knowledge, enabling new forms of social innovation.

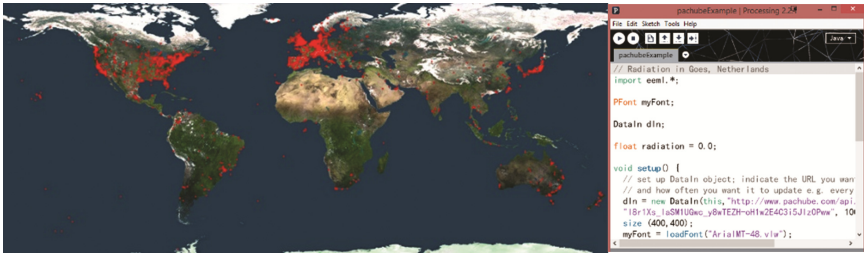


Fig. 2. Open data from internet of things, accessible using open source software tools

2.3 Social Things as “Simulation” Platforms for Design

The integration of the networks of humans and things gives the opportunity to bring design much closer to the end users, to other stakeholders and to its social and situational context, and vice versa. It sheds a promising amount of lights on improving the validation process of design, as computational simulation has done to electrical and mechanical engineering when computer was introduced to these disciplines.

Social things have their physical forms, but also can be easily captured and represented in digital means. It enables them to be used for validating design in earlier phases of the process. It is interesting to investigate how social things could be utilized as “simulation” platforms for earlier concepts – in this case physical prototypes might still be necessary but the situational context (people, other things and the environment) can

be brought in or closer in order to quest the concept earlier (Fig. 3 shows a project in which the early concepts of a physical clock was evaluated with potential users in a virtual world [3]).



Fig. 3. Digital model of a physical clock is evaluated in a virtual world [3]

2.4 Social Things as a Competency and as a Tool in Design Education

New types of designers have to be equipped with systematic understanding and perspectives, be competent in utilizing the social things to harvest the creativity, the input and the feedback through social interaction. The developments also bring up new opportunities in utilizing social things in facilitating the learning to make learning a more effective and more enjoyable social experience. Figure 4 shows a set of open source software, hardware and learning environment used in the design education at the department of industrial design, Eindhoven University of Technology.

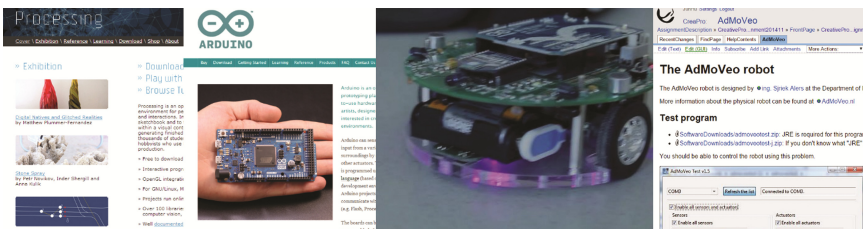


Fig. 4. Open source software, hardware and learning environment in a design education [4]

The perspective and the ability of utilizing social things as an enabler in design should be implemented in the design education. This research area should investigate how this can be carried out in a self-driven learning process, and how to utilize the social things and social computing technologies to facilitate this process.

2.5 Research Methods

Social things as a research topic is at the intersection of computational systems and social behavior. This research should employ engineering and empirical research methodologies, or a research-through-design approach, depending on the subject under investigation.

Social things can be used to empower end-users, for example in the medical field, where patients get faster and more accurate information about their personal health

status, exchange experiences, and keep track of the performance of medical institutions. The research question is how to design such social systems, and how to measure their performance, which includes the perceived quality. The measurement instruments themselves can be designed as social tools (on-line questionnaires, data logging with the social things, network-oriented data visualization, distributed data mining, and crowd wisdom).

Not only the end-users will change their way of working, also the design community itself will change when adopting the power of social things and social computing. The effect is already visible in the communities around Arduino, Processing, and DIY 3D printers. Whereas most of the present-day tools are still traditional editors, compilers and CAD tools, the next generation of tools will be designed as social tools. This asks for a research-through-design approach: creating new tools, co-creating and sharing them inside the design community, and evaluate their performance and perceived quality with appropriately designed new tools. State-of-the-art engineering and design methods should be deployed to bootstrap the design of these new tools.

3 Research Areas and Activities

With the above mentioned research vision, we have been involved in a number of research projects in related areas. “Social things” as a research area is broad, as seen from the examples to be introduced next. It is not our intention to give a complete overview here, rather it is to demonstrate our effort in its two-fold focus on both technological and social aspects.

3.1 Social Things to Connect the Digital and the Physical

Social things can be utilized to connect the digital and the physical, employing and developing computational technologies such as distributed multimedia and interaction for entertainment in ambient intelligent environments [5–7], semantic web for interoperability of smart objects in intelligent environments [8–10], augmented and mixed reality for installations in social and cultural computing [11–14], virtual reality for serious games as learning or diagnostic tools [12, 15, 16] (Fig. 5 shows an augmented home that integrates a digital game with the physical environment), tangible interfaces



Fig. 5. Augmented home: integrating a virtual world game in a physical environment [12]

to digital systems [9, 17, 18]. All these research activates have been engaging sensing and actuating technologies, or embedded technologies that integrate both for an integrated system that merges and blurs the digital and the physical.

3.2 Social Things for Health and Care

Sensors, actuators, smart objects and integrated systems have been utilized in several projects in delivery simulators for medical training [19, 20], comfort and bonding in perinatology research [21], reducing stress in long haul flights [2, 22], emotional care for elderly with dementia [23, 24], social connectedness through unconscious and peripheral data [25, 26] (Fig. 6), and relaxation with bio-feedback [27–29]. In recent years, both the ageing society and the general needs of improving the quality of life and well-being have lead policy makers in many countries to turn to individuals at home and the social networks of the individuals, and to deliver the service over the networks, as an important source of long-term health care, where social things and social computing would play important roles.

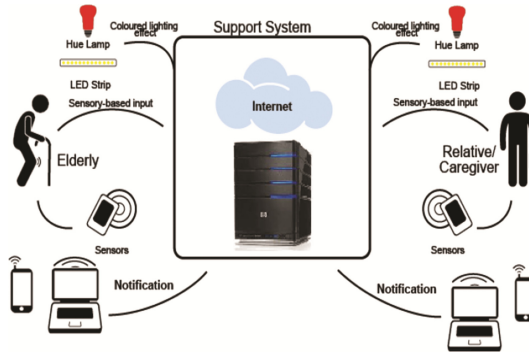


Fig. 6. Social connectedness through unconscious and peripheral data [25, 26]

3.3 Social Things in Public Spaces

Social things are often situated in public spaces, enabling social interaction among multiple users and systems, and the analysis of the social behavior based on the collected data [30–33]. Several research carriers in our projects are interactive and participatory public installations, either functional or artistic [11, 34–36]. These interactive installations require gathering input, data and information using computer vision, mobile devices, connected or embedded sensors from either the physical space or social networks. For output, many of these installations using projection mapping to augment the physical objects or spaces with a digital layer, being a good example for designing systems that integrate the physical with the digital. These installations often aim at an environment or connected spaces, being a very good research carrier for the Internet of Things as situated and large scale objects, and for studying the group user behavior and experience [37]. Figure 7 shows the installation designed for the city of Taicang, China.

The installation is roughly 10 by 10 meters on its base and 8 meters high. On top of the base are constructions that give the impressions of a large sail, and the moon rising from the waves. Images, animations and videos can be projected onto the inner surface of sail in the evenings, allowing the public to contribute their photos from social media to induce the feeling of social connectedness [11, 35].



Fig. 7. Moon rising from sea [11, 35]

3.4 Social Things for Sustainability

Several projects have been carried out in the TU/e DESIS lab, part of the DESIS (Design for Social Innovation and Sustainability) association, a “network of design labs, basked in design schools and design oriented universities, actively involved in promoting and supporting sustainable change”. Next to the research activities in designing for social interaction in public spaces as already mentioned, activities are mostly educational with student projects. Recently together with two Ph.D. students we started our research activities in a social recipe recommendation system for food sustainability, with the help of the Internet of Things (Fig. 8, mobile devices and intelligent trash bins) [38, 39].

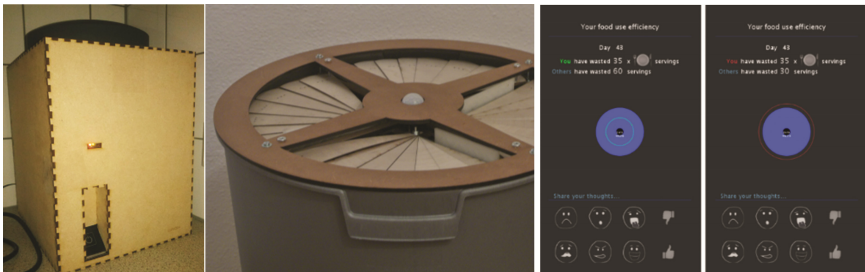


Fig. 8. Intelligent trash bins for a social recipe recommendation system [38, 39]

4 Concluding Remarks

The research area “social things” focuses more on social computing as tools and platforms for design. The design context of social interaction, social innovation and service centric design requires close cooperation with other expertise. It is expected to closely collaborate on social interaction with colleagues from the user centered design and research, on tangible and physical interaction as well as social innovation with colleagues in interaction design and social design, and on the service centric design process with the colleagues with a business perspective. The Internet of Things elements of this research will not only generate data for data driven design, but also blend the analyzed results into the physical forms in the created designs.

The research focus is more on designing social computing tools and platforms than it is on developing the enabling technology itself, which requires collaboration with computer science and electrical engineering.

It is also expected to contribute to key societal issues such as energy, health and mobility. Possibilities in contributing to other areas shall be considered, for example the environment and energy domain offers many opportunities for exploring crowdsourcing; techniques and social intelligence in systems design; social networking can provide ad-hoc yet real time information from the drivers and vehicles for a more efficient traffic, or for a better experience on move.

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