

Robotics

Robot → Reprogrammable, multifunctional tool designed to manipulate or move parts or devices through pre-programmed motions to perform various tasks.

Robotics → branch of study that deals with

Reasons a robot is required,

• hazard environment

APPLICATIONS OF ROBOTS!

↳ Most important

study and go

or

certain

deth.

Terms related to robot

1) Manipulation → arm-like mechanism designed to manipulate parts.

2) Joint → Integrates 2 or more links → controls motion between input and output link.

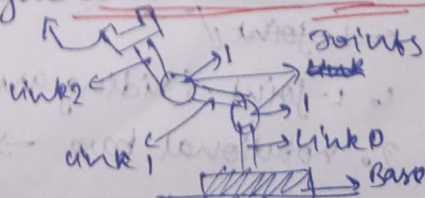
3) Link → rigid supports that connects 2 joints → Input → Output → effects

Robots

4) Degree of freedom → freedom of motion in 3D space.

5) End effectors: AKA end of the arm tool. → at the end of the robotic arm that is designed customized acc to its spec robot's application.

6) Base: support for the robot's arm.



Elements of a Robotic system

1) The Robot

↳ End of arm tooling

↳ manipulators → (base + arm) assembly.

↳ actuators → convert stored energy into movement
eg: ~~to~~ motors and linear actuators

↳ transmission elements → ball screws, pulleys, belts, gears

2) Control system

↳ controls → mechanical

→ pneumatic

→ hydraulic

→ electrical / electronic

} open loop (non-sens.) control
→ feedback control
→ feed forward control
→ adaptive control.

↳ sensors → piezoelectric sensors

◦ Electrochemical gas

◦ proximity sensors

◦ stress / strain.

◦ etc.

↳ equipment interfaces.

3) Computer systems: Programmable part → acc. to the task that needs performing

↳ req. necessary software.

4) Power source → electrical power source eg: lead-acid or re-
-ed battery.

Classification of Robots based on Robot configuration

↓
Polar

AKA

spherical
config.

↓
cylindrical

↓
Cartesian

AKA

rectilinear robot
AKA

XYZ robot.

↓
Joint arm

Polar Config

↳ 1. joint

↳ 1. joint (sliding arm) → actuated relative to the body

↳ 2. rotational base → along with a pivot → can rotate along about a horizontal axis
R (Joint) ← joint

S. and (T joint) \rightarrow vertical axis rotation.

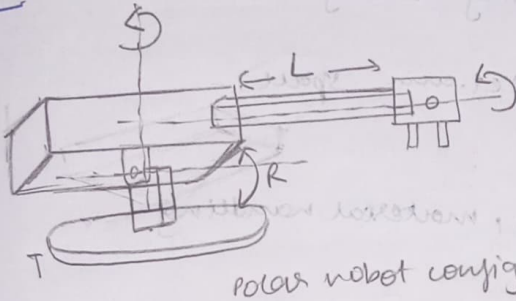
basically \rightarrow 1 ~~linear~~ linear + 2 rotary joints = spherical work volume.

eg: Unimate 2000 series robot.

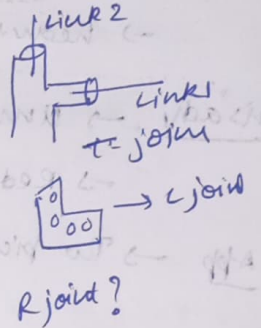
Adv \rightarrow long reach ~~relative~~ \rightarrow in horizontal position.

dis Adv \rightarrow vertical reach is low.

uses \rightarrow die casting, forging, ~~also~~ cleaning of parts.



polar robot config



Cylindrical config

1) slide in the horizontal post
column in vert. post.

L-joint \rightarrow used to move the arm up/down wrt column.

T-joint \rightarrow used to rotate the L-joint.

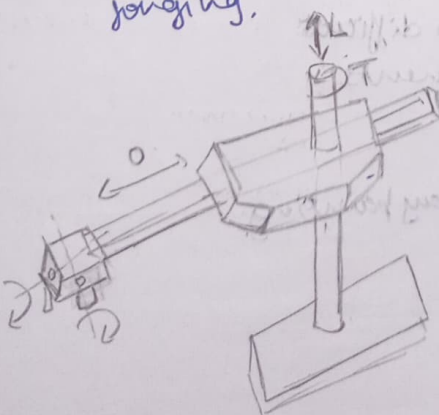
O-joint \rightarrow gives radial movement to the arm.

eg: Model 1A Robot GMF Robotics Corp.

Adv \rightarrow Rigidity \uparrow , robustness \uparrow
 \rightarrow high payload ability

disadv \rightarrow work volume less
 \rightarrow occupies more floor space.

Applic \rightarrow machine loading/unloading, foundry and forging.



Cylindrical config

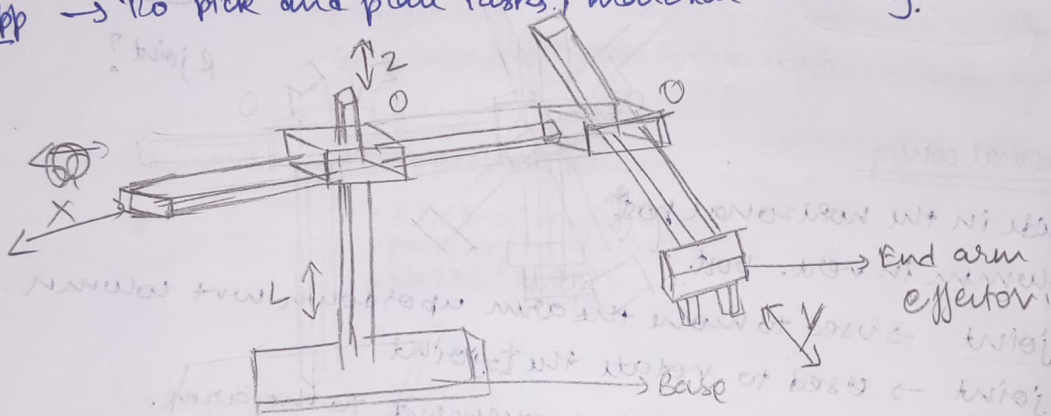
Cartesian Co-ordination Robot

- 3 sliding joints along X, Y, Z axes.
- 2 orthogonal joints.
- movement can stop/start simultaneously along X, Y and Z axes $\Rightarrow \therefore$ tool tip is smoother

Adv \rightarrow simplifies controls
 \rightarrow ~~stiff~~ rigidity \uparrow , accuracy \uparrow , repeatability \uparrow
 \rightarrow heavy payload carrying ability \rightarrow w.

disadv \rightarrow limited to small rect. area space.
 \rightarrow reduced flexibility.

App \rightarrow To pick and place tasks, material handling.



To

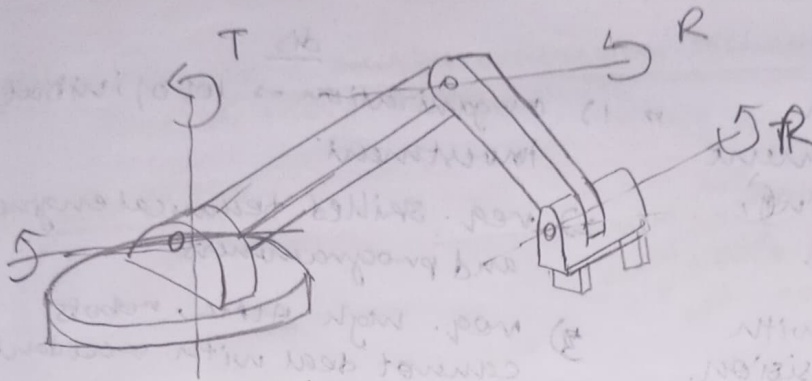
Joint Arm config

- Resembles human arm
- column swivels about base \rightarrow T-joint.
- column top + shoulder \rightarrow R-joint (now shoulder joint)
- shoulder + elbow \rightarrow R-joint (elbow joint)

Adv \rightarrow work volume $\uparrow\uparrow$
 \rightarrow quick operations
 \rightarrow ~~flexibility~~ flexibility $\uparrow\uparrow$

disadv \rightarrow operation procedures difficult
 \rightarrow more no. of components.
 \rightarrow expensive.

Application \rightarrow arc welding, spray painting.



Applications of Robots

1) Material and Part handling applications.

- 1) pick and place
- 2) palletizing → stack cartons onto a pallet at various posn
- 3) Depalletizing → unstack to diff plans
- 4) Stacking application
- 5) insertion application

2) Machine loading and unloading

- 1) Machine loading → used only to load the machine
eg: putting press work
- 2) " unloading → used only to load to
eg: plastic moulding and die casting
- 3) Machine loading & unloading eg: Machining operation

used for welding

Arc welding

- welded together by the heat generated by an electric arc
- continuous
- tough conditions to manually carry out
- end-effector: welding torch

Spot welding

- metal pieces are squeezed together between 2 electrodes
- ↓
- subjected to high current to form a joint at particular points

end-effector → spot welding gun

- robot has enough joints to approach spot out any angle
- difficult for manual robots

Spray coating

Advantages and dis. adv of robots

adv

- 1) replace humans in hazardous environment
• during arc welding, foundry etc.
- 2) large production with accuracy and precision.
- 3) ~~and~~ ~~consistency~~
- 3) consistency without breaks.
- 4) heavy payloads
- 5) tight small places where human reach isn't possible
• manholes
- 6) Better than fixed automation
• can be reprogrammed.
- 7) can be easily integrated to other computer systems

dis

- 1) organization → lot of initial investment
- 2) req. skilled technical engineers and programmers
- 3) req. high AIML, robots cannot deal with accidents or emergencies
- 4) Robots ^{req.} ~~have~~ very high precision parts → expensive