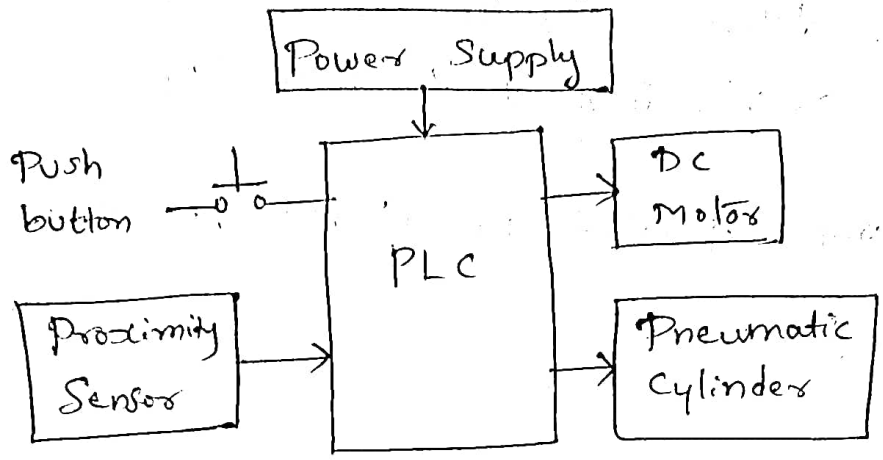
WEEK-8

How would you Setup Pneumatic Valves, actuators & Sensors to build automatic Stamping, labelling machine.



Block Diagram

→ Stamping labelling machine is an industrial equipment used for labelling products or packages with various information such as dates, batch numbers, barcodes or text details.

→ The System is automated & Controlled by PLC.

→ The process is started using push button. DC motor is used to run the Conveyor belt.

→ place the object to be Printed on the Conveyor belt. When the Product reaches the Stamping base, IR Sensor will detect the object which will indicate a signal to PLC to Stop the Conveyor motor. and start the Stamp motor.

→ The stamp mounted on the Pneumatic cylinder is activated with the help of Solenoid valve which initiates Stamping Process.

→ After printing is done stamp motor will stop. Conveyor motor will start again & then next object will landed on the Conveyor belt & that will be detected by IR Sensor and the proces will continue to print the next object.

→ Final stamped product is counted & collected in the tray.

Analyze the Importance/Need of Robotics in Automation Industries

→ Robot is a re-programmable manipulator performs series of tasks automatically.

→ Robotics plays a crucial role in automation industries by enhancing efficiency, precision & safety.

→ Robots can perform repetitive tasks with consistency, reducing human error & increasing productivity.

→ Robots can work in hazardous environments, minimizing the risk to human workers.

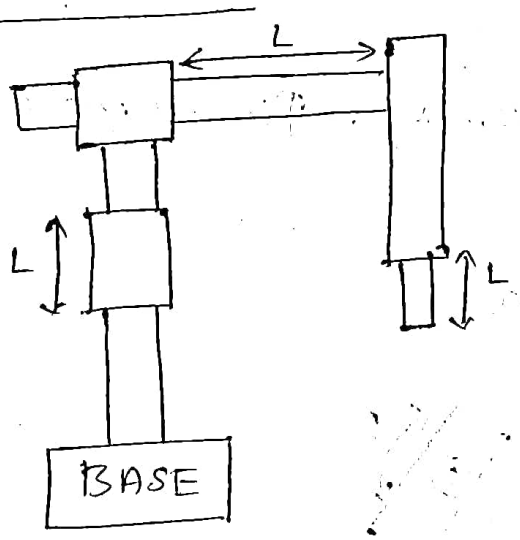
→ Integration of robotics leads to improved production speed, cost-effectiveness & overall competitiveness for automation industries.

Types of Robots used in Automation Industries

Types of industrial Robots

* Cartesian Robots
* Articulated —11—
* SCARA —11—
* Delta —11—
* Mobile —11—
* Automated Guided Vehicle (AGV)
* Cobots.

Cartesian Robot



→ Also called Gantry robots or linear robots or XYZ robots.

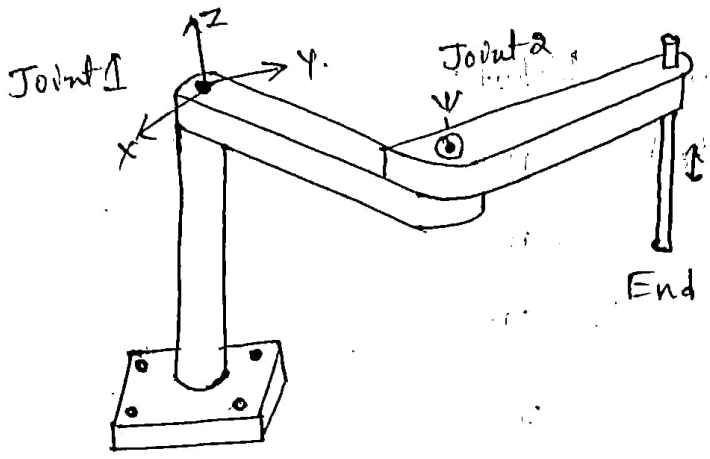
→ provides linear movement in X, Y & Z axes (up & down, in & out, side to side)

→ Carry high payloads.

→ Used in Pick & place, loading & unloading, material handling, CNC machines & 3D Printing.

SCARA Robot

→ Selective Compliance Assembly Robot Arm.

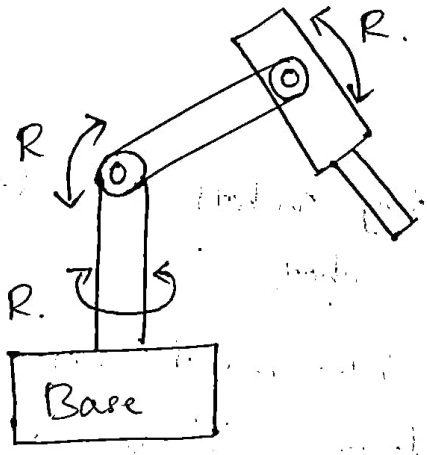


→ provides both linear (Z – direction) & Rotary (X-Y) motion.

→ faster & more precise than Cartesian robots.

→ Used in Assembly, Pick & place applications

Articulated Robot



→ Structure of Articulated Robot is Similar to human arm.

→ Rotary joints in the articulated robots range from 2 to 10.

→ More flexibility (greater degree of motion)

→ Assembly & welding applications.

Delta/parallel Robot

→ Robot arms have Concurrent prismatic or Rotary joints.

→ Used in high speed pick & place applications like packaging & sorting.

Collaborative Robots (Cobots)

→ Robots designed to work alongside humans, facilitating interaction & cooperation in tasks.

Types of sensors Used in Industrial Robots.

* Cameras – Visual perception & Object Recognition
* LiDAR → to create 3D maps & obstacle detection
* Ultrasonic – for measure distance & obstacle detection
* Infrared – to detect heat & measure distance.
* Touch Sensor – detecting physical Contact
* Force Sensors – Measuring pressure & detecting Collisions.
* Gyroscope – detecting & measuring changes in Orientation
* Accelerometer – to measure Changes in Speed & movement
* Magneto meter – to detect magnetic fields to navigate the robot.

Work Volume

→ The work volume of a robot refers to the space within which the robot can operate perform its tasks.

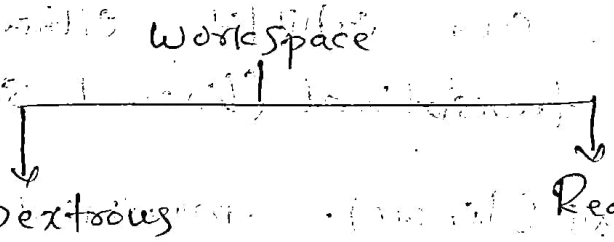
→ It is determined by its physical configuration, size and range of its arm & joints.

→ The work volume is described interms of x, y & z coordinates

x-axis : Horizontal movement from side to side.

y-axis : Horizontal movement ~~from~~ back & forth

z-axis :- Vertical movement up & down.



Dextrous WorkSpace

It is the volume of space, which the robot's end effector can reach with various orientations

Reachable WorkSpace

It is the volume of space that the end effector can reach with one orientation.

→ The shape of the work volume depends on the robot's kinematics.

→ Work volumes can vary based on robot's design, the number of joints, lengths of the robot's arms.

→ It's crucial to consider the work volume when planning & programming robotic tasks to ensure that the robot can reach & manipulate objects within its designed space.

Degrees of Freedom (DOF)

→ Degrees of Freedom (DoF) in a robot refer to the number of independent movements that the robot can exhibit either in a rotational or translational (linear) sense.

→ Translational DOF (linear) — movement along a straight line in X, Y or Z axis

→ Rotational DoF (Angular) — Rotation around an axis (X, Y or Z)

→ Radial DoF — Spherical movement. It allows the end effector to reach different points in 3D space.

→ Arm & Body motion.
  * Vertical motion
  * Radial motion
  * Rotational motion

→ Wrist motion
- Wrist rotation movement
- Wrist bend.

→ Robotic arm with six joints can have six degrees of freedom, allowing it to move in six independent ways.

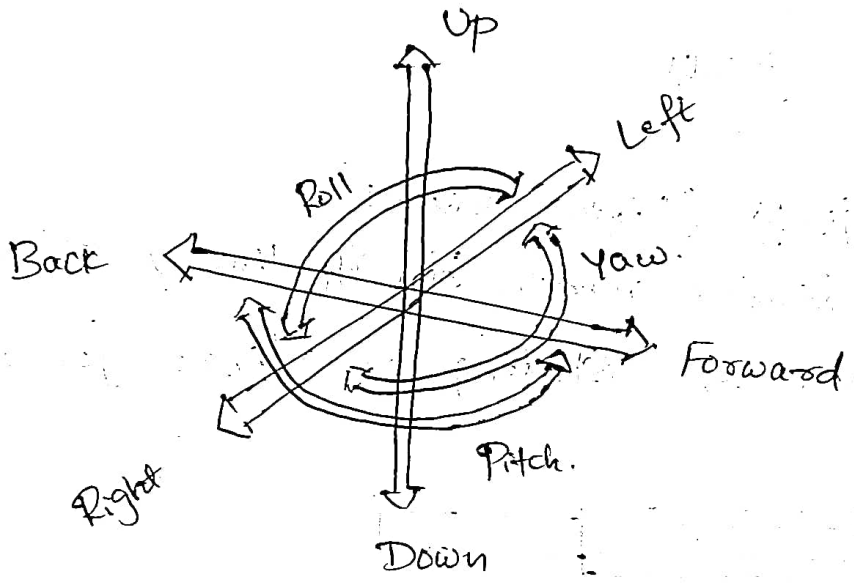


Fig:- 6- Degree of Freedom

1. Moving up & down (Heaving)
2. Moving left & right (Swaying)
3. Moving forward & back (Surging)
4. Tilting up & down (Pitching)
5. Tilting left & right (Yawing)
6. Tilting side to side (Rolling)

Types of Joints in a Robot

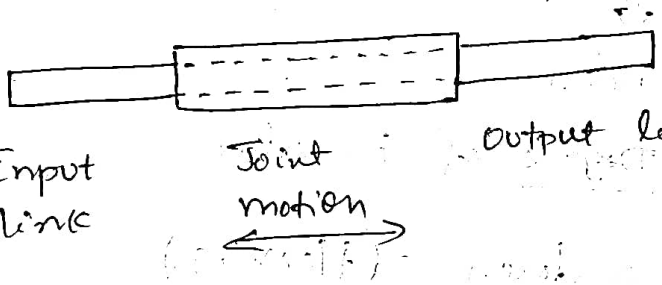
A robot joint is a mechanism that permits relative movement b/w parts of a robot arm.

Depending on the nature of relative motion joints are classified as

* Prismatic joints
* Revolute joints.

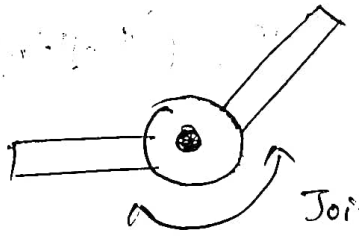
Prismatic joints (Linear Joint-L)

→ provides linear motion. b/w i/p link & o/p link
→ Also called as sliding or linear joints



Revolute joints

→ Pair of links rotates about fixed axes.

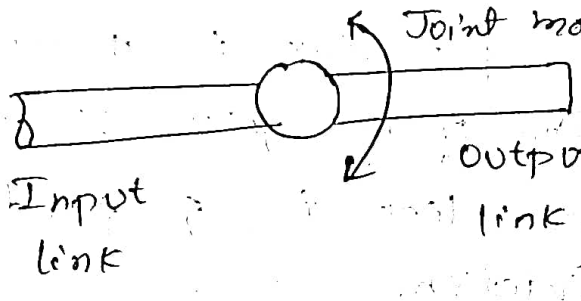


Revolute joint

Variations of revolute joints

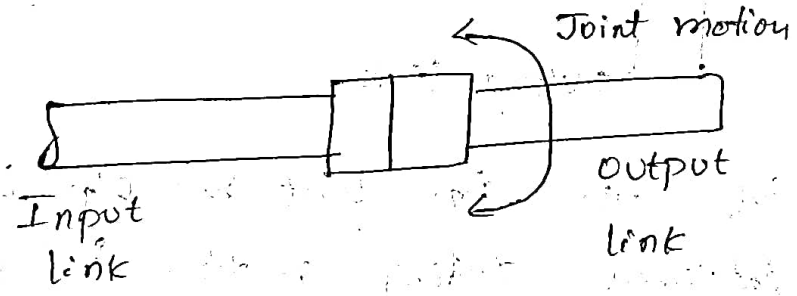
* Rotational joint (R)
* Twisting joint (T)
* Revolving joint (V)

Rotational Joint (R)



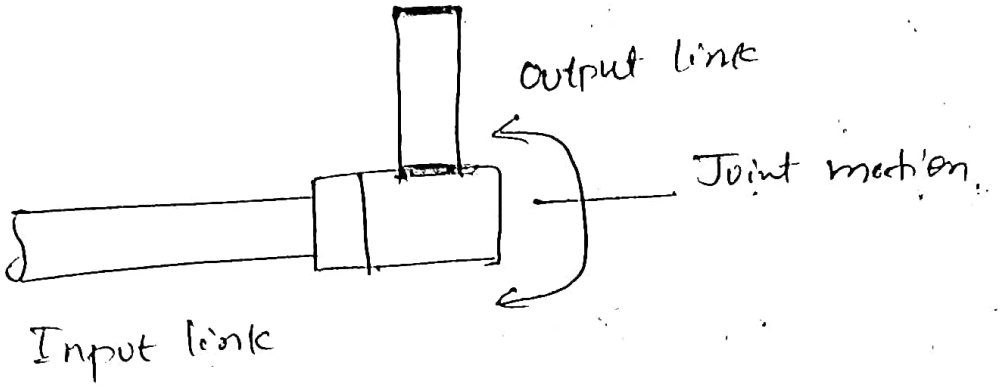
R Joint provides rotational motion, with the axis of rotation perpendicular to the axes of i/p & o/p links.

Twisting Joint (T)



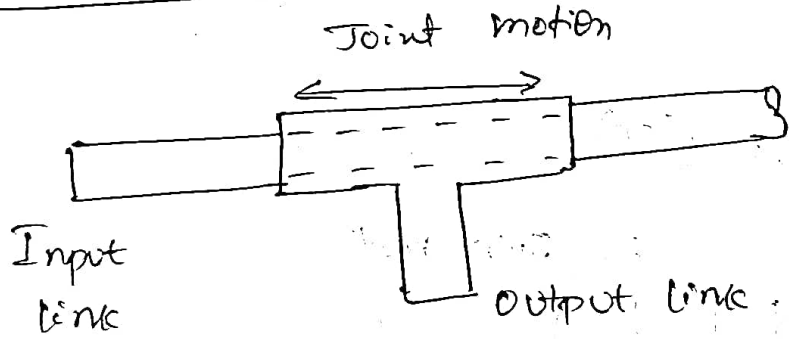
T Joint provides rotary motion but the axis of rotation is parallel to the axes of the two links.

Revolving Joint (V)



The axis of the input link is parallel to the axis of rotation of the joint & the axis of the output link is perpendicular to the axis of rotation.

Orthogonal Joint (O)



Movement b/w the i/p link & o/p link is a translational sliding motion but the output link is a perpendicular to the input link.

Types of Grippers

* Vaccume grippers
* Pneumatic —"—
* Hydraulic —"—
* Electric —"—
* Magnetic —"—

Vaccume Grippers

→ Vaccume grippers use atmospheric pressure to lift, move or hold objects.

→ Vaccum is created by compressed air driven pumps.

→ Used in packaging & palletizing.

Pneumatic Grippers

→ Use pistons & Compressed air to operate fingers (jaws).

→ found in 2 or 3-finger Configuration.

→ Used in CNC machines

Hydraulic Grippers

→ Powered by hydraulic fluids

→ Gripping Power is more than Pneumatic grippers

→ Suitable for Heavy duty applications.

Electric Grippers

→ Uses an electric motor to control the grippers fingers.

→ popular choice for machine tending & pick & place applications.

→ Gripping power is less compared to hydraulic but it can be used in high speed pick & place applications.

Magnetic Grippers

→ Configured by Permanent magnets or electromagnets.

→ Permanent magnets, don't need external supply for grasping but electromagnets need a DC Power & a Controller to grasp magnetic objects.

Criteria for selection of the right robot gripper

The factors to be considered while selecting a robot grippers are

* Gripper force – weight of the object, method of holding, speed during motion, friction b/w fingers

* Power & Signal transmission
  - Pneumatic
  - Electric
  - Hydraulic

* Part to be handled
  - weight
  - Size
  - Shape.

* What type of items
  - food stuffs
  - Electrical Components etc.

* Will the gripper be handling single item or mix?

* Operating environment
  - light Spaces
  - Humidity
  - Dirt environment.

* Positioning -

length of grippers

tolerance of the part size.

* The feedback data from the gripper is required or not is to be considered.