

The Internet of Things

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The Internet has transformed our lives beyond recognition in the two decades since the term “world wide web” first emerged. Google, YouTube, Face Book, Amazon and almost 25 billion other web pages (more than 3 web pages for every human alive) have become such a part of everyday existence that it is difficult to remember when they did not exist. Traditional libraries and books have become almost redundant as sources of technical information, internet telephony is displacing traditional networks and the Internet is an everyday tool for engineers. However, while wireless browsing has in recent years released us from the tether of desktop computers, our method of accessing the Internet is largely the same as in 1990 – we enter or click on an address and watch the result on a screen; our interaction with the internet is mediated by computers of one sort or another and the richness of that interaction is severely limited by the relative primitiveness of keyboards, mice and screens and the necessity for us to deliberately “issue commands” at every step.

The next step should be to release our interaction with the internet from the tether of any form of computer and move to more natural forms of interaction but how can this be done? We are beginning to get some a glimpse through the MEMS accelerometers and gyroscopes that are being added to phones and game controllers to allow gestural interaction with technology but this is simply replacing pushbuttons and mouse clicks with an alternative method of issuing commands which we still have to learn from the manual. However, what if the everyday objects around us, the rooms in which we live and work and even our own bodies could autonomously communicate with each other and a new form of Internet? A world where the health of the elderly is monitored in their homes and a doctor or relative is alerted to any deterioration; where nothing gets lost anymore because every object can be located by the Internet; where cars communicate to reduce traffic jams and accidents; where an engineer can monitor and control a production process by manipulating a production line model on a desk; where a building autonomously minimises its energy consumption while respecting the individual preferences of its users; where we can personalise the multiple modalities by which we interact with technology; where we don't even have to consciously interact – where technology intuitively responds based on our behaviour, actions, location and even mood... This is the Internet of Things and doesn't it sound great?

The technology exists – embedded computers (there are also already three of these for every living human), RFID, wireless sensors, adaptive networking, knowledge engineering, data mining, responsive surfaces, smart rooms... – and global governments are strongly behind it and have committed large proportions of research budgets to it. It is the great economic hope of the old western economies which are seeing the steady march eastward of manufacturing industries; it will be a major component of Ireland's Smart Economy with the anticipation that this generation of engineering and business graduates will be the Internet of Things entrepreneurs who will produce an economic impact that will dwarf that of today's Internet. Yet major unresolved concerns remain about security and privacy in a world whose socioeconomic functioning has already become (unhealthily?) dependent on the Internet. At least today we can largely choose when, where and how we interact with the Internet and what information we send – what will be the social impact of reducing or even completely removing this freedom of choice? Do we want second-by-second details of our location, actions and health propagating through the Internet? We have seen the

almost unpoliceable criminality that can be committed via the Internet; management theorists suggest we are actually becoming less productive due to the overwhelming amount of information we now have to deal with; psychologists claim that stress from information overload is the cause of increasing levels of mental illness while sociologists highlight the paradoxical personal social isolation caused by the Internet.

Engineers will deliver the infrastructure for the Internet of Things and it will change society as a whole and the way in which every branch of engineering does its work - it is technologically very exciting for us! However, given the potential human and social impact and the ever-accelerating pace of technology development, we have to ask ourselves if engineers are properly equipped to assess and limit this human "collateral damage" as we drive the technology forward? We have seen the consequences of the pursuit of "profit for profit's sake" in the financial sector; are engineers equally as guilty of pursuing "technology for technology's sake", regardless of the potential consequences?

By examining current technology research and by exploring future application scenarios for the Internet of Things, this lecture will highlight its potentially enormous benefits and suggest key non-technological questions that we engineers, both as practitioners and educators, should be trying to at least ask before we "unchain the monster".