Robotics & Automation – Unit 2.2

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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

Asimov's Three Laws of Robotics

Law One

A robot may not injure a human being or, through inaction, allow a human being to come to harm.

Law Two

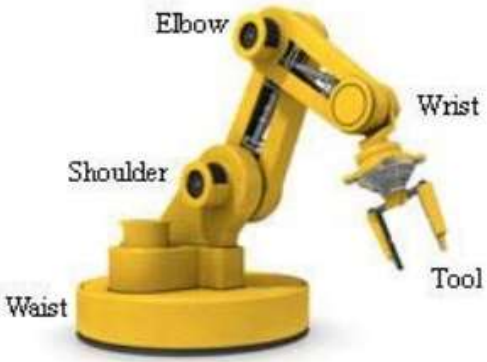
A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

Law Three

A robot must protect its own existence as long protection does not conflict with the First or Se

Robot Anatomy

- Manipulator consists of joints and links
  - Joints provide relative motion
  - Links are rigid members between joints
  - Various joint types: linear and rotary
  - Each joint provides a “degree-of-freedom”
  - Most robots possess five or six degrees-of-freedom
- Robot manipulator consists of two sections:
  - Body-and-arm – for positioning of objects in the robot's work volume
  - Wrist assembly – for orientation of objects



Selection criteria of a Robot

The selection criteria are based upon application, maximum reach, payload, number of axes, repeatability, and mounting position.

Robot Specifications

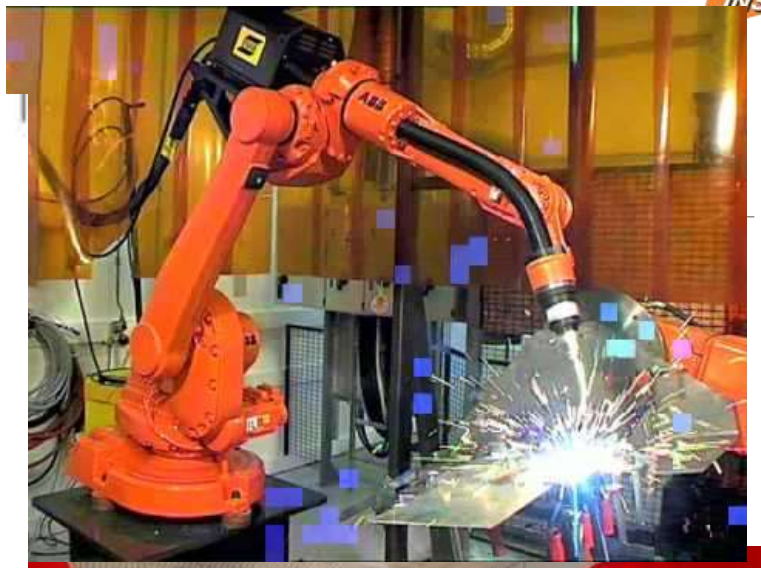
1. **Accuracy, resolution, repeatability, speed and payload.**
2. **Number of degrees of freedom.**
3. **Geometric configuration of the manipulator.**
4. **Maximum and Minimum reach.**
5. **Type of Drive system.**
6. **Type of Control system.**

https://tinyurl.com/ywz9hhac

https://www.bastiansolutions.com/blog/top-10-things-to-know-about-industrial-robots/

Table: Selection of Robots

APPLICATION	TYPICAL TECHNICAL FEATURES REQUIRED
Arc Welding	Anatomy: polar, revolute Number of axes:5 to 6 Control System: continuous path Drive System: electric or hydraulic Programming: manual, powered lead through
Spray Coating	Anatomy: revolute arm Number of axes: 6 or more Control System: continuous path Drive System: hydraulic Programming: manual lead through
Assembly	Anatomy: revolute arm, SCARA Number of axes: 4 to 6 Control System: PTP or Continuous path Drive System: electric Programming: powered lead through, textual language Accuracy and repeatability: high



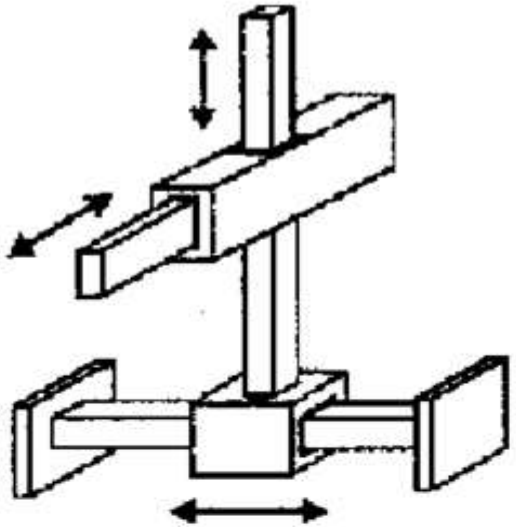
Factors in Gripper Selection and Design

(as defined by Joseph Engelberger)

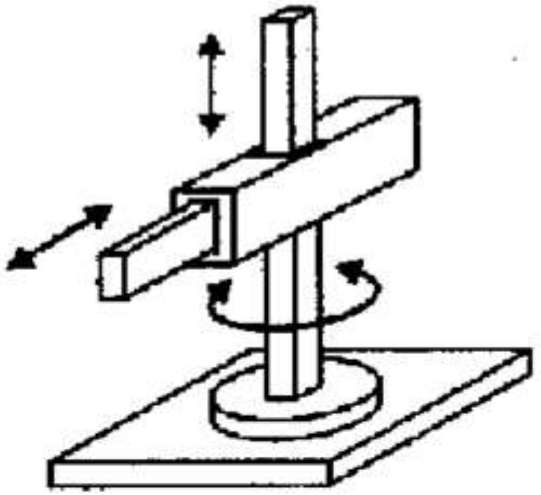
FACTOR	CONSIDERATION
Part to be handled	**Weight and size** **Shape** **Changes in shape during processing** **Tolerances on the part size** **Surface condition, protection of delicate surfaces**
Actuation method	**Mechanical grasping** **Vacuum cup** **Magnet** **Other methods (adhesives, scoops, etc)**
Power and signal	**Pneumatic** **Electrical** **Hydraulic** **Mechanical**
Gripper force (mechanical gripper)	**Weight of the object** **Method of holding (physical constriction or friction)** **Coefficient of friction between fingers and object** **Speed and acceleration during motion cycle**
Positioning problems	**Length of fingers** **Inherent accuracy and repeatability of robot** **Tolerances on the part size**

Factors in Gripper Selection and Design

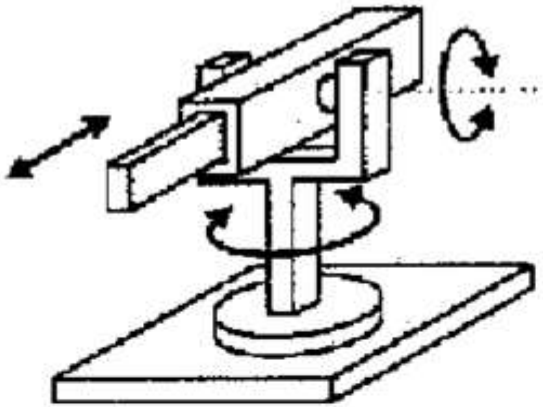
FACTOR	CONSIDERATION
Service conditions	Number of actuation during life time of gripper Replaceability of wear components (fingers) Maintenance and serviceability
Operating environment	Heat and temperature Humidity, moisture, dirt, chemicals
Temperature protection	Heat shields Long fingers Forced cooling (compressed air, water cooling etc) Use of heat-resistant materials
Fabrication material	Strength, rigidity, durability Fatique strength Cost and ease of fabrication Friction properties for finger surfaces Compatability with operating environment
Other considerations	Use of interchangeable fingers Design standards Mounting connections and interfacing with robot Risk of product design changes and their effect on the gripp Lead time for design and fabrication Spare parts, maintenance and service Tryout of the gripper in production



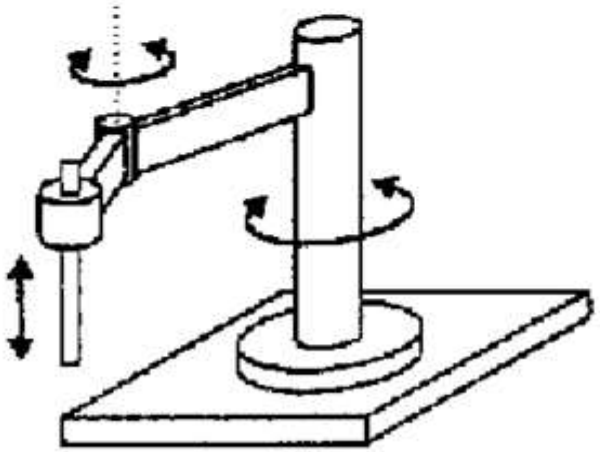
Cartesian Robot



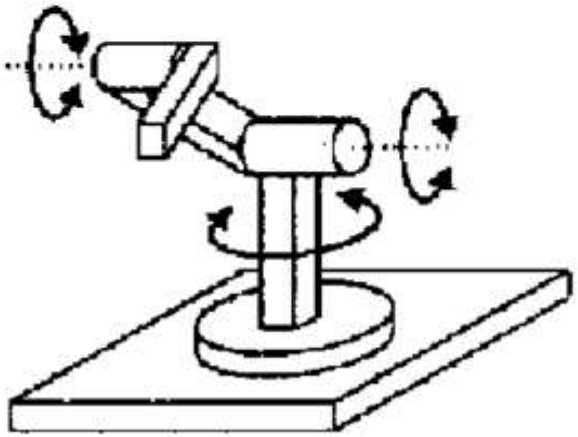
Cylindric Robot



Polar or spheric Robot



SCARA Robot



Angular or anthropomophic Ro

Summary

Robot Anatomy,

specifications.

Robot configurations-

cartesian,

cylinder,

polar

and articulate.