ROBOTICS FOR ALL

New platforms are helping to transform the sector, according to **Michael Seren**

Through the emergence of open source software and low cost development boards, we have already witnessed what can be described as a 'democratisation' of electronics. Now, it seems, the same principles are starting to be applied to robotics. A growing number of enterprises are looking to make robotics more accessible and are helping to accelerate its proliferation. Each organisation is employing their own distinctive strategy, as they look to enable a broader cross section of different parties to benefit from such technology.

London start-up, and British Engineering Excellence Awards winner (BEEAs), Automata Technologies is among those championing this cause. Its Eva product presents the market with highly effective table-top robotic apparatus that is almost an order of magnitude cheaper than standard industrial robotic systems, thereby opening up an array of possible use cases that wouldn't have previously had the necessary budget.

Through implementing Eva, manufacturers can offload jobs which aren't really making best use of trained staff. This 6-jointed robot arm has been purposely built with dimensions that are in-line with those of humans, so that it offers a practical automated alternative. It can be supplied with multiple suction cups or a 2-finger gripper.

As the company's co-founder Mostafa Elsayed explained, "Until this point a very large proportion of the potential application opportunities for robotics simply haven't been served, just because the financial barriers proved too high. Now, jobs may be automated that would never have been considered for it before.

"Bottlenecks can be removed and throughput increased. It also allows staff retention issues to be tackled, as employees aren't stuck doing repetitive and mundane tasks which bore them, but can undertake work that is more meaningful."

Figure 1: The Eva robot arm from Automata

Crucial to the company, was the development of Eva's powertrain. Much of its engineering resource was concentrated on construction of a unique, streamlined gearbox arrangement. This avoided the need to horizontally integrate everything, and brought the overall expense down.

The Eva robot arm has also been designed to be straightforward to programme (via a web-based user interface), which equates to less time and expense.

By placing the hardware in a more attractive price bracket and backing this up with intuitive control software, Eva has a lot more widespread appeal than competing robotic systems - being suitable for deployment in much smaller manufacturing facilities, workshops, technical colleges, etc. Key functions that it can execute are machine tending (i.e. loading/unloading), correcting orientation or performing quality inspection on items during production processes and carrying out testing procedures.

The modest financial outlay involved will also mean companies can add Eva robot arms to their operations so that sudden ramp ups in production demand can be dealt with, or to take care of seasonal increases.

Generally, everything can be implemented in about an hour (as opposed to several days, or possibly a week, for conventional systems). Furthermore, Eva has a much higher degree of mobility than its bulkier, heavier counterparts.

Academic community

MIT's Biomimetic Robotics Laboratory has similar goals to Automata, but in the context of helping the academic community. Announced back in the spring, its Mini-Cheetah biomimicry quadruped robot is similar in format to the units currently on the market from firms like Boston Dynamics, et al. However, it is far smaller and lighter (weighing little more than 9kg), and (most important of all) markedly cheaper - relying on easily available off-the-shelf electronic devices.

Sturdy, but agile, it provide ease of movement and can travel at speed (easily managing 2.45m/s), traversing over relatively challenging terrain when necessary. It supports forward,

reverse and lateral movement, as well as having the ability to jump, land, rotate and do backflips. Balance and orientation controls ensure that it remains upright even when kicked, and if it is knocked over then a self-righting mechanism steps in.

The Mini-Cheetah's robustness allows research departments to significantly reduce the simulation time undertaken. Instead they can participate in direct experimentation, without the risk of component parts failure. It also means that students can use it without the risk of any expensive damage being done.

The Biomimetic Robotics Laboratory's intends to start offering Mini-Cheetahs to other MIT departments, and universities, in order to conduct their own investigations.

As Professor Sangbae Kim, who masterminded Mini-Cheetah, explained, "Right now we are building ten Mini-Cheetahs to collaborate with robotics departments in other institutions, such as Berkeley and Notre Dame, as well as for commercial robotics ventures.

"There are also discussions underway with our industry sponsor to support the funding needed to donate an additional twenty to thirty units to numerous robotics research groups across North America, and possibly further afield," he continues "though this is still at a very early stage."

If these ambitious plans come to fruition, then there is the prospect of it becoming a common, almost open source, foundation for future robotics projects across the globe.

There aren't just costs and logistical aspects to consider though, other dynamics must be factored in too - in particular how robots will fit into the environments that we live and work in.

Humans and robots together

Since 2008, thanks to European Union funding, the Bristol Robotics Laboratory (BRL) has undertaken pioneering research into how human beings and modern robotic systems might coexist with one another. This work is contributing to the technological progression of a new breed of collaborative robots - or 'cobots'.

Based on predictions from various industry analysts, major growth markets in the coming years (aside from the industrial space) are likely to be agricultural robots, social functioning 'companion' robots (building on the popularity of smart speakers) and assisted living robots (to make up for the shortfall in carers and our aging population demographic). Professor Manuel Giuliani, who leads the BRL's Embodied Cognition for Human-Robot Interaction (ECHOS) Team, shares the sentiments of Automata's Elsayed.

"It is important to understand that this isn't about replacing human workers, but about them working alongside on another, with each bringing their own particular strengths to the partnership," he notes. "Carer robots could do day-to-day chores, like washing dishes, changing bedclothes, attending to the laundry, and suchlike. That doesn't negate the services of human care assistants, it just means time is freed up for them to deal with the social needs."

Whether they are placed on production lines or in homes, hospitals or retail outlets, cobots will come into close proximity with human co-workers, patients and customers.

As a result, numerous sensors must be encompassed to give them full awareness of their surroundings (and any alterations that might occur), so as to stop them harming anybody.

Figure 2: The MIT Mini-Cheetah

"In industrial locations, workers coming into contact with robots will have been trained appropriately beforehand, but when we talk about these other scenarios, the general public won't have any formal training, and early experiences could be somewhat unnerving," Giuliani believes.

Communication between robots and humans is another area where research is on-going. As humans we can converse vocally, but this is often less applicable to robots, with it being difficult for them to fathom what someone requires them to do.

"Full arbitrary dialogue is still a long way off, with the complexity of human speech, and the many nuances relating to it, still representing a challenge, plus this may be accentuated in noisy environments," said Giuliani. This is why his team focuses much of their attention on developing non-verbal forms of communication, based on gestures and body posture.

Other issues being addressed include robots' ability to identify and then grasp different household implements correctly without damaging them. In his opinion: "For the foreseeable future, robots will remain too expensive to be present in most homes or offices, so clever business models need to be formulated that maximise their utilisation and spread the costs over multiple end users. As with any technology trend, in time the volume levels will rise and this will gradually increase commercial viability."

Breaking down the current barriers to entry that prevent more widespread adoption of robotic technology, and also looking at ways in which these pieces of machinery can cooperate with us, will eventually lead to a better functioning society.

The next generation of affordable robotics solutions is getting ever closer.