

Robotics

Robot is defined as "a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks"

Robots designed for industrial purposes are called **industrial robots**

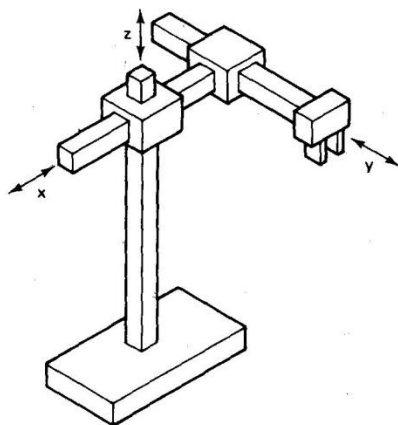
An **industrial robot** is a manipulator designed to move materials, parts and tools, and perform a variety of programmed tasks in manufacturing and production settings.

Classification of Robots based on their configuration

Robots may be classified based on their physical configuration as follows

1. Cartesian or rectangular co-ordinate configuration robots
 2. Polar or Spherical configuration robots
 3. Cylindrical configuration robots
 4. Articulating or jointed-arm configuration robots
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Cartesian or rectangular co-ordinate configuration robots



Cartesian robot is formed by 3 prismatic joints, whose axes are coincident with the X, Y and Z planes. In the Cartesian coordinate configuration shown in figure, the three orthogonal directions are X,Y and Z. X-coordinate axis may represent left and right motion; Y- coordinate axis may describe

forward and backward motion; Z-coordinate axis may be used to represent up and down motions. The manipulator can reach any point in a cubic volume of space. It allows three DOFs (x, y, z) in translation only.

Advantages:

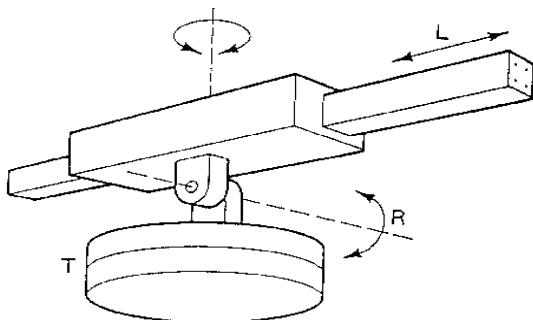
- 1) 3 linear axes.
- 2) Easy to visualize, ability to do straight line insertions into furnaces.
- 3) Most rigid structure for given length.
- 4) Easy computation and programming.

Disadvantages:

- 1) Can only reach front of it.
- 2) Requires large floor space.
- 3) Axes hard to seal.

Applications: Pick and Place operations, Assembly and Sub-Assembly (Mostly Straight), automated loading CNC Lathe and Milling operations, Nuclear Material handling, Welding etc.

Polar or Spherical configuration robots



In the Spherical coordinate configuration shown in figure, the robot has one linear and two angular motions.

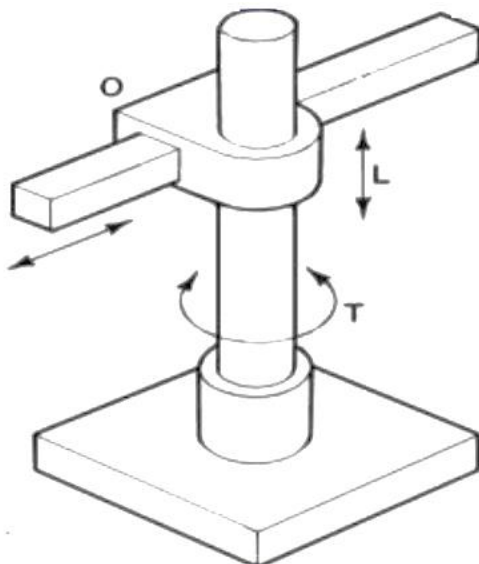
Advantages:

- 1) 1 linear + 2 rotating axes.
- 2) Large working envelopes.

Disadvantages:

- 1) Can't reach around obstacles.
- 2) Low accuracy.
- 3) Complex coordinates more difficult to visualize, control, and program.

Applications: Die Casting, Dip Coating, Forging, Glass Handling, Heat Treating, Injection Moulding, Machine Tool Handling, Material Transfer, Parts cleaning, Press Loading etc.

Cylindrical configuration robots

Cylindrical robot is able to rotate along his main axes forming a cylindrical shape. In the cylindrical coordinate configuration shown in figure, Consists of a vertical column, relative to which an arm assembly is moved up or down. The arm can be moved in or out relative to the column.

Advantages:

- 1) 2 linear axes +1 rotating.
- 2) Can reach all around itself.
- 3) Reach and height axes rigid.
- 4) Rotational axis easy to seal.

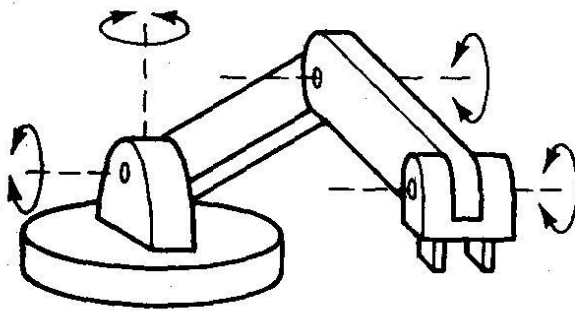
5) Relatively easy programming.

Disadvantages:

- 1) Can't reach above itself.
- 2) Base rotation axis as less rigid.
- 3) Linear axes are hard to seal.
- 4) Won't reach around obstacles.

Applications: Assembly, Coating Applications, Conveyor Pallet Transfer, Die Casting, Forging Applications, Inspection Moulding, Investment Casting, Machine Loading and Unloading etc.

Articulating or jointed-arm configuration robots



Jointed arm Configuration robots are mechanic manipulator that looks like an arm with at least three rotary joints. The workspace of an articulated arm is complex, often a three dimensional crescent. With all joints revolute, this type of robot requires the most complex kinematic calculations.

Advantages:

- 1) All rotary joints allows for maximum capacity.
- 2) Any point in total volume can be reached.
- 3) All joints can be sealed from the environment.

Disadvantages:

- 1) Extremely difficult to visualize, control, and program.

2) Low accuracy.

Applications: Assembly operations, Welding, Spray painting, Weld sealing etc.

Applications of Robots

1. Industrial robots – These robots bring into play in an industrialized manufacturing atmosphere. Typically these are articulated arms particularly created for applications like- material handling, painting, welding and others. If we evaluate merely by application then this sort of robots can also consist of some automatically guided automobiles and other robots.

2. Domestic or household robots – Robots which are used at home. This sort of robots consists of numerous different gears for example- robotic pool cleaners, robotic sweepers, robotic vacuum cleaners, robotic sewer cleaners and other robots that can perform different household tasks. Also, a number of scrutiny and tele-presence robots can also be considered as domestic robots if brought into play in that sort of environment.

3. Medical robots – Robots employed in medicine and medicinal institutes. First & foremost surgical treatment robots. Also, a number of robotic directed automobiles and perhaps lifting supporters.

4. Service robots – Robots that cannot be classed into any other types by practice. These could be various data collecting robots, robots prepared to exhibit technologies, robots employed for research, etc.

5. Military robots – Robots brought into play in military & armed forces. This sort of robots consist of bomb discarding robots, various shipping robots, exploration drones. Often robots at the start produced for military and armed forces purposes can be employed in law enforcement, exploration and salvage and other associated fields.

6. Entertainment robots – These types of robots are employed for entertainment. This is an extremely wide-ranging category. It begins with model robots such as robosapien or the running photo frames and

concludes with real heavy weights like articulated robot arms employed as movement simulators.

7. Space robots – I would like to distinct out robots employed in space as a split apart type. This type of robots would consist of the robots employed on Canadarm that was brought into play in space Shuttles, the International Space Station, together with Mars explorers and other robots employed in space exploration & other activities.

8. Hobby and competition robots – Robots that is created by students. Sumo-bots, Line followers, robots prepared merely for learning, fun and robots prepared for contests.

9. Repetitive operations: such as placing a hot block on table of press by pick up and correct placing as the robot can repeat these functions which are very simple and easy, where as human effort is subjected to fatigue, monotonous.

10. Hazardous environment: Movements of unsafe, unhealthy or uncomfortable actions are potential use of a robot. For example, loading fuel rods into nuclear reactor core or loading and unloading material into and out of a hot furnace or spray painting or spot welding.

11. Handling hot or heavy jobs: such as transferring, positioning heavy jobs on the machines, hot forging or furnace loading

Advantages of robots

Robots can carry out simple and repetitive work for human beings.

1. Robots do not take rest and so can work continuously for a longer period. The productivity is raised.
2. They can be used in assembly work with high precision and density. The quality of products is enhanced.
3. Robots can replace workers without laboring cost, and robots can achieve stable production rate as robots will not be late to work, resign, take day off or strike.

4. The program can be modified easily so robots can increase the flexibility in manufacturing.
 5. They can work in unfavourable circumstances, e.g. removing the high-temperature artifact from a casting machine, welding task, spraying task, transportation of chemicals, etc., such work will affect the health of the workers.
 6. The manufacturing speed can be increased and the cost be reduced when robots are used.
 7. Using robots may minimize the wasting of materials.
 8. Using robots can improve the quality of a product by its ability to assemble precise components.
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Disadvantages of robots

1. Very high initial cost
 2. Needs skilled programmers
 3. Leads to loss due to operational and technical problems
 4. Robots are suitable only for large mass production industries
 5. High maintenance cost
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