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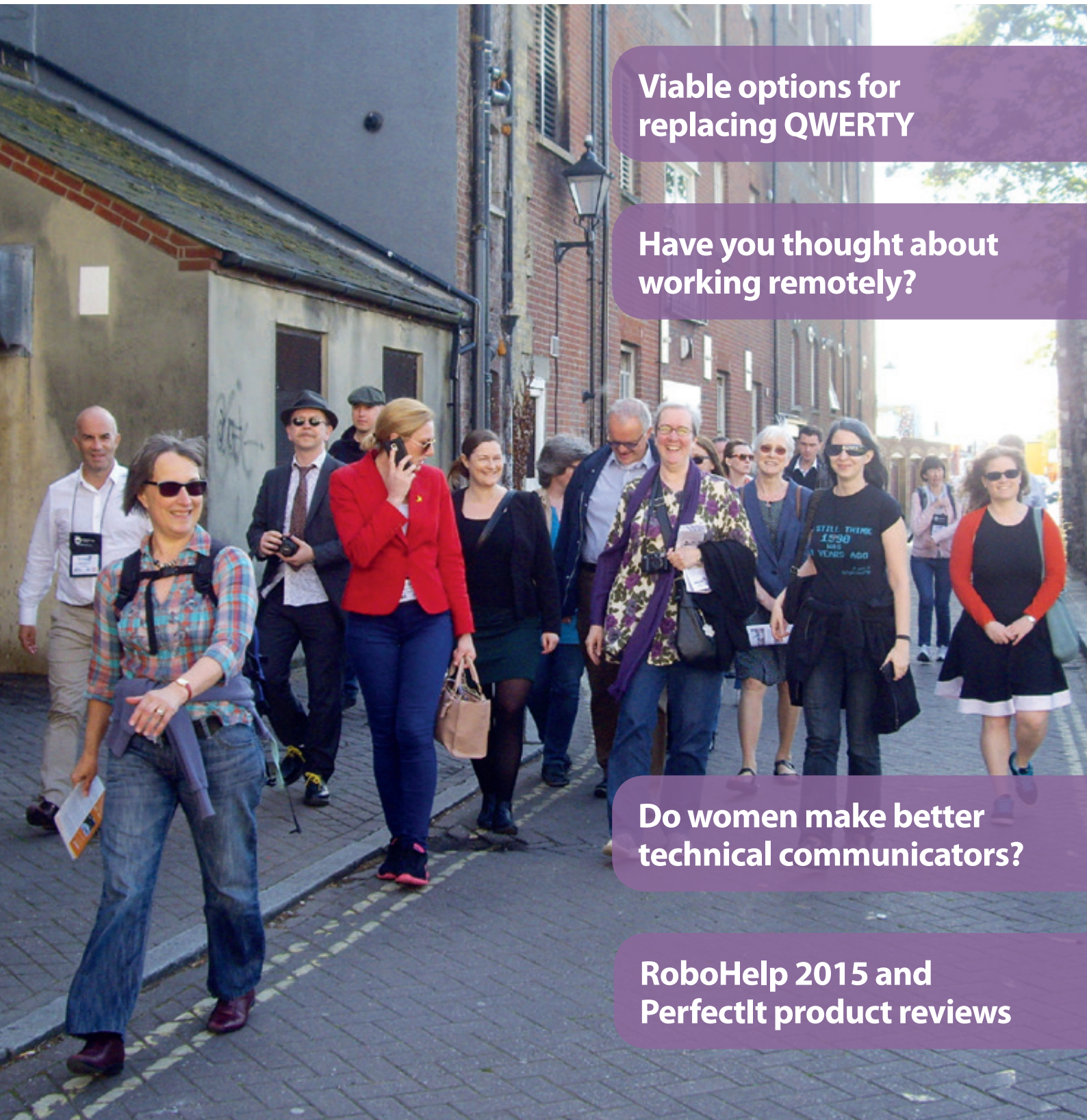

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An introduction to robotics

In this introductory technology column, Wael Elazab and Warren Singer, discuss the relevance of robotics to technical communication.

Robotics encompasses electrical and mechanical engineering, computer science, artificial intelligence, nanotechnology and bioengineering disciplines, among many others.

There are many advantages of using robots: they don't tire, get bored or get distracted, they can function in environments that are undesirable and they can operate at a level of precision and reliability that humans cannot achieve.

Introduction

Welcome to the first Technology column. It is written by a team of contributors with the aim of describing technology that is relevant to technical communicators. The purpose is to explain what the technology is, why it is relevant, and provide background information and links where you can find out more.

Robotics

Robotics is concerned with the design, manufacture and application of autonomous machines and their interaction with humans. The field encompasses electrical and mechanical engineering, computer science, artificial intelligence, nanotechnology and bioengineering disciplines among many others. Robotics exemplifies a philosophy called STEM, combining the academic fields of **s**cience, **t**echnology, **e**ngineering and **m**athematics.

Definitions of what a robot is are wide and varied. Within robotics, a robot is commonly explained as a machine that can sense its environment, is able to function autonomously (independently of human control) and can cope with change in its environment (that is, has a level of processing intelligence that enables it to respond to external stimuli). A robot that can perform its functions in the presence of uncertainty is considered intelligent.

There are many advantages to using robots: they don't tire, get bored or get distracted, they can be designed to function in environments that are undesirable to humans and they can operate at a level of precision and reliability that humans cannot achieve. And don't forget the jobs that humans simply can't do at all like visit Mars, take samples in the Marianas Trench or remember each topic we've ever looked up online.

Today's robots can carry out many activities previously performed by humans. Medical robots carry out surgery, industrial robot arms weld, paint and build machinery and hobby robots compete in sports, climb steep inclines and mimic animal and insect behaviour movement. Space robots explore planets and return pictures and data to earth, military robots are used to defuse bombs and domestic applications of robots include automated vacuum cleaners and lawn mowers.

The pilotless aerial vehicles, called drones, are robots which can be programmed to run entirely autonomously. The Roomba autonomous robotic vacuum cleaner receives data via its sensors to enable it to navigate around obstacles and detect dirt.

Robots — along with mobile devices and anything with an appropriate sensor — are increasingly being designed to communicate with each other, and are able to transfer data without necessarily needing human intervention.

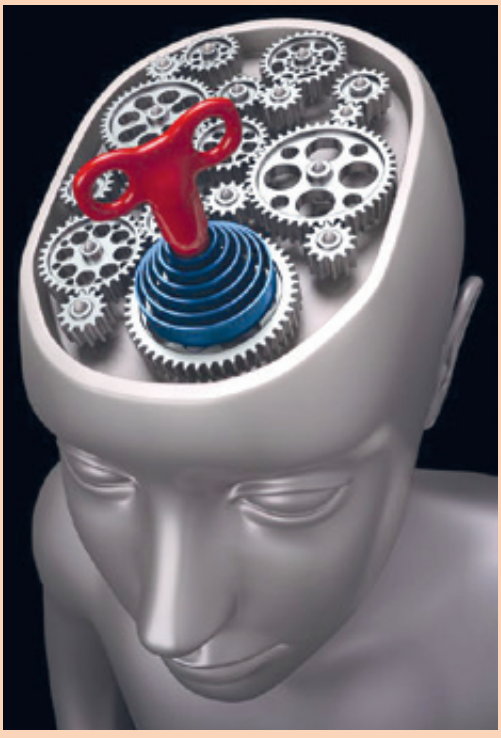
History of Robotics

Designs for self-operating machines go back to the 3rd century BC when ancient Greek engineers described bronze-spring catapults, water mills and an automaton-maid that poured wine into a vessel placed on its palm.

The first industrial applications of mechanical machines were the automated weaves of the 19th century, which used punched cards to store programs and data. These early machines replaced semi-skilled human labour and resulted in outrage at the time. In 1834 Charles Babbage designed an Analytical Engine, which was the forefather of the computer. The first electronic computer, Colossus, was developed by Alan Turing and others at Bletchley Park to decipher German signalling during World War 2.

Origins of the word 'robot'

The word robot originates from a 1920 play entitled *R.U.R., Rossum's Universal Robots*, by Karel Čapek, about the manufacture of efficient, emotionless and simplified humanoids to do all the work that humans don't want to do. The humanoids do so well that they end up



taking over the world (and, ahem, killing all the humans). Think of it as an allegory for the united insurrection of workers against totalitarian authority. Originally planning to use the Latin term *labori* to describe the humanoids, Karel Čapek felt something less academic was in order and had a chat with his brother about it — Josef Čapek came up with *roboti*, a Czech word often used to describe 'drudgerous hard work'.

The term 'robot' was first introduced into popular culture in the 1940s by the science fiction writer Isaac Asimov.

Development of robotics in the 20th century

The development of robotics in the 20th century has largely been an attempt to replace manual labour with more efficient automated technology. The first generation of robots carried out mundane tasks on factory lines. These were non-programmable and primarily mechanical devices that were electronically governed and had no sensors.

Countries like Japan and Germany led the early robotics industrial revolution. Automation in car manufacturing in Japan resulted in the huge leaps in productivity for the automobile industry.

By the 1980s, a new generation of robots became available. These were programmable, with sensors enabling them to react to their environment via light, pressure, chemicals and even noise, all of which mimic what we think of as the human senses.

Today

Today, robots are ubiquitous, and can be found in manufacturing plants, warehouses and factories across the globe. However, the high costs, not only of purchase but also of servicing and maintenance, remain a barrier to their widespread adoption.

Next generation

The forthcoming generation of robots will present a huge leap forward in capability. These robots will combine improved mobility and manual dexterity, with autonomous behaviour, enhanced intelligence and the ability to interact with humans at a more sophisticated level and are likely to have capabilities around independent thought, possibly meaning self-governance.

Some examples of the next generation of robots include:

- Robotic nurses and childminders, which can detect human emotion, speak and even mimic human facial expressions.
- Robotic body suits, which can be worn by the very frail and elderly, increasing the wearer's strength seven-fold.
- Machines that can interface with the human brain, to enable paraplegics to control the movement of their wheelchair through thought alone.
- Pilotless drones to deliver packages to your doorstep.
- Humanoid-like robots are being designed, which are able to climb stairs, run, talk and understand human speech.

Relevance to technical communicators

Automated writing

Recent years have seen the dawn of 'robots' that write. Far from a metal humanoid pushing you out of your desk chair, these are essentially pieces of software code, or algorithms, governing the automated analysis and repackaging of data. The Associated Press, Forbes and the Los Angeles Times use such robot-like automation to write business articles, cover sports and even issue news bulletins.

Robots can be found in manufacturing plants, warehouses and factories across the globe.

Lest you think an algorithmic approach couldn't get much beyond formulaic earnings reports of a few paragraphs, a man named Phillip M Parker has published over a million books courtesy of computer algorithms developed with his company Icon Group International. "*It is a means to an end to overcome certain market failures,*" says Parker, "*to cover topics that human authors cannot or will not ever cover, yet for which there is a need. Automation is a method of reducing the costs of production, a common issue in all industries.*"

How decent is the writing though? Slate Magazine compares news stories written by people to those written by software programs. It looks at the elements of storytelling, framing information and a human's intuitive ability to understand what people will find useful. But computer's don't sleep, they crunch data really well and in one of the example comparisons in Slate's piece, the computer misses the 'why', but hits the 'who,' 'what,' 'where,' and 'when'.

Automation is a method of reducing the costs.

Ramifications of automating

In an interview with the Financial Times in October 2014, Google co-founder and CEO Larry Page spoke about the necessity, and downplayed negative ramifications, of automating many of today's jobs: "*Even if there's going to be a disruption on people's jobs, in the short term that's likely to be made up by the decreasing cost of things we need ... the things you want to live a comfortable life could get much, much, much cheaper.*"

Technical communicators ideally placed

With many manual jobs already automated to varying degrees — a classic example being the travel agent's almost full-scale replacement by online flight and hotel booking aggregators — further profound changes are coming. Robotics applications are going to extend further into the workplace, in ways we might not have thought possible. At the same time, technical communicators are ideally placed to document how these applications work and communicate this new technology to a non-technical audience.

Robotics exemplifies the STEM philosophy:
• Science
• Technology
• Engineering
• Mathematics

Jobs are at high risk of being automated in 47% of the occupational categories (Carl Benedikt Frey and Michael Osborne, 2013).

Evolutionary robotics puts robots into competition with one another and their ability to perform specific things assessed, measured and compared.

New systems will need documenting

Robotic applications will increasingly work alongside us, to enhance the work we do and take away the more monotonous tasks, making us quicker and more efficient. Their use in medical surgery is one example, where robots are able to do what humans can't. The Economist reported in April 2015 that robotics expert Hugo Guterman is leading a team to almost completely remove the human factor in inserting needles into deep veins and blood vessels, with the robot placing the needle and the human merely pressing a button to proceed.

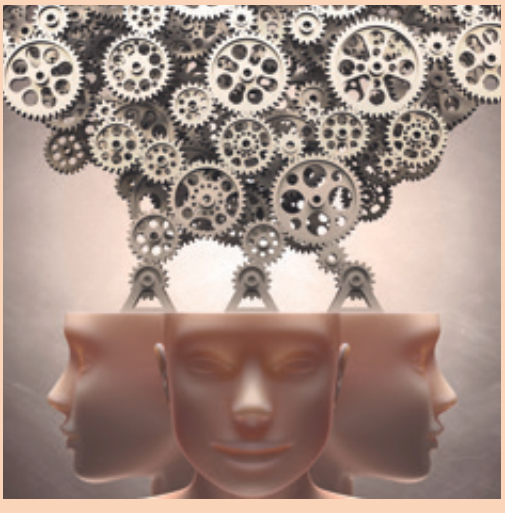
Just as robot-driven assembly lines impacted many automotive factory workers in recent decades, and since the 2007/2008 global financial crisis and resulting recession, we've seen more and more middle-class jobs lost and the work instead relegated to online applications.

If these trends continue, it seems likely that the need for technical communicators should continue, at least in the short term, as these new sophisticated systems and applications will need documentation.

Future of robotics

In January 2014, The Economist published 'The onrushing wave', an article that looked at technology-driven unemployment and cited a 2013 paper by Carl Benedikt Frey and Michael Osborne of the University of Oxford, which argued that 'jobs are at high risk of being automated in 47% of the occupational categories into which work is customarily sorted'. The article quotes from the paper a list of jobs and the probability that computerisation will lead to job losses in the next two decades. It begins harmlessly enough (1=certain to be replaced by technology): dentists, 0.004; clergy, 0.008; editors 0.06; actors, 0.37; real estate sales agents, 0.86; and the next most likely, technical writers at 0.89, but don't worry, telemarketers will be worse off at 0.99.

The alarming rate at which data is continually farmed at all levels of society means it can be manipulated and managed much more easily by machines working via automated algorithms to provide a range of services for our benefit. Predictions of a robotic revolution for industry, commerce and technology are not new. Bill Gates wrote positively about robotics in Scientific American almost a decade ago: "*I can envision a future in which robotic devices will become a nearly ubiquitous part of our day-to-day lives ... distributed computing, voice and visual recognition, and wireless broadband connectivity will open the door to a new generation of autonomous devices that enable computers to perform tasks in the physical world on our behalf.*"



Commercially, there are already many market-ready robotic applications, but on the horizon there are nanobots for molecular-level applications, biomechatronics for combining mechanical and electronic constructs with biological organisms now called 'transhuman', social robots that enable interaction with people and the overall application of an ideology referred to as evolutionary robotics.

Evolutionary robotics puts robots into competition with one another and their ability to perform specific things assessed, measured and compared. Akin to natural selection, the worst performing robots are removed, then replaced with robots designed around the winning characteristics of the robots that weren't eliminated. The aim is to create robots that can endure and adapt to their environment, and the unique element to this approach is that the entire robot be replaced, not just its malfunctioning motion sensor.

Conclusion

Robotics has had a profound impact on how we live and work, and its influence will only grow in the future, as robotic machines and applications start to take over many of the jobs we currently do. These redundant jobs will be replaced by new ones, which we have not yet thought about. New roles will be required to design, service and market these new robotic applications.

There will continue to be many aspects of human behaviour that will be hard or impractical to replace with the current generation of robots. For example, the things that people are really good at, like cross-functional synthesis, where people from diverse backgrounds work together toward a common goal, or creative and unstructured problem solving where people can literally sleep on it and come back the next day to see a solution or risk-brainstorm workshops to unearth the potential pitfalls in a complex technology project — essentially the roles that require a person to be physically, mentally and emotionally present — are out of the reach of machines in the near term.

Every area of our lives will see robotics implemented to enhance our endeavours. Technical communicators are ideally placed to help document and explain these new robotic applications, which

will work alongside us and take over many of the more mundane and routine activities of our current jobs, freeing us up to do other things. C

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Thanks

A special thanks to Katherine Judge for her assistance with this article.

Wael Elazab MISTC is a technical editor with roots in journalism, he works with science, technology and engineering content for print, digital and social media.

Tw: @waelae

E: waelelazab@gmail.com

Warren Singer MISTC is a founding partner of Cambridge Technical Communicators, based in Cambridge, UK. He has 20 years' international experience as a technical communicator.

E:warrens@technical-communicators.com

W: www.technical-communicators.com

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T: +44 (0)20 8253 4506
F: +44 (0)20 8253 4510
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