Advances in robotics will only get you so far: context is crucial

Robots and intelligent systems have gained a significant amount of attention recently. Various authors and reports detail advances in robotics and artificial intelligence and speculate on the role of humans in the robotic future. In such commentaries, robots are often presented as independent and tireless machines that are rational and efficient; they are removed from their creators and contexts of use. Unfortunately, as appealing as this image might be, it resembles more of a science fiction hero than the contextual nitty-gritty that revolves around the development and deployment of robotic applications. To obtain a more holistic picture, let us have a look at some contextual factors that surround robotics innovation today.

To begin, there are many ways to describe robots. For our purposes, the idea of robotics is to transfer some human labour to machines, or alternatively, to have machines do something that would not be done otherwise. As such, this is nothing new. Roads, fields, factories and offices are filled with all sorts of machines and computers that are brought in to help us in heavy, unpleasant or repetitive tasks. However, decoupling them from their operators by making them more autonomous is a challenging problem, which roboticists are trying to solve.

For instance, think about self-driving cars. They are expected to navigate roads to reach their destination in a safe and graceful manner. To survive, a car needs to respect the conventions of road transit, observe surrounding traffic and pedestrians, know its location as well as a convenient route to a desired destination, and yet come up with a suitable sequence of actions such as acceleration, braking and turning left and right. In other words, a robotic system must transform environmental inputs to meaningful behaviour constantly, reliably and in real-time. This is easier said than done.

Although showcases and competitions demonstrate the latest advances in robotics and artificial intelligence, decades of research have shown the difficulty of mastering the contingencies of reality. The real world is open-ended and unpredictable, whereas the computer programs that control robots' behaviour are good at pre-defined and narrow tasks and contexts. Moreover, the context-dependence of behaviour makes it difficult to transfer programs to different settings.

Managing the risk of robotic technologies

Environmental inputs, social conventions and meaningful behaviour vary significantly from a use case to another, as do the consequences if and when something goes wrong. It might be essential for a berry picking robot to recognise the ripeness of a strawberry, yet an occasional mis-pick or veering off into a ditch is unlikely to be fatal. However, a failure of a self-driving car or a medical application may put human lives in danger.

There are various approaches to overcome the narrowness of current robotic technologies. Robots are often placed in constrained environments to safeguard humans and to prevent inputs that may interrupt their operations. Industrial robots that are housed in factories provide a prototypical example of robots that operate in heavily constrained environments. As an alternative approach, tasks and environments can be selected so that the likelihood and impact of negative consequences are low if something does go wrong, such as crop farming or using drones for deliveries in sparsely populated areas.

Often it is not possible to select or constrain an environment, and influencing the context is beyond human control. In these scenarios manageable aspects of the task should be automated to ensure ultimate control is maintained in human hands. Some European automakers are introducing self-driving capabilities in a gradual manner, providing a car with the ability to shift control back to the driver if a situation on the road becomes unmanageable for its computer. On the other hand, Google aims at developing technologies that make the driver the passenger, preferring not to equip their cars with steering wheels. Yet what works in sunny and well-mapped Californian roads may not be comparable to snowy and unmapped mountain roads or chaotic small alleys.

To further complicate matters, legal affairs for robotic applications are currently unclear. To pave the way for responsible innovation, the EU and its member states are working to develop regulatory frameworks that define liability and insurance rules as well as data protection and cyber security related matters.

Seeking the opportunities

However, robotics innovation is not just about agonising over the limitations of technologies and missing regulations. Instead, it is about finding the locales where robotic technologies and methods can be used in a commercially feasible, robust and socially acceptable way. ZenRobotics develops and builds robotic waste sorting systems. Using advanced computer vision, the waste sorters recognise and classify valuable materials and pick the valuables from a conveyor belt using robotic hands. Although developing such a system takes significant time and effort, there is a market for waste sorting machines, and the negative consequences of an occasional misclassification are at the lower end of the spectrum.

Similarly, robotic process automation is a sufficiently predictable area of application for low risk implementation.

Robotics innovation is as much about understanding the contexts of use as it is about developing technology. This is not to dismiss the importance of technological development. Instead, it is to remind us that the reliability requirements, usefulness and acceptability vary significantly across the contexts of use. To make better use of existing and developing technologies, we should find ways to bring together technologies and solvable problems. This cannot be done by technologists alone as they often lack the knowledge of contextual finesse. Instead, technology savvy managers and entrepreneurs are in an ideal position to identify such opportunities, yet they need to co-operate with roboticists to evaluate the key characteristics and solvability of the identified opportunities. Or, perhaps, there is a need for a new role of robotics analysts who specialise in bringing robotic technologies and practical problems together.

Notes:

- *Feature image credit: Dan Rucose. Inside image: Michael Shick CC BY-SA 4.0*
- *Listen to a LSE public events podcast on Service Automation: robots and the future of work from 9 May 2016*

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