Robotics & Automation – Unit 2.5

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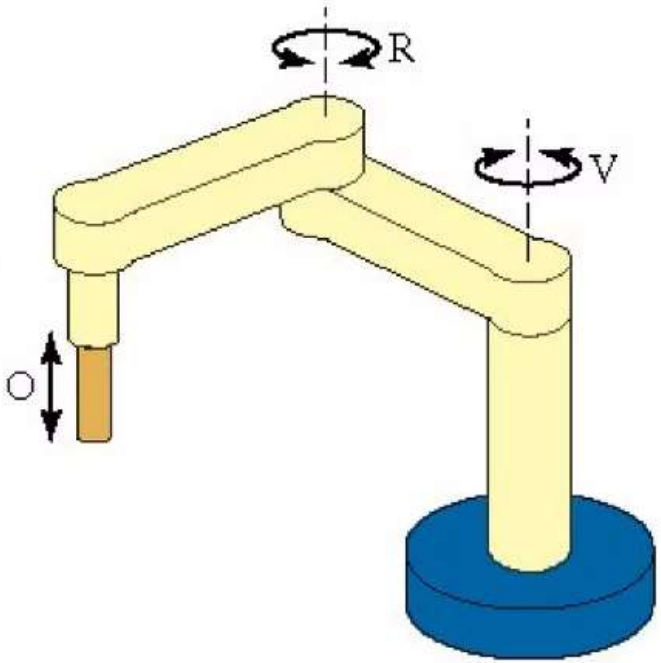
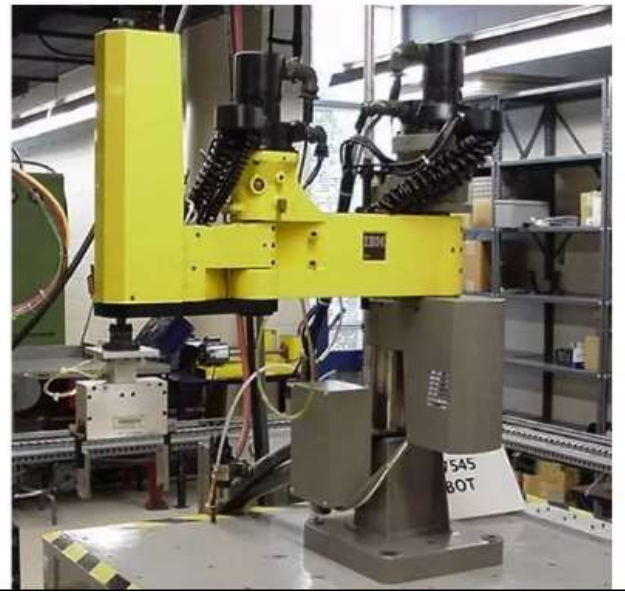
Second Unit of the syllabus

Robot-Basic concepts, Need, Laws of robotics, History, Robot Anatomy, specifications. Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot. End-effector and Grippers- Classification of robot- progressive advancement in robots, anatomy: links, joint and joint notation scheme, degree of freedom, arm configuration, wrist configuration - Human arm characteristics - applications

SCARA Robot



- Notation VRO
- SCARA stands for Selectively Compliant Assembly Robot Arm
- Similar to jointed-arm robot except that vertical axes are used for shoulder and elbow joints to be compliant in horizontal direction for vertical insertion tasks



Joint Drive Systems

- Electric
  - Uses electric motors to actuate individual joints
  - Preferred drive system in today's robots

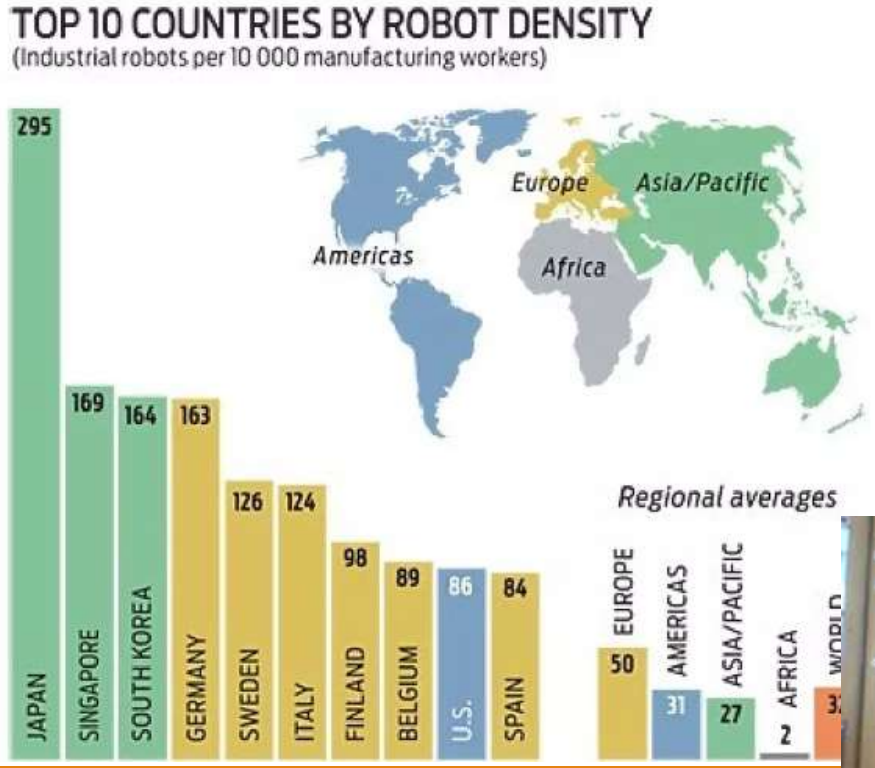
- Hydraulic
  - Uses hydraulic pistons and rotary vane actuators
  - Noted for their high power and lift capacity
- Pneumatic
  - Typically limited to smaller robots and simple material transfer applications

Robot Control Systems

- **Limited sequence control** – pick-and-place operations using mechanical stops to set positions
- **Playback with point-to-point control** – records work cycle as a sequence of points, then plays back the sequence during program execution
- **Playback with continuous path control** – greater memory capacity and/or interpolation capability to execute paths (in addition to points)
- **Intelligent control** – exhibits behavior that makes it seem intelligent, e.g., responds to sensor inputs, makes decisions, communicates with humans

Industrial Robot Applications

1. Material handling applications
   - Material transfer – pick-and-place, palletizing
   - Machine loading and/or unloading
2. Processing operations
   - Welding
   - Spray coating
   - Cutting and grinding
3. Assembly and inspection

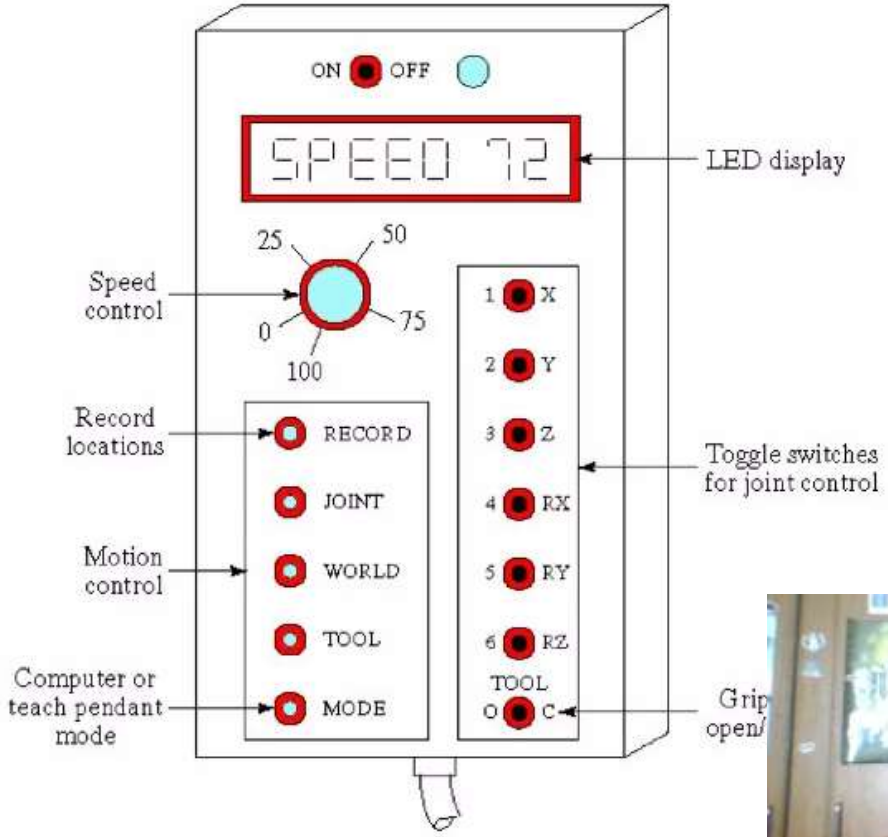


Robot Programming

- Leadthrough programming
  - Work cycle is taught to robot by moving the manipulator through the required motion cycle and simultaneously entering the program into controller memory for later playback
- Robot programming languages
  - Textual programming language to enter commands into robot controller
- Simulation and off-line programming
  - Program is prepared at a remote computer terminal and downloaded to robot controller for execution without need for leadthrough methods

Leadthrough Programming

1. Powered leadthrough
   - Common for point-to-point robots
   - Uses teach pendant
2. Manual leadthrough
   - Convenient for continuous path control robots
   - Human programmer physical moves manipulator



Leadthrough Programming Advantages

- Advantages:
  - Easily learned by shop personnel
  - Logical way to teach a robot
  - No computer programming
- Disadvantages:
  - Downtime during programming
  - Limited programming logic capability
  - Not compatible with supervisory control

Motion Commands

MOVE P1

HERE P1 - used during lead through of manipulator

MOVES P1

DMOVE(4, 125)

APPROACH P1, 40 MM

DEPART 40 MM

DEFINE PATH123 = PATH(P1, P2, P3)

MOVE PATH123

SPEED 75

Interlock and Sensor Commands

Interlock Commands

- WAIT 20, ON
- SIGNAL 10, ON
- SIGNAL 10, 6.0
- REACT 25, SAFESTOP

Gripper Commands

- OPEN
- CLOSE
- CLOSE 25 MM
- CLOSE 2.0 N

Summary

- Joint Drive systems
- Robot control systems
- Programming of robots