DENSO

Robotics

Small Assembly Robots: Evaluating Controllers

A Guide for Manufacturers, Machine Builders and System Integrators

Knowing how to evaluate key controller features can lead to making a wiser buying decision.

Small assembly robots are continuing to achieve ever-higher levels of implementation in all manufacturing sectors.

In order to function, a robot requires a controller that (1) contains the programs that tell the robot what to do, (2) serves as a coordinating link between the robot and other devices in the automation cell and (3) captures operational and error data and communicates it to the outside world — which increasingly today means the Industrial Internet of Things, or IIoT.

Robot controllers are usually designed to work with a specific robot or line of robots, and in most cases cannot be used with robots from a different vendor.

As a result, controllers are not offered separately, but as part of the complete robot package, and are consequently not always given as thorough an evaluation as the robot itself.

Since controllers play such a vital role in robot operation, however, knowing how to evaluate their key features can lead to making a wiser buying decision.

Small Assembly Robots Defined

Small assembly robots are a class of industrial robot arms consisting of four-axis (also referred to as SCARA) and six-axis articulated robots. Despite their name, small assembly robots can carry out a much greater variety of tasks than just

Small assembly robots are used for many more applications than just assembly.

assembly. These include all the various functions involved in manufacturing, packaging and other industrial applications, such as:

Assembly	Nut driving
Dispensing	Package forming
Encapsulating and potting	Parts finishing
Grinding	Pick and place
Insertion	Polishing
Inspection	Press fitting
Labeling	Product insertion
Loading and unloading	Screw driving
Laser welding	Soldering
Machine tending	Spot-welding
Machining	Surface finishing
Material handling	Test handling
Material removal	Ultrasonic welding

For the purposes of this paper, small assembly robots are considered to be those with payload capacities up to 20 kg (44 lbs.) and reaches up to 1,300 mm (51 in.).

Larger robot arms have different types of controllers, and therefore different evaluation criteria.

Essential Controller Considerations

Form factor: Small robots, which have been around since the 1960s, originally had controllers the size of a refrigerator.

Today's trend is toward much smaller controllers, some of which are only about the size of a desktop computer. These take up less valuable floor space, and are easier to integrate and redeploy in new applications. They are also easier ship for repair if necessary.

Some manufacturers who are not specialists in small robots, however, use the same large controller design for their small robots as for their large ones, resulting in significantly less ease of use, but no gain in function.

Number of axes and auxiliary functions controlled: Most manufacturers offer only one specific controller for each of their robot models.

Some, however, offer a choice of controllers for a given model, usually as a way of presenting lower-cost options. When this is the case, the onus is on the buyer to ensure that the controller

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is capable of running extended axes and auxiliary functions such as conveyor tracking and network IOs.

Processing speed: Some controllers have a user-upgradable CPU, to accommodate code-intensive applications involving high-speed vision checking, higher math operations, multiple robot tasks, multiple cooperative robots, an entire cell being controlled by a single controller, etc.

Ease and cost of integration: Some controllers come with all of their functions built in and allow the user to activate them, saving the time and expense of a service call. Additional built-in capabilities can also make it easier to integrate commonly used peripherals such as a vision system, extended axes, a conveyor or a vibratory table.

Other controllers have software and firmware licenses, with additional post-sale charges required to activate even basic features such as palletizing, singularity avoidance and collision detection.

Further charges and a service call may also be required to extend the I/O configuration, or obtain updates and license renewals.

Ease and cost of programming: Traditionally designed controllers require the user to learn a specialized programming language, plus additional languages for each piece of peripheral equipment.

Today's newer-style, PC-based controllers are more flexible, and can take advantage of ORiN (Open Robot/Resource Interface Network), a standard created by the Japan Robot Association.

ORiN allows users to program the robot in a single, common language such as C++, C#, Java, Visual Basic or VBScript, greatly speeding up and reducing the cost of development and integration.

The same language can also be used to program peripheral devices, eliminating the need to use different, proprietary programming software for each one.

In addition, many manufacturers offer offline programming software packages, often with 3-D simulation modules, that can further reduce development time and costs. Some of these packages come with expensive but often unnecessary advanced features, however, offsetting the cost-saving advantages.

Collecting all device data in a master control center where it is easily accessible is a distinct advantage when connecting with the Industrial Internet of Things.

Versatility: Some controllers can be used with any robot in a manufacturer's lineup. This allows stocking of only a single spare controller instead of a separate one for each type of robot, saving considerable time and money and reducing the length of possible downtime.

Connectivity: Most controllers are available with a wide variety of network I/O options, but some have only a limited choice, so the user needs to verify in advance which are available.

In addition, some controllers come with built-in functionality that allows easy connection with a PLC or PAC, enabling single-platform control of the robot and peripherals without having to learn a different programming language for each device.

Thus being able to collect all device data in a master control center where it is easily accessible is a distinct advantage when connecting with the Industrial Internet of Things.

Expandability: Some manufacturers offer inexpensive, user-upgradable DAQ (data-acquisition) expansion boards while others may require a service call to install and enable them.

Teach pendant: Teach pendants do not typically come with a controller, but must be purchased separately. They are usually considered to be a necessary timesaving tool for programming the robot.

Some manufacturers require the purchase of a teach pendant for every robot; others do not have such a requirement, so a single pendant can be used for any number of robots of the same type, a significant cost savings.

11 Things to Look for When Choosing a Robot Controller

When choosing a robot controller, here are eleven important things to consider:

1. Experience and specialized expertise of the manufacturer: Look for a manufacturer that has established itself as an industry leader and whose robots have stood the test of time.

Small, high-speed, high-inertia robots and their controllers have their own unique design challenges. A manufacturer that specializes in such robots is likely to have expertise that others do not.

Manufacturers who depend on their robots to keep their products competitive in the marketplace are likely to design robots and controllers that have the lowest cost of ownership.

2. Type of manufacturer: Robot manufacturers fall into two basic categories: (1) those whose primary business is selling robots and (2) those whose primary business is producing and selling other products, which they manufacture with robots they design and build themselves.

Manufacturers in the second category depend on their robots to keep their products competitive in the marketplace. As a result, they are likely to design robots and controllers that have the highest productivity levels, longest working lifetimes and lowest maintenance requirements — and therefore the lowest cost of ownership.

3. Compact design: A lightweight controller with a small footprint makes integration easier and saves valuable factory floor space.

4. Stackability: Controllers with a front-to-back airflow design allow multiple units to be stacked on top of each other without danger of malfunctioning or shutting down due to overheating, which can otherwise be the case with a bottom-to-top airflow.

5. Processing speed: An upgradeable CPU means that the controller can be redeployed in future applications that may require more processing speed. It also saves costs by not having to purchase excess processing speed that may never be needed.

6. Modular expandability: A controller that can accommodate additional peripheral equipment without having to purchase a new unit when needs change can result in substantial long-term cost savings.

7. Ease of integration with a vision system, PLC or other devices: Look for a controller that is easy to integrate with peripheral devices. Some controllers have built-in vision systems, but these tend to be limited and might not meet the requirements of your application.

8. Affordable offline programming software: In general, most applications are not difficult to program. Be sure the offline programming software being offered does not include expensive, advanced features that are unnecessary for your needs.

9. External connectivity: To take advantage of the many benefits of the Industrial Internet of Things, be sure to verify

Not all controllers have an automatic backup system, so it pays to ask.

whatever additional hardware is required for the controller to send and receive properly formatted data.

10. Automatic backup: An automatic backup system can prevent the loss of valuable data. Not all controllers have one though, so it pays to ask.

11. Safety standards: Virtually all controllers today meet RIA and ANSI safety standards, but not all are available with UL certification, so if this is a requirement, it should be verified at the beginning of the buying process.

About DENSO Robotics

As one of the world's largest automotive parts manufacturers, DENSO Corporation has been a pioneer and industry leader in robot design and manufacturing since the 1960s.

DENSO is also the world's largest user of small assembly robots, employing more than 17,000 robots in its own manufacturing facilities. Other companies use more than 77,000 additional DENSO robots worldwide.

DENSO Robotics offers a wide range of compact four-axis SCARA and five- and six-axis articulated robots for payloads up to 20 kg, with reaches from 350 to 1,300 mm and repeatability to within ±0.015 mm.

Available configurations include standard (IP40), dust- and mistproof (IP65), dust- and splashproof (IP67), cleanroom (ISO 3, 4 and 5) and aseptic (resistant to H_2O_2 and UV light).

ANSI and CE compliance enables global deployment. UL-listed models are available for both the U.S. and Canada.

Easy-to-use programming software, controllers and teaching pendants are also offered. The company's offline programming software, which features 3-D simulation, also allows remote monitoring of robot operations.

DENSO robots are used in a large variety of applications, such as assembly, dispensing, insertion, inspection, machining, machine tending, material handling, material removal, pick and place, test handling and ultrasonic welding.

Industries served include appliances, automotive, chemical, consumer products, disk drives, electronics, food and beverage, general manufacturing, life sciences, machine tools, medical devices, packaging, pharmaceuticals, plastics and semiconductors.

For more information, visit the DENSO Robotics website at www.densorobotics.com.