**VARIOUS COMPONENTS OF SCARA ROBOTS**

**SHITAL SANJAY BORIKAR**

***Student*, KDKCE**

*Email id:shitalb42@gmail.com*

**K.D.K COLLEGE OF ENGINEERING, NAGPUR**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**ABSTRACT**

 This paper discuss about anthropomorphic characteristics including mechanical arms, used for various industry tasks, or sensory perceptive devices, such as sensors, which allow SCARA robots to communicate and interact with other machines and make simple decisions. The technology is quite similar to numerical control, as it has followed the same developmental path. Both SCARA robots and numerical control are similar in that they seek to have coordinated control of multiple moving axes (called joints in robotics). Both use dedicated digital computers as controllers. The combination of drive system, sensors, and feedback control system determines the dynamic response characteristics of the manipulator. It can be programmed into the work cycle so that different portions of the cycle are carried out at different velocities.

**INTRODUCTION**

 A SCARA robot is a general-purpose, programmable machine possessing certain

anthropomorphic characteristics —that is, human-like characteristics that resemble the human physical structure, or allow the robot to respond to sensory signals in a manner that is similar to humans. The SCARA acronym stands for Selective Compliance Assembly Robot Arm or Selective Compliance Articulated Robot Arm. Its arm are rigid in the Z-axis and pliable in the XY-axes, which allowed it to adapt to holes in the XY-axes. By virtue of the SCARA's parallel-axis joint layout, the arm is slightly compliant in the X-Y direction but rigid in the ‘Z’ direction, hence the term: Selective Compliant. This is advantageous for many types of assembly operations, i.e., inserting a round pin in a round hole without binding.

 The second attribute of the SCARA is the jointed two-link arm layout similar to our human arms, hence the often-used term, Articulated. This feature allows the arm to extend into confined areas and then retract or “fold up” out of the way. This is advantageous for transferring parts from one cell to another or for loading/ unloading process stations that are enclosed.SCARA (Selective Compliance Assembly Robot Arm) is a cylindrical type, whose reach is obtained by using a revolute, instead of a prismatic joint. SCARA robot is suitable for assembly operation and is therefore extensively used in several industries for this purpose. A robot with at least 2 parallel rotary joints.

**ROBOT ANATOMY**

 The manipulator of a SCARA robot consists of a series of joints and links.

*In a robot, the connection of different manipulator joints is known as* ***Robot Links****, and the integration of two or more link is called as* ***Robot Joints.***

 A joint of an industrial robot provides relative motion between two links, and often, only one degree-of-freedom is associated with each joint. The purpose of the joint is to provide controlled relative movement between the input link and the output link. SCARA robots have following joints:

**Rotational Joint:** Rotational joint can also be represented as R – Joint. This type will allow the joints to move in a *rotary motion* along the axis, which is vertical to the arm axes.

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**Linear Joint:** Linear joint can be indicated by the letter L – Joint. This type of joints can perform both translational and sliding movements. The two links should be in *parallel axes* for achieving the linear movement.

**Twisting Joint:** Twisting joint will be referred as V – Joint. This joint makes *twisting motion* among the output and input link. During this process, the output link axis will be vertical to the rotational axis. The output link rotates in relation to the input link.

**ROBOT CONFIGURATIONS**

**** The Configuration explains what happens when a drive motor is actuated. A Configuration includes the physical shape of the robot as well as a model of how the robot can move in the environment. Depending on the configuration and size of the links and wrist joints, robots can reach a collection of points called a Workspace.This consists of a vertical column that swivels about the base using a T joint. the shoulder and elbow rotational axes are vertical, which means that the arm is very rigid in the vertical direction, but compliant in the horizontal direction. The SCARA body-and-arm configuration typically does not use a separate wrist assembly; its usual operative environment is for insertion-type assembly operations where wrists joints are unnecessary. The other four body-and-arm configurations more-or-less follow the wrist-joint configuration given above, by deploying various combinations of rotary joints type R and T.



**ROBOT CONTROL SYSTEMS**

 Joint movements must be controlled if the robot is to perform as desired. Micro-processor-based controllers are regularly used to perform this control action.

1. ***Point-to-point (PTP) control robot***: is capable of moving from one point to another point. The locations are recorded in the control memory. PTP robots do not control the path to get from one point to the next point.

2. ***Continuous-path (CP) control robot****:* with CP control, the robot can stop at any specified point along the controlled path. All the points along the path must be stored explicitly in the robot’s control memory.

3**. Controlled-path robot**: the control equipment can generate paths of different geometry such as straight lines, circles, and interpolated curves with a high degree of accuracy. All controlled-path robots have a servo capability to correct their path.

**END-EFFECTORS**

 End-effector mounted on the wrist enables the robot to perform specified tasks. Various types

of end-effectors are designed for the same robot to make it more flexible and versatile.

***1. Grippers:***are generally used to grasp and hold an object and place it at desired location. Grippers can be classified as mechanical grippers, vacuum or suction cups, magnetic grippers, adhesive grippers, hooks, scoops, and so forth.



2. ***Tools****:* a robot is required to manipulate a tool to perform an operation on a workpart. Here the tool acts as end-effector. Spot-welding tools, arc-welding tools, spray-painting nozzles, and rotating spindles for drilling and grinding are typical examples of tools used as end-effectors.

**DRIVE SYSTENS**

There are three basic drive system used in commercially available robots:

1. **Hydraulic drive:** gives a robot great speed and strength. These systems can be designed to actuate linear or rotational joints.

2. **Electric drive:** electric drive systems are adopted for smaller robots.

3. **Pneumatic drive**: are generally used for smaller robots. These robots, with fewer degrees of freedom, carry out simple pick-and-place material handling operations.

**SENSORS**

 Sensors provide a robot with feedback so that it can "understand" its surroundings. Internal sensors are used to monitor and control the various joints of the robot; they form a feedback control loop with the robot controller. External sensors are external to the robot itself, and are used when we wish to control the operations of the robot with other pieces of equipment in the robotic work cell. A few common kinds of sensors are listed below.

1. **Cameras -** Cameras are inexpensive and usable for many kinds of imaging applications. They enable a robot to process its environment so that it can move freely without bumping into something.

2. **Position sensors:** are used to monitor the position of joints. Information about the position is fed back to the control systems that are used to determine the accuracy of joint movements.

3. **Range sensors:**measure distances from the reference point to other points of importance. Range sensing is accomplished by means of television cameras or sonar transmitters and receivers.

4. **Velocity sensors:**are used to estimate the speed with which a manipulator is moved.

5. **Proximity sensor:**are used to sense and indicate the presence of an object within a specified distance or space without any physical contact.

**ROBOT PROGRAMMING**

A robot program is a path in space to be followed by the manipulator, combined with peripheral actions that support the work cycle. To programme a robot, specific commands are entered into the robot’s controller memory, and this action may be performed in a number of ways. For limited sequence robots programming occurs when limit switches and mechanical stops are set to control the endpoints of its motions. A sequencing device controls the occurrence of the motions, which in turn controls the movement of the joints that completes the motion cycle.

***1. ON-LINE PROGRAMMING:***

**Teach Pendant** is a handheld control and programming unit. The common features of such units are the ability to manually send the robot to a desired position, or "inch" or "jog" to adjust a position. They also have a means to change the speed.

**Lead-by-the-nose** is a technique in which one user holds the robot's manipulator, while another person enters a command which de-energizes the robot causing it to go limp. The user then moves the robot by hand to the required positions and/or along a required path while the software logs these positions into memory. The program can later run the robot to these positions or along the taught path.

**2.** ***OFF-LINE PROGRAMMING:***

*Offline programming* is where the entire cell, the robot and all the machines or instruments in the workspace are mapped graphically. The robot can then be moved on screen and the process simulated. The technique has limited value because it relies on accurate measurement of the positions of the associated equipment and also relies on the positional accuracy the robot which may or may not conform to what is programmed.

***Programming Languages***

Large number of robot languages available like AML, VAL, AL, RAIL, Robot Studio, etc. (200+) Each robot manufacturer has their own robot programming language and no standards exist.

**ADVANTAGES**

* · High speed.
* · Height axis is rigid
* Large work area for floor space
* Moderately easy to program.

**DISADVANTAGES**

* Limited applications.
* 2 ways to reach point
* Difficult to program off-line
* Highly complex arm

**Commonly used for:**

* Pick and place work
* Assembly operations

**CONCLUSION**

SCARA robots consists of 2 rotary and 1 linear joint.The work volume, or work envelope, is the three-dimensional space in which the robot can manipulate the end of its wrist. Joint movements must be controlled if the robot is to perform as desired.SCARA robots tend to promote the substitution for human labour where there is hazardous work environments for humans; where there is a repetitive work cycle; where there is difficult handling for humans; in multi-shift operative environments; where there are infrequent changeovers; and where part position and orientation are established in the work cell.

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