
Collection to Interaction: Designing for the Internet of Self within Ubiquitous Environments

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Abstract

The internet of things (IoT) describes a rapidly growing collection of smart objects, typically non-computer based, embedded with numerous sensors that are connected to the internet. These objects have both simultaneously made the internet useful, as well as complicated. In this paper, we describe our early notion of the internet of self (IoS) – a perspective on IoT devices specifically focused on single user personal (typically mobile) devices (e.g. smart watches, fitness trackers, etc) and how the data these devices collect can influence ubiquitous environments (e.g. multi-surface environments) in a meaningful way. We also briefly describe our prior work in creating ubiquitous environments and then discuss design-based methods focused on the IoS.

Author Keywords

Wearable technology; universal design; internet of self; Ubiquitous computing

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

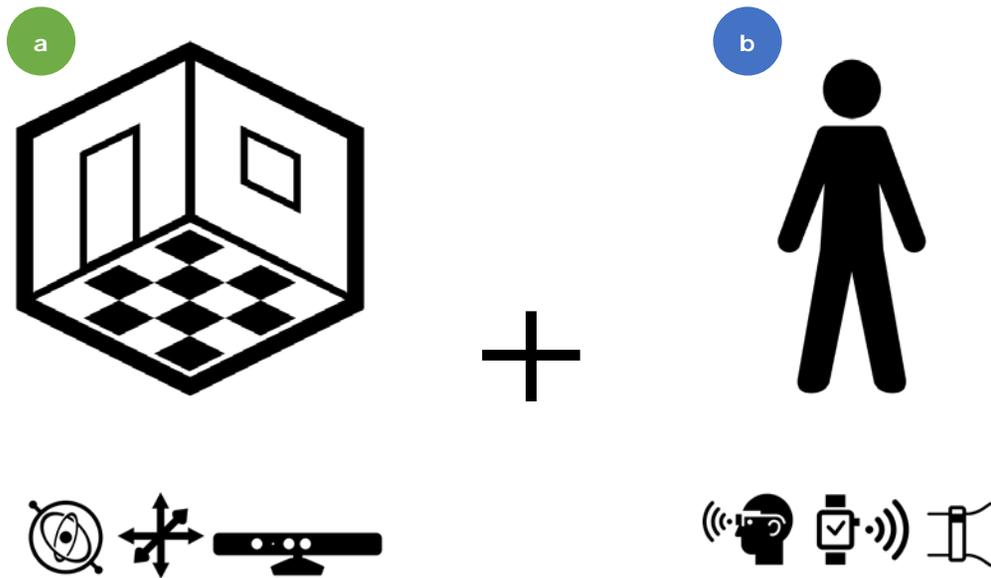


Figure 1. Describing the components of the Internet of Self (IoS) perspective. (a) A ubiquitous environment with multiple sensors to provide intelligence (based on MSE-API toolkit). (b) Examples of wearables that can provide personalized data about a user and the notion of “self”.

Introduction

Ubiquitous environments, such as Multi-Surface Environments (MSE), incorporate heterogeneous devices into unique interactive spaces, where interaction can be spread across and between different devices (e.g. mobile phones, tablets, digital tabletops and large wall displays). Interactions in these types of environments can also utilize unique characteristics of devices (i.e. size, mobility, resolution), as well as the spatial layout of the environment (i.e. flicking to another device) [1].

More recently, devices that aren't typically smart (or have screens) have are being connected to the internet, steadily increasing the ubiquity of the everyday environment and even moreso for already ubiquitous environments. These devices are a part of the “internet of things” (IoT) which advocates internet connectivity for everyday objects (e.g. a thermostat). By the year 2020, it is estimated that approximately 50 to 100 billion devices will be connected to the “internet of things” (IoT). This means a large explosion of wearable and other personal IoT devices in increasingly ubiquitous environments [2].

From a system and interaction designer perspective, integrating ubiquitous environments with wearables and IoT devices presents a number of challenges. A key challenge motivating this work is related to how to use the information provided by wearables to meaningfully impact the sensors and technology in ubiquitous environments.

Related Work

The research literature for ubiquitous environments and MSEs is extensive, from both an HCI perspective and engineering perspective. An early example is the iLand project by Streitz et al. [3] in which users moved personal content between different devices in the environment. The ability to move content underscores one of the primary purpose of interactions in ubiquitous environments. Interactions such as flicking [4] or picking and dropping [5] are examples of interactions that require spatial information and inter-device communication. In prior work, we created MSE-API, a toolkit that allows for rapid creation and prototyping of ubiquitous environments and explored different

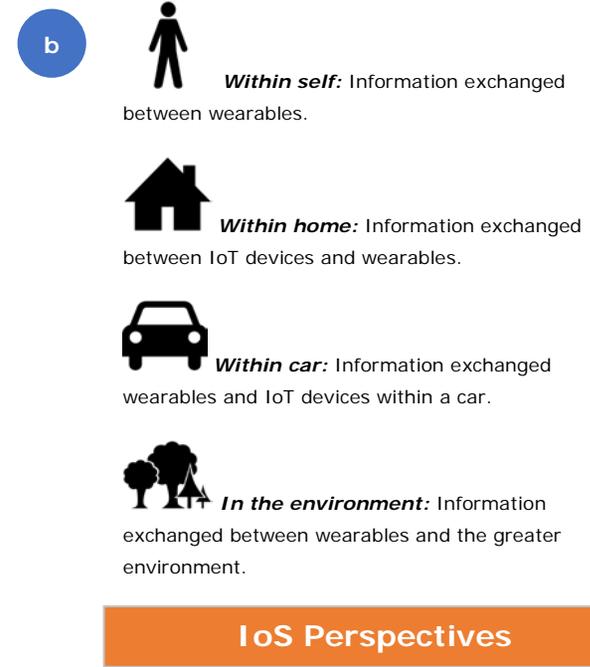
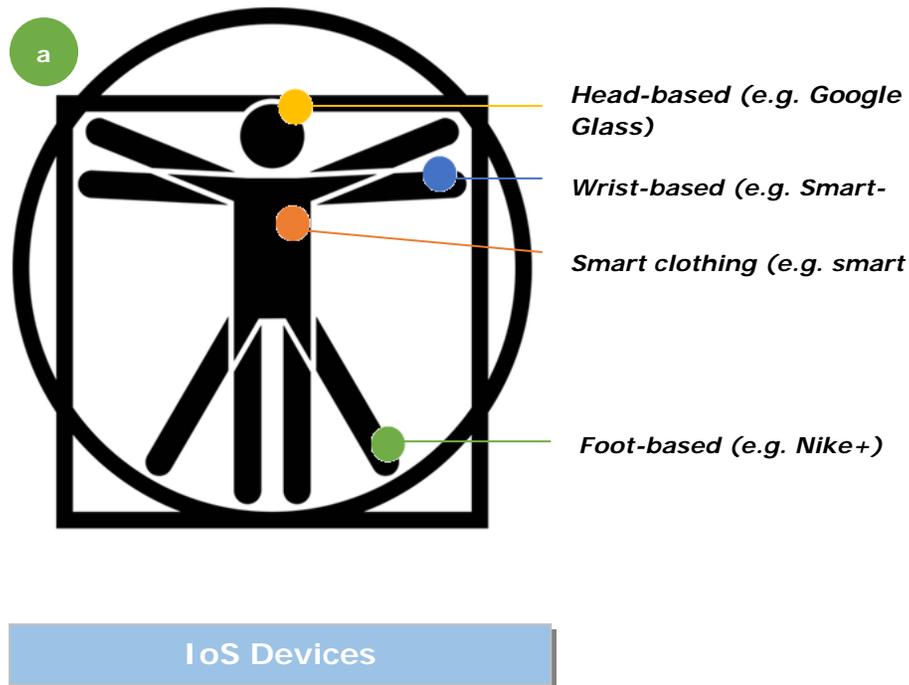


Figure 2. The IoS perspective. (a) Examples of devices that can provide influence in an IoS perspective (b) Examples of different contexts of the IoS perspective.

interaction techniques for various domains (e.g. retail and emergency response).

One aspect unexplored in the context of MSE-API and ubiquitous environments in general, is the role of wearables and the influence they can have. As wearables become smaller and more ubiquitous, with different shapes and sizes, the potential impact on interaction design they can have is wide. Houben and Marquardt explored watch-based interactions with displays and the influence of the watch on interaction

[6]. Overall however, the growing body of wearables and IoT devices in ubiquitous environments provides an interesting context for exploring the perspective of the IoS.

The Internet of Self Perspective

As mentioned earlier, the IoS perspective we propose, takes a human-centered approach to designing and interacting within different ubiquitous environments. With many of the wearables already augmenting our daily lives and influencing decisions (e.g. health

watches), the IoS further extends and links information/decision making into different contexts. In Figure 2, we illustrate examples of the IoS devices that can influence IoS perspective. For example, an IoS perspective with a wrist-based sleep cycle monitor (e.g. Fitbit [7]) within the home to adjust the lighting/energy used within a home. Another example would be using a foot based sensor (e.g. Nike+ sensor [8]) to detect movement patterns and if a user had consumed too much alcohol, a ubiquitous car would not allow a user to drive.

Designing for the Internet of Self

The examples of IoS perspectives presented in Figure 2 are human-centered and not necessarily focused on the sensors themselves and what they collect instead of connecting and interacting with the environment, which often seems to be the case with the trend of current wearables. In the context of IoS interaction design, we believe in the need for more design-based approaches to examine how to integrate wearables into ubiquitous environments. For example, this means using methods such as activity theory or technology probes to properly understand how users would utilize wearables and other smart devices in different environments, before attaching a multitude of sensors to them. For the design of the wearables themselves within IoS, we also believe that they can benefit from the perspectives of use from ubiquitous environments. For example, we have already seen smart devices that don't require screens (e.g. Fitbit) are used frequently, but the user experience without one when trying to connect to the information is not necessarily ideal.

Overall, we believe the design space of connecting wearables in the IoS to ubiquitous environments provides an interesting research direction for the future of connected devices. This is especially true as devices are increasingly adding sensors without necessarily being smart enough to interact with the environment.

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