Industrial Robots and Automation

Victor Splittgerber for Mouser Electronics

(Source:greenbutterfly - stock.adobe.com)

MOUSER ELECTRONICS

Ever since industrial robotic systems were first introduced, they have faced numerous challenges. The first robotic platforms date as far back as the 1960s and initially experienced issues with high prices and complex hardware. Older robotic platforms were also reliant on a network of infrastructure (e.g., rails, tracks, magnets, and strips) that seriously limited such platforms.

Another major challenge faced by early mobile robotic systems was the lack of high-density energy storage solutions. As cables cannot be used to power mobile robotics, batteries are needed, which means the range and capabilities of the robot depend on the weight of the battery and its energy capacity.

Fast forward to 2022, and the problems faced by mobile robotic systems have changed dramatically. To start, industrial processes are often cost-sensitive, and the use of robotics in such applications means optimization is essential. However, this can be extraordinarily difficult where mobile robots and humans share spaces, as either party can make mistakes, and robotic systems must often give way to humans (or vice versa), which can disrupt tasks.

Another problem faced by modern robotic systems is the need for coordination. While robotic systems from a single manufacturer will come with software solutions, trying to coordinate across different manufacturers can be challenging, as numerous application programming interfaces will be needed (which may even require the use of custom software).

Finally, modern robotic systems face difficulties when being modified to perform different tasks. The ability to customize hardware on modern robotic platforms (e.g., different types of arms, grabbers, and detection systems) makes them highly adaptable, but making such changes requires extensive code updates, planning, and experimentation to perfect the process.

Emerging technological developments in hardware, software, and advanced analytics could address these challenges and better support modern robotic systems by improving interactions both among robots and between humans and robots, increasing productivity, and reducing costs.

What Technologies Have Helped Develop Robotics?

To help improve robotics in the field of industrial and commercial environments, robotic systems have deployed numerous technologies in both the hardware and the software used to support them.

The first major technology that robotics has begun to leverage is the Robot Operating System (ROS). The ROS is an open-source project that aims to provide engineers with common libraries, tools, and drivers to create robotic systems that use common interfaces and programming methods. As such, engineers can develop the first prototype of a robot for a specific task quickly without starting from scratch. Once the prototype is done, the project team can focus on the challenges around scalability, quality, and cross-compatibility with other robotic systems.

The second major technology that robotics is starting to use is edge computing. While artificial intelligence (AI) is extremely powerful at providing robots with intelligence, the need to be mobile means that AIs need to be run locally. The ability to run AIs locally also provides lower latencies as well as the freedom to navigate without being tied to a local network. Thanks to the development of high-performance mobile central processing units and neural net processors, robots can now combine data from light detection, ranging, and cameras to be aware of their surroundings in real time—a process called sensor fusion.

Third, robotic companies are developing new software solutions (e.g., WAKU Sense) that go beyond a single robot or a fleet of identical robots. The new tools provide plant operators with a singular application capable of operating entire fleets of robots for different tasks from different vendors.

For example, WAKU Sense allows engineers and even nontechnical personnel to add different robots to an existing fleet and move step-by-step to a fully automated production or warehouse. WAKU Sense's no-code interface (which is becoming common among software solutions in general) simplifies the job of automating new processes or adjusting robotized processes. Thanks to advanced analytics, the overall efficiency of robots in action can be increased, thus maximizing performance.

Finally, robotic companies generally have avoided trying to create a singular standard, as such attempts often quickly result in fragmented industries where hardware from different manufacturers can never work together. Instead, companies are focusing on creating their own personal standards, which then provide transition mechanisms to interface with devices from other manufacturers.

How Can Robotics Be Used to Achieve Success?

To make the most of modern robotic systems, operators should focus on gathering as much data as possible, including journeys made by robotic systems, the time spent idling, charging times, and downtime from errors and bugs. For example, a site may consider purchasing a new robotic platform to increase productivity, but thanks to advanced analytics, existing robotic systems may have enough idle time to handle a second job. This not only improves efficiency but also generates a significant cost saving while reducing the need for additional maintenance (i.e., one robot is easier to maintain than two).

Furthermore, operators also need to identify areas where humans can make mistakes that can interrupt the robot's process. For example, humans could easily place items in the wrong location, causing significant confusion to mobile robot platforms as the robot cannot pick up the needed goods. If these errors are eliminated, robotic efficiency can increase.

To appreciate the extent to which robotic systems can help a business, let's look at two examples.

Example 1—Amazon

Amazon is a worldwide business famed for its same-day delivery, massive warehouses, and extremely customer-friendly return policies. While Amazon has traditionally used manpower to operate its vast warehouse facilities, it has recently started to use robotics to help store, locate, and shift goods.

Currently, Amazon has 500,000 robots across all its warehouses, and yet this only makes up 10–20% of its process (with the remaining 80% being done manually). If Amazon further leverages robotic platforms for handling warehouse goods, it could reduce labor costs and thus offer its services at a lower rate to customers. Considering that Amazon is one of the world's most valuable businesses, it goes without saying that mobile robotic platforms can help businesses expand if used correctly.

Example 2—Moving Goods Through a Factory

In one factory, robotic systems also faced challenges in the transportation of goods throughout the facility; the setup suffered from low efficiency. An investigation revealed that workers didn't understand how to behave correctly around the platform (e.g., getting in the way of its path), thus demonstrating how robotic systems are equally dependent on the humans with whom they operate.

To help alleviate these challenges, the use of advanced analytics and data collection allowed plant operators to identify the key issues and adjust the process to specifically target the problems. Furthermore, basic robotics training around the robotic platform helped raise workers' awareness of how robotic systems behave. By recognizing the importance of the human element in robotics, overall efficiency can be improved quickly.

Where Will Robotics Go in the Future?

While robotics will continue to find applications in repetitive and laborious tasks, the challenge facing these robotic systems will be how they connect and synchronize their operations. Developing low-latency networks will certainly help to improve communication, but robots may work together through low-latency local networks that they broadcast individually. Thus, communication between two robots is more akin to a conversation than a networked message.

Robotics will also become increasingly easier to install, so much so that operators will likely use self-serving marketplaces to configure robots (one such example is lotsofbots.com, which allows engineers to compare robotic systems across various manufacturers).

In fact, the high cost of robotic platforms may even see the Robot-as-a-Service (RaaS) business model become massively popular. Instead of investing large amounts in hardware up front and spending time learning how to program a specific platform, RaaS can help customers use robotic manufacturers to provide hardware for, to program, and to maintain the platforms. Such platforms could even be used as temporary work staff that can be installed and removed daily to help businesses tackle changes in demand.

The deployment of private 5G networks will most likely usher in cloud computing for robotic systems. Instead of running all algorithms locally to a robot, most of the expensive processing hardware can be located on some remote server that allows for quick upgrades, data monitoring, and reinforced machine learning. This use of remote computing can also reduce overall energy consumption and thus increase the range of mobile robotic platforms.

Conclusion

With all the developments in hardware, software, and advanced analytics to better support modern robotic systems, two factors need to be addressed. The first is that people require better training to not only understand how robotic platforms work but to learn how to develop their own platforms using open-source environments, such as the ROS, as well as no-/low-code solutions for robotic platform programming. The second is that robotic developers need to focus on situational awareness. Current robots are surprisingly dumb when it comes to their surroundings and can rarely understand the environment they are in or how to behave around humans. As such, a truly intelligent robot would be mindful of its surroundings and make better decisions without the need for human supervision. These improved robotic interactions create opportunities for increased productivity and reduced costs in industrial and commercial environments.