Robotics

Title: Types of Robots & Applications | ESP32

Learning Objectives

- Understand the main types of robots.
- Learn how robots are categorized based on motion, structure, and application.
- Explore real-world industrial and everyday applications.

Classification of Robots

Robots can be classified in multiple ways:

Based on Mobility

- Stationary Robots – Fixed in one place, usually industrial robotic arms.
- Mobile Robots – Can move in their environment.
    - Wheeled robots – Common for ground navigation (e.g., delivery bots).
    - Tracked robots – For rough terrains (military, rescue).
    - Legged robots – Humanoids, quadrupeds (Boston Dynamics Spot).

Based on Application

- Industrial Robots
    - Welding, painting, assembly, packaging.
- Service Robots
    - Vacuum cleaners, delivery bots, hospital assistants.
- Military Robots
    - Bomb disposal, surveillance, unmanned vehicles.
- Medical Robots
    - Robotic surgeries (Da Vinci system), rehabilitation aids.
- Exploration Robots
    - Mars rovers, underwater drones.

- Agricultural Robots
    - Automatic harvesting, crop monitoring.

Based on Control

- Manual Control – Remote controlled (via joystick, Bluetooth).
- Autonomous – Fully self-operating using sensors and AI.
- Semi-Autonomous – Mix of manual and autonomous (self-driving cars).

Kinematic Structure

- Open-loop Manipulator – No feedback, simple control.
- Parallel Manipulator – Multiple arms supporting a single platform.
- Hybrid Manipulator – Combination of both.

Based on Workspace Geometry

- Cartesian Robot – Moves along X, Y, Z (linear axes).
- Cylindrical Robot – Combines linear and rotary motion.
- Spherical Robot – Uses rotary joints for spherical workspaces.
- Articulated Robot – Robotic arm with multiple rotary joints.
- SCARA Robot – Selective Compliance Assembly Robot Arm (high-speed assembly).

Key Examples of Robot Types

- Humanoid – ASIMO by Honda, Sophia Robot.
- Quadruped – Boston Dynamics Spot.
- Autonomous Mobile Robot (AMR) – Warehouse robots (Amazon).
- Aerial Drone – DJI Phantom for photography.
- Underwater Robot – Used for ocean exploration.

Industrial Applications

- Automotive – Welding robots, painting arms.
- Electronics – PCB assembly.
- Food Industry – Packaging and sorting.
- Pharmaceuticals – Medicine dispensing, lab automation.

Robots in Daily Life

- Cleaning robots (Roomba).
- Delivery robots (Swiggy pilot bots).
- Personal assistants (Alexa-powered robots).
- Robotic lawnmowers.

Diagram: Types of Robots (Hierarchy)

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Robots
│
├── Based on Mobility
│    ├── Stationary
│    └── Mobile (Wheeled, Tracked, Legged)
│
├── Based on Application
│    ├── Industrial
│    ├── Service
│    ├── Medical
│    ├── Military
│    └── Exploration
│
└── Based on Workspace geometry
     ├── Articulated
     ├── SCARA
     ├── Cartesian
     └── Cylindrical
```
