The Internet of Things as an Extension and Augmentation of the User

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ABSTRACT

The development of the Internet of Things is redefining the relationship between humans and objects. It is also equipping users with new forms of agency. In this article, I distinguish two forms among these technologies: extensions, which strengthen existing human abilities, and augmentations, which enable humans to acquire new abilities. On the basis of qualitative research, I demonstrate that through technology, users have gained access to the equivalent of new senses or character traits, as well as acquiring new skills. This article also intends to demonstrate that such dependencies can be two-sided. As well as the natural senses, users feel compelled to employ technologically generated ones.

Keywords: Internet of Things, Human technology interaction

INTRODUCTION

In recent decades, the world of objects and tools has altered markedly. New devices, have emerged that communicate with other devices via digital protocols. Digital creations, including programs, applications, websites, and bots have also become widespread. These can be considered tools, but are simultaneously immaterial. A raft of Internet of Things products have also entered the market. The term, Internet of Things (IoT) generally describes situations in which network connectivity and computing capabilities are extended to sensors, and everyday objects that are not normally considered computers; this allows these devices to generate, exchange, and consume data with minimal human intervention (Rose et al. 2015).

A system in which easily identifiable objects can communicate with each other brings many new possibilities and qualitatively alters the human toolkit. In this new world, technology will become active in new ways and gain new kinds of agency. Emerging technologies enter into a specific kind of relationship with their users and impact them significantly. According to Andy Clark, humans are 'natural-born cyborgs': in the course of evolution, they adapted to using and extending themselves through tools. In Clark's opinion, humans are distinguished from animals by their plasticity, which allows humans to redefine themselves with every new invention. Due to the extended length of human childhood and the neuroplasticity of the human brain, our species has adapted naturally to complement itself with different tools and technologies (Clark 2003). It can be asserted that humankind has an 'open architecture'. If

new IoT technologies expand users' fields of agency, how do the users themselves perceive it? In this article, I present the results of a qualitative study conducted between 2018 and 2020 on twenty-eight users of various types of digital internet-connected devices. These devices included smart home installations, smart speakers, smart bands/ watches and various applications that are available on mobile devices. From the users' statements, it is possible to paint a picture of how certain functionalities of IoT devices and applications are perceived. New technologies can complement users' abilities in a multitude of ways (Kowalski et al. 2019), this article intends to focus on two: digital IoT devices that serve as extensions of their users, and enhance or amplify skills that their users already possess; and those that serve as augmentations and equip new kinds of agency—in other words, they enable the equivalent of a new sense or skill.

TECHNOLOGY AS AN EXTENSION

One example of an extension can be found in the functionality of the Endomondo application when linked to a smart band. For some users, such a combination has a motivational function; it becomes an amplifier of perseverance. Constant contact with data that measures their efforts enables users to mobilise themselves, to continue their exercise routines, and to stay motivated. One user said: *'I can check how much I ran, how many calories I burned, how fast I ran, how slow I ran. I also like to summarise these things later. It motivates me more because I can see that I'm trying harder to improve my results. I want to train regularly and improve my results; to make them better and better. So that there is progress, not regression'* [M6, female, 32 years old].

Specific, measurable data frees users from subjectivity and presents their progress unambiguously. It also allows users to compare present with past performance easily; to race against themselves. This is exemplified by the account of another smart band user: *'I was going for the record. It came to, let's say, thirty thousand steps I took there. Including the fact we are not taking the bus now, we are walking. I've been nagging everyone to walk, because I have to do my number of steps. I'm trying to break my record'* [M17, female, 35 years old].

Constant contact with technologically objectified data from one's own body can lead to interesting results. On the basis of some of the following statements, it appears that users trust the measurement from a smart band more than they trust the information coming from their own body: *'Sometimes it's even hard for me to tell if I'm sleep-deprived. I feel normal. And then I see in the app that my deep sleep was short, [...] that those percentages were lower,'* [M21, male, 30 years old]; *'It seems to me that [without the smart band] I would have to wonder all the time if I'm physically active'* [M17, female, 35 years old]; *'It's nice because you can see, for example, when you went to bed and when you got up. I know that I go to bed too late and I get up too late'* [M18, male, 34 years old]. Each of the statements above are compelling by the sequence of their logic: users first look at the data and then, by doing so, know whether they are physically active, tired, or go to

bed too late. This demonstrates how technology absorbs and elicits processes that once occurred internally; it is now technology that tells its users what they are feeling.

The availability of high-quality cameras and the storage of large numbers of photographs in cloud computing functions as a form of memory empowerment—the equivalent of eidetic (photographic) memory. For example, when describing to a salesperson what parts we need for our computers, we no longer need to know the name of the part; a photograph will usually suffice. This also applies to clothing, jewellery, or even handwritten notes, for which photographing minimises the probability of them being lost. *'I noted down a doctor's appointment on a piece of paper somewhere, [...] and I took a picture of it. The card will probably be thrown away or lost, but the photo will always be there. And sometimes, I also take photos of myself... for example, in clothes before I buy them. I keep the pictures. When I'm wondering, for example, about something that's broken, I say: "OK, how much more warranty do I have on this?" and I look through and find the right photo'.* [M10, female, 22 years old].

TECHNOLOGY AS AUGMENTATION

Additional Senses

Some IoT technologies act as new senses. We assume the definition of a sense to be "any of the media through which one gathers information about the external environment or about the state of one's body in relation to the environment" (APA 2020). An example of technology as a function of sense can be found in smart home installations'—such as sensors, actuators, and cameras—enablement of real-time user control in homes. One user of such an installation describes it as follows: *'I get a picture or a video that there is this person in the house. Or I can set it so that the camera detects only strangers. Because the camera learns the faces of the household members. And if I don't want it to react to the face of the household members, I don't get notifications; I just don't get them. If a stranger comes in, it reacts immediately, records that person's face, and, of course, I also get a notification'* [M23, male, 52 years old]. The possibility of constant contact with the domestic space acts as an additional and desirable sense. Once given the opportunity to view on a smartphone what is happening in their homes, users often continue doing so—even when there is no obvious need. This illustrates an inversion of "necessity is a mother of invention". It is the technological artefact, the functionality that generates the need to use it (Kranzberg 1986). *'Just as you buy a new car, you want to drive it. I wanted to switch things on and off [at home]. In this way. Like a camera, I also wanted to peep. I don't know why, but I wanted to peep'* [M19, male, 37 years old]; *'For example, I often use this... every time I go away, there is a mode set up where I can keep an eye on everything; that is, I do a preview of the house several times a day'* [M7, male, 42 years old].

Another example of an application acting as an additional sense lies in solutions that provide accurate information on what time a bus will arrive. The user becomes aware of the routes of all local buses and what locations

they currently occupy. *'It's an app you can install on your phone. You just have to be connected to the internet to use it. [...] It knows, for example, where a certain bus is and how long it is delayed or how far ahead of schedule it is. So, it adds or subtracts a certain number of minutes if the bus is going to be early or late,'* [M6, female, 32 years old].

Modern parenting is supported by a wide range of 'connected things'. Smart bands worn by children allow their parents to monitor their locations and access cloud-based school attendance registers. Such technologies alter the parent-child relationship fundamentally. Parents are able to know (in real time) whether their children are at school, for example: *'You can't play truant at all nowadays because there is automation in the form of an electronic register'* [M16, male, 32 years old]. Another respondent states: *'Children are screwed. In my case, I had such a period in my life that I had 200 unexcused hours in one semester. Nowadays, it's impossible to do that. I see that a child is marked late or absent and I immediately call him: 'Jim, why aren't you at school?'* [M14, male, 33 years old].

Additional Abilities

An example of IoT's utility as an additional ability is Google navigation, which at its core provides its users with precise knowledge of topography and transport in unfamiliar locations. Equipped with the Google Maps application, users can navigate areas they have never visited as if they knew those areas well. The application acts as a prosthesis to knowledge that could once only be gained through the personal experience of being in a place. *'When I was at a conference last year [in another city], I took a bike. [...] Ordinary navigation. I typed in the address, started the GPS, and found the place without any problems, I rode to the place. Later, I rode from the centre to the outskirts to meet with my friends with whom I was staying. And I thought: wow, this is great! I've just cycled around the city with a map on my phone without checking where, how to get there, or by what means of transport, and I haven't get lost'* [M6, female, 32 years old].

The smartphone, through its coupling with internet resources, can also act as a substitute (or prosthesis) for skills. Today, it is possible, for example, to prepare a dish that was unfamiliar mere seconds ago. *'I type in "chicken dinner" and think to myself, what have I got? I've got broccoli! So, chicken, I check [which recipe] has some broccoli in it. And I love going... instead of going page by page, I go into the images. And I can immediately see what these dinners look like. OK, this is nice. So, I go in. It's got a good composition. So, we're doing this. And it's so... I'd have to go through this book or ten others. Or something, I don't know, combine, change something. And so... it's quicker'* [M9, female, 27 years old].

Smartphone use at school also constitutes an interesting phenomenon. The richness of the variety of applications, combined with the resources of the internet, enables many skills to be 'prosthesised'. Students frequently take advantage of such opportunities. An example of such duality is an application that makes it possible to solve any equation. *'FotoMath. It's a maths app. I have some kind of activity. It scans it for me and just solves it for me without*

a calculator. You can write some equation and it solves it for you, yes. Here I have some functions and so on, some things... I wanted it to solve for me. And it does' [M12, female 20 years old].

CONCLUSION

This study presents how new technologies connect not only with various devices and networks, but also with humans via wireless communication in the real world. It also presents how these developments equip users with new forms of agency, as well as how the users perceive them.

Measuring oneself and objectifying the observations in the Quantifying Self trend (Sharon, Zandbergen 2017) leads to easier self-reflection. The digital technologies of the Internet of Things have become 'technologies of the self' (Foucault et al. 1988)—tools that enable humans to analyse and develop themselves more effectively, as well as styling themselves (shaping their own social identity—i.e. finding answers to two crucial questions: 'who do I consider myself to be?'; 'who do others consider me to be?').

This study demonstrates that the smartphone plays a special role in the landscape of 'connected things'. It is also linked to technologies that one might assume function separately. The smartphone and its associated functionalities stand at the centre of the personal electronics ecosystem. The smartphone not only serves as an interface for the extension and augmentation of its user, but also as interfaces and extensions of devices, technologies, and things (e.g. domestic space) that were not previously connected. It is an extension of the washing machine. It is an extension of the dishwasher. It is an extension of a child (by the tracking of his/her location and the ability to hear what they hear an say), and it is an extension of the school (through access to electronic attendance registers). It is an extension of abstract concepts like 'domestic space'. It is a meta-tool and a super-interface. Such a wide range of extensions and augmentations causes users to function in a relational space of human and non-human actors.

This study has demonstrated that IoT technologies lay claim to the human psyche. The impact in bidirectional: it is not only the human that 'uses the technology'; the technology, as an instrument of extensions and augmen-tations, also evokes the need to be used. This demonstrates how new IoT technologies intertwine with the psyches of their users.

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