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# New Horizons for the IoT in Everyday Life: Proactive, Shared, Sustainable

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## Abstract

IoT applications that act on behalf of people are becoming reality. In this workshop we explore the opportunities and challenges that arise when these proactive technologies become increasingly embedded in our world and carried on our bodies, particularly when converging with the emerging 'sharing economy' paradigm. IoT sensors enable new sharing economy services that are personalised, hyperlocal, and can be delivered at short notice, for example food sharing among neighbours to prevent waste. Yet, there are many design challenges and ethical concerns that the HCI community needs to address to make these proactive services intelligible and accountable. In this workshop we seek to begin a dialogue to gather and respond to these challenges, collect design examples and ideas, and learn from each other.

## Author Keywords

Internet of things; automation; sharing economy.

## ACM Classification Keywords

H.5.m. Information interfaces and presentation.

## Introduction and Goals

As the IoT is beginning to bring automation to domestic practices such as heating, washing, and cleaning, this trend may instigate a shift from home automation

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towards a 'sharing economy' by opening up the home to an interconnected network of suppliers of goods and services, as well as the local neighbourhood [8]. The sharing economy may disrupt existing industries with new decentralized peer-to-peer market places [2]. For example, proactive software agents may purchase locally available goods based on sensing stock at home, schedule their automated delivery, and trade with neighbours to optimise the use of resources, promoting sustainable trade, fair treatment of producers, and minimising cost, waste, and emissions. However, user studies of nascent proactive IoT devices show that they lack intelligibility and controllability, which has led to users being frustrated and wasting time and money, which may ultimately lead to abandoning the technology [12]. Additionally, new mechanisms of consent and withdrawal may be necessary for technologies that constantly gather data from our homes [7]. It is these challenges that we seek to address in this workshop.

#### *Workshop goals*

We will address important questions, including: How should interactions with proactive IoT systems be designed to embed into peoples' everyday lives? What capabilities are essential for proactive technologies to provide services that are intelligible and accountable? How can we design such systems so that they allow users to delegate control, yet easily regain it? The workshop then turns upon three key themes or perspectives, including

- **IoT infrastructure** such as sensors, actuators, networks, storage, visualization and presentation UI, and the ways in which this can be made manageable

and controllable by people (including ensuring their privacy and security),

- **Appropriate methods** that make systems accountable, intelligible, and responsive to the contingent nature of human activity, that use techniques that provide proactive reasoning and actuation, such as machine learning, activity sensing, modelling, and multi-agent systems; for example, methods of consent and withdrawal
- **'Sharing economy'** application ideas and examples that go beyond home automation towards leveraging the IoT to support neighbours, communities, and alternative marketplaces, in which goods and services may be shared for the benefit of all involved.

#### **Background**

The workshop is motivated against a background of a new research grant on "Future Everyday Interaction with the Autonomous Internet of Things"<sup>1</sup>. This aspect of the workshop is related to a substantial body of work at CHI and UbiComp related to home automation of activities such as heating [10], washing [3], and energy tariff switching [1]. This proactive IoT will be focused on *acting on anticipated need* on behalf of users on the basis of data gathered from the IoT. This brings into focus the fundamental challenge of *anticipation as a topic for automation*. Seminal research into this topic in human-computer interaction has highlighted the challenges for interactive systems design to respond appropriately to the contingent and situated nature of human action [11]. In turn, we wish to foreground the

<sup>1</sup>

<http://gow.epsrc.ac.uk/NGBOViewGrant.aspx?GrantRef=EP/N014243/1>

ways in which the devices making up an Internet of Things might be situated in the context of everyday activities and connected to a broad ecology of resources. Consequently, rather than focus on IoT artefacts (the things) we suggest an emphasis on the everyday activities these are implicated in, the broader human practices involving these activities, and their place in the broad ecological arrangement. While many IoT technologies have been envisioned, prototyped or even commercialized, they have tended to lack support for the flexibility of everyday life that would be necessary for *accountable autonomous operation*. This workshop seeks to investigate this shortcoming.

### Participant Contributions

Against this background, we seek contributions in the form of a poster and a 2-page abstract in extended abstract format including, but not limited to:

- Studies, concepts and positions on the IoT-enabled sharing economy;
- User studies of deployments of proactive IoT technologies and/or sharing economies 'in the wild';
- Interaction design for intelligible and accountable user interfaces for the proactive IoT;
- Techniques for IoT data acquisition, processing, presentation and action for and with users that can support proactive IoT and/or sharing economies applications;
- Risks and ethical concerns associated with a proactive IoT-enabled sharing economy.

### Workshop organisation

We will recruit up to 20 participants perusing emailing lists, and the organisers' social networks. A website has

been setup at [iothorizons.wordpress.com](http://iothorizons.wordpress.com) to host the CfP and the posters and abstracts of consenting authors, and will be kept up to date with pre-workshop announcements, agenda, etc.

On the day, participants present their positions in a poster session, we will run an ideation session using the privacy-by-design cards<sup>2</sup> to brainstorm new forms of consent and withdrawal, and the afternoon will be spent designing in small groups. Concrete outcomes of the workshop will include a ***map of the design space***, and ***design ideas*** that exemplify the future IoT-enabled sharing economy. We seek to encourage follow up activities such as joint publications and workshops.

#### *Poster session*

All posters will be displayed around the room. Each participant will have the chance to introduce themselves and their poster to all participants for 2 minutes. After the introductions, participants will have time to follow up and mingle freely.

#### *Privacy-by-design session*

This session will make use of tailored ideation cards to consider some of the privacy and broader ethical issues arising from the practicalities of an IoT context. Participants will be divided into small groups and, through guided activities, asked to imagine creative solutions to key problems (such as sustaining user awareness and control, managing consent, and withdrawal). The activity is intended to stimulate creative solutions at the inception stage of systems design.

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<sup>2</sup> <http://www.designingforprivacy.co.uk/>

*Hands-on mapping and prototyping session*

Based on inspiration from the participant talks and the privacy session, we will map the emerging design space. In turn, low-fi design probes that exemplify the IoT-enabled sharing economy will be developed in groups. We will provide paper-prototyping material, as well as a number of IoT bits, such as GrovePi sensor kits including accelerometers, light, motion, temperature etc., BLE motion tags, and low power radios. We will also provide some seed applications for the IoT sensor data that do not have proactive functionality—the challenge will be to envision the ways in which these systems can be appropriated towards proactive IoT-enabled sharing applications.

**Organisers**

The organising team brings together early career and experienced international industry and University-based researchers with diverse backgrounds in HCI-related disciplines and AI, and have ran workshops and published in leading HCI venues on IoT-related themes [e.g., 1, 3, 4, 5, 6, 7, 8].

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