HOT TOPICS

NESTA Making Innovation Flourish

NESTA Hot Topics

Demanding devices

Introduction

With the 'Internet of Things' comes the prospect that everything from phones to fridges, boilers, energy meters and the television will be demanding attention from us. It won't be possible to pay attention to everything that is generating data, so we will need a different approach to interfaces and information. Making sense of and making use of these data streams will demand great new ways of engaging with data and devices.

Two pioneers in the field came to NESTA to talk about this subject: Usman Haque, director of Haque Design + Research Ltd, founder of Pachube.com and CEO of Connected Environments Ltd; and Matt Jones, formerly at the BBC, Dopplr and Nokia, and now a principal at design agency BERG.

Jon Kingsbury, NESTA's Director of Creative Economy Programmes, opened the discussion by explaining the 'Internet of Things' as a phrase to describe internet-connected real-world devices, a term as divisive to some as 'new media' used to be. Whether it's called the Internet of Things, ubiquitous computing or Everyware, more of our real world is becoming connected and we are at the foothills of exploring this new landscape.

Early days

Individual creators are driving new uses for devices and data, though you still need to be quite technically skilled to do so. Usman Haque was keen to emphasise the early days of this trend – his analogy was with the early days of the web around 1996 and sites like Geocities that allowed people to create their own pages, but didn't seem to have much useful content at the time. People want to create something of their own, and this need has driven rapid technological progress on the web.

The founders of BERG, Jack Schulze and Matt Webb, started playing with the challenges of connected devices in 2006 with Availabot, a little avatar of Matt Jones that stood up when he was online (on Instant Messenger) and fell down again when he logged off. This simple application meant dealing with all layers of the computing stack, from the most basic level of the network all the way up to the application, as well as the manufacturing needed to make the doll.

Technology has progressed to make it easier to build connected devices, with the arrival of Arduino and Pachube [see box: Terminology], but you still need to be technically adept to create a new device. Other platforms will undoubtedly emerge to make it even easier in future, engaging more people who will create new ways to use the technology.

Many connected devices simply connect to the web for an end service that was packaged

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Availabot

Terminology

Internet of Things: This phrase is credited to Kevin Ashton, co-founder of the Auto-ID RFID research lab at MIT, in a talk he gave in 1999. There is a range of possible definitions, but in general it refers to the concept of internet-connected objects that generate data without human input, using sensors and other electronics.

Pachube: (pronounced patch-bay) A company founded by Usman Haque and acquired in 2011 by LogMeIn, Pachube provides an intermediate platform layer between devices and sensors generating data feeds, and the applications that can use this data. Anyone can connect a data feed from their device into Pachube, and allow others to build applications with their data.

Arduino: Arduino is an open-source electronics platform that makes it easy to prototype and build interactive devices and sensors.

Natural Fuse

with the product. Smart energy meters and Nike Plus running shoes may allow you to view your data on your phone or a website, but don't allow any cross-communication. You can't export your Nike Plus data and take it to your doctor – you don't own that data.

Novel behaviour becomes possible with connected devices, allowing them to influence each other. Usman described Natural Fuse: *"a plant with a power socket on it"* which connects your power use to a plant that can offset the emissions. The trick is that the plant on its own is not enough to offset the power from a low wattage light bulb. To be carbon neutral, you link up other people's 'unused' plants to power your light. It connects to the internet, checks to see whether there are unused plants elsewhere in the network. There is a switch and you can choose to be selfish to turn the power on. But if you overuse the power by being selfish, you'll kill off someone else's plant (there's a vinegar injection linked to each plant).

Control of data and sharing

Japan radiation feeds

Usman described the qualitative difference between the old world of devices and the Internet of Things as being about opening up data silos *"You don't know who's going to extract value from your machines, your sensors or your devices. You don't know who is going to build an application on top of it."* This is what powered the growth of sharing on the web. It doesn't necessarily mean everything will be public and open, but you can open up the data and delegate access to others, even if it's to a closed group.

In the open 'Internet of Things' model, some companies will build devices and different companies will build applications that work on those devices. One of the major barriers to broader use of connected devices is the need for greater co-operation between companies and cities, to allow different devices to speak to each other, or many devices to talk to a single application.

Portable data and common standards for interaction are important to allow anyone to find the data that is important to them and develop applications that use them. NESTA is involved in a European project to establish a 'city commons' for devices and applications, based on the successful 'Code for America' programme.

The next step for connected devices is not just measuring and visualising but a toolkit for figuring out what to do about it – what is the action you can take?

In Fukushima, the Pachube community mobilised to fill a gap in the information people were looking for. After the Fukushima earthquake and tsunami, a nuclear facility in Kyoto with a Geiger counter became one of the most popular data feeds on Pachube – it's one

of the oldest feeds. Users started to discuss the limitations of this data. It was recorded in a lab, hundreds of miles away from Fukushima, but was the best source available at the time. At this point, the Japanese government was providing updates once a day, by PDF and often using inconsistent units. So the Pachube community in Japan started to buy Geiger counters, connect them up and add the data feeds to Pachube. Within about a week, there were 2,000 Pachube feeds across Japan, some of them updating every five seconds.

Once the data feeds were there, the next step was for people to build applications on top of this data. A map was built on Pachube data which linked the radiation levels to health outcomes and allowed people to comment on the data. Then came an Android app called Wind from Fukushima, which used wind direction and speed information along with the radiation feeds to predict radiation exposure in a specific area. There were 3D visualisations, heat maps, SMS alert services, web forms for adding more data: the community created much more innovation than a single organisation or company could have done.

Usman Haque, founder of Pachube.com

Companion devices

Matt Jones looked forward to the future of connected devices, suggesting that we would see 'companion-centred design' – smart assistants that experience the world alongside us and enhance our capabilities. Rather than being smart and independent, these are devices that support our smartness.

> *"When you cut into the present, the future leaks out."*
> **William Burroughs**

He gave examples of a range of devices that act as smart companions. The difficulty is in avoiding the problems associated with 'Clippy', the Microsoft Assistant introduced in 1997. This was supposed to offer smart, context-sensitive help, but in fact irritated most users by not being smart enough. To overcome this 'uncanny valley'[1] of devices, the design principle they have used at BERG is BASAAP: Be As Smart As A Puppy. They describe this as *"Making smart things that don't try to be too smart and fail, and indeed, by design, make endearing failures in their attempts to learn and improve. Like puppies."*

1. The Uncanny Valley is a dip in a graph of human preferences that occurs as robots or images become more and more lifelike. While cartoons and humanoid robots (like C3PO) are seen as non-threatening, robots that imitate humans too well can create an aversion or disgust – they are seen as 'uncanny'.

However smart these devices become, they will fail, and Matt suggested that the best solution is to display a legible model on the surface, making it evident what is happening. *"Something with motive and behaviour that fails is perceived differently from a tool that fails. A robot puppy that expresses disappointment that it failed and gives some indication of how you can help it next time, will elicit a very different response from a program that repeatedly throws an error page back to you."* You will have very different expectations of a device if you assign motive, agency and behaviour to it. *"The material you are working with is human psychology rather than technology."*

BigDog

There are a whole series of dog or puppy robots, that intentionally or not, create an emotional relationship. From Sony's Aibo to the haunting Boston Dynamics military robot 'BigDog', we feel differently about them than about other machines. BigDog is a large transport robot capable of climbing snowy hills, walking over ice and tackling all sorts of challenging terrain. The articulated legs and narrow feet give it a peculiarly lifelike gait and seem to create an emotional connection, even in a military robot.

Puppy-like devices don't have to be puppy-shaped, or even physical objects at all. Usman thought that the distinction between physical and virtual was old-fashioned: *"a little like the quaint 19th century distinction between mind and body."* All these devices have physical inputs, even if just from people clicking keyboards. Something like BigDog is driven by its software – is that physical or virtual? Does it matter? It's more about how we respond to those devices – do we really respond differently to a virtual 'personality' like Apple's virtual assistant Siri compared to a robot like BigDog or Aibo?

As these devices become smarter, it becomes harder to understand who the 'user' is. When

interacting with a network of smart devices, some virtual assistants like Siri, the predictive algorithms seen on recommendations sites like LoveFilm and physical devices or robots, everything is an actor, with a capability to make decisions and take actions.

Smart devices might not always involve building computing capabilities into objects around us. In many cases it will be just as helpful to provide a machine-readable link. Many people already carry a £500 computer in their pockets. (More than 95 per cent of 16-54 year olds have a mobile phone, and 39 per cent of these are using smart phones.)[2] It might be preferable to print QR codes onto every parking meter, and use our smart phones to read them and pay for parking, instead of building a computer into every meter.

Truly smart devices might give us answers we don't like. We expect a degree of pliability and compliance in our smart devices, but perhaps not to be contradicted. When most people talk about smart devices, they really mean smart, pliable devices. Usman argues that we should abandon the idea that smartness resides in the device or the building – instead we should build devices that can converse with us and make us smarter.

Matt Jones, Principal at BERG

Sharing and standards

One of the most active questions was the control of data and sharing that these devices enable. Who chooses what is shared and how it can be accessed? Some were concerned that governments and big companies might control the devices and data, limiting experimentation. Conversely, others thought that the Internet of Things was more likely to be successful if one or a few companies had closed or proprietary standards to drive progress.

Usman's argument was that we have already been through the phase of closed, proprietary systems, and *"the closer we get to the Internet of Things, the more it looks just like the internet"*, and that the web really grew from individuals' desire to share their personal pages and link to each other. The Internet of Things is not just the province of large companies like IBM: it's also being driven by the individual developers and creators who are interested in data important to them.

Although the technology is being driven by many individual creators, it can also be used to address global challenges. The Fukushima example is part of a wider trend to monitor air quality independently. In China and East Asia, air quality reviews are really important when choosing apartments and restaurants. In most cities there already exists an official mapping of air quality, with 3 metre high sensors used to generate standardised data. The problem with these is that they are 3 metres above the ground, which smooths out the peaks and troughs of the data, giving a steady reading. *"But ordinary people will be interested in the peaks, so it's important that we are able to make those measurements ourselves of the metrics that are important to us"*.

The desire is there to talk about data and the reasons that might drive changes – Usman highlighted how they can see these discussions happening on Pachube. That's the first step, but the next one is going beyond measuring and visualising to a toolkit for taking action.

2. Ofcom, 'The Communications Market 2011' http://stakeholders.ofcom.org.uk/market-data-research/market-data/communications-market-reports/cmr11/