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The Three Types of Robots

There are basically three types of robots used in automation processes: articulated, gantry/Cartesian, and Scara. Each is defined by unique action, and each is designed to perform specific tasks. It is important to know the differences among them in order to correctly define the proper robot type for the application in question.

Articulated Robots

An articulated robot is one with rotary joints. It can be used to lift and place parts with great accuracy. It is sometimes known as a jointed-arm robot.

The articulated robot has a main body, shoulder, arm, forearm, and wrist, with the capability to rotate all its joints. The majority of these types of robots have six degrees or axes of freedom:

- Axis 1 – Arm sweeps from side to side
- Axis 2 – Shoulder moves forward and backward
- Axis 3 – Elbow moves up and down
- Axis 4 – Middle of forearm pivots up and down
- Axis 5 – Wrist moves up and down
- Axis 6 – Wrist sweeps from side to side

Movement is made in three ways: pitch, yaw, and roll. Pitch defines the up and down movement, yaw reflects left and right movement, and roll is rotation. This mobility allows articulated robots to be used often for tasks such as welding, painting, and assembly.

Gantry/Cartesian Robots

A gantry, or Cartesian, robot looks very different from the popular image of a robot. This version is stationary, and typically contains a minimum of three elements of motion in which each motion refers to a linear motion in a single direction.

In the gantry robot, each motion is arranged perpendicular to each other, and typically labeled X, Y, and Z. Both X and Y are located in the horizontal plane; Z is vertical. Visualize X and Y as the width and length of a box, with Z as the height.

The interior of this box is referred to as the working envelope of the gantry robot. The robot can move things anywhere within the envelope, or perform an operation on an item within the envelope.

A typical application for a gantry robot is device assembly, or pick and place. Components required for the device being assembled are brought into the working envelope, and the gantry robot picks up each component to attach or place it on the device. The entire device itself must also be contained within the working envelope. Grippers of various types can be bolted to the end of the Z-direction motion to assist in grasping parts. Rotating motions can also be added to both the Z-direction motion and the working envelope to enable even greater part manipulation ability.

Another typical application for the gantry robot is the performance of a specific action on a part. The robot can be programmed to weld, drill holes, or perform various other operations on the part. Again, the part must be placed within the working envelope. Rotary motions and appropriate tools are added to the gantry robot to enable it to perform its required function.

Scara Robots

A scara robot can perform motions similar to that of a human arm. It has a shoulder and elbow joint, along with a wrist axis and vertical motion. The shoulder and elbow joints rotate around the vertical axes. The scara configuration provides substantial rigidity for the robot in the vertical direction, as well as flexibility in the horizontal plane.

Scara robots are ideal for a variety of general-use applications requiring fast, repeatable and articulate point-to-point movements like machine loading/unloading and assembly.

Because of their elbow motion ability, scara robots are also used for applications requiring constant acceleration through circular motions, like dispensing and in-place gasket forming. Scara robots are cylindrical robots, having two parallel rotary joint, and provide compliance in one selected plane.