

## 0.1 Overview of different types of robots

Robotics is a diverse field that encompasses a wide range of machines designed to perform tasks autonomously or semi-autonomously. Robots can be classified based on their structure, application, mobility, and control mechanisms. Below is a detailed breakdown of the different types of robots commonly used in industry, research, and everyday applications.

---

### 0.1.1 Classification by Mobility

One of the most fundamental ways to categorize robots is based on how they move and interact with their environment.

**0.1.1.1 Stationary Robots (Fixed Robots):** These robots are anchored in place and perform tasks within a limited workspace. They are primarily used in industrial settings and rely on precise control systems.

- **Robotic Arms** – The most common type of stationary robot, used in manufacturing for welding, painting, assembly, and material handling. Examples include the **ABB IRB series** and **Fanuc robotic arms**.
- **SCARA Robots (Selective Compliance Articulated Robot Arm)** – Specialized for high-speed pick-and-place tasks, common in electronics manufacturing.
- **Delta Robots (Parallel Robots)** – Used for high-speed sorting and packaging in food and pharmaceutical industries.

**0.1.1.2 Mobile Robots:** Unlike stationary robots, mobile robots can move freely in their environment. They are equipped with wheels, tracks, legs, or even flight capabilities.

**Wheeled Robots:** Wheeled robots are among the most common mobile platforms due to their efficiency and simplicity.

- **Differential Drive Robots** – Use two independently controlled wheels for movement, like the **TurtleBot** or **Roomba** vacuum cleaner.
- **Omnidirectional Robots** – Equipped with mecanum or omnidirectional wheels, allowing movement in any direction without turning, used in logistics and soccer robots.

- **Self-Balancing Robots** – Utilize gyroscopes and accelerometers for balance, such as the **Segway** or the **NASA's Robonaut**.

### **Tracked Robots**

- **Tank-like robots with caterpillar tracks** – Used for rough terrain, such as bomb disposal robots (*PackBot* by iRobot) and planetary rovers (*Curiosity* and *Perseverance*).

**Legged Robots:** Designed for navigating complex environments where wheels are ineffective.

- **Bipedal Robots** – Humanoid robots like **Boston Dynamics' Atlas** or **Honda's ASIMO**.
- **Quadrupedal Robots** – Four-legged robots used for search and rescue, such as **Spot by Boston Dynamics**.
- **Hexapods and Multi-legged Robots** – Used for stability and adaptability in hazardous environments.

**Aerial Robots (Drones, UAVs):** Flying robots designed for surveillance, mapping, and delivery services.

- **Quadcopters and Multirotors** – Used for aerial photography, military reconnaissance, and package delivery (*DJI Phantom*, *Amazon Prime Air*).
- **Fixed-Wing Drones** – Longer flight times for mapping and agriculture (*Parrot Disco*, *NASA's UAVs*).
- **Hybrid VTOL Drones** – Combine the advantages of quadcopters and fixed-wing aircraft.

**Underwater Robots (ROVs and AUVs):** Submersible robots for underwater exploration, maintenance, and research.

- **Remotely Operated Vehicles (ROVs)** – Controlled via tethered cables, used for underwater inspections (*Deep Discoverer*).
- **Autonomous Underwater Vehicles (AUVs)** – Capable of autonomous navigation for ocean mapping (*Bluefin-21* used in MH370 search).

---

### **0.1.2 Classification by Application**

Different industries require specialized robots optimized for their specific tasks.

**0.1.2.1 Industrial Robots** Used in manufacturing and automation.

- **Assembly Line Robots** – Perform repetitive tasks with high precision (*KUKA, Fanuc, ABB robotic arms*).
- **CNC and 3D Printing Robots** – Convert digital designs into physical objects using subtractive or additive manufacturing.

**0.1.2.2 Service Robots** Designed to assist humans in daily tasks.

- **Household Robots** – Vacuum cleaners (*Roomba*), lawn mowers, personal assistants (*Amazon Astro*).
- **Medical Robots** – Used in surgery (*Da Vinci surgical robot*), rehabilitation, and diagnostics.

**0.1.2.3 Military and Defense Robots** Used for surveillance, reconnaissance, and combat.

- **Unmanned Ground Vehicles (UGVs)** – Explosive ordnance disposal (*Talon, PackBot*).
- **Autonomous Combat Robots** – Armed drones (*MQ-9 Reaper*).

**0.1.2.4 Space Exploration Robots** Robots designed for planetary exploration and maintenance.

- **Rovers** – Used for planetary exploration (*Curiosity, Perseverance*).
- **Autonomous Satellites** – Repair and maintenance (*DARPA's Robotic Servicing Program*).

**0.1.2.5 Agricultural and Environmental Robots** Designed for precision farming and environmental monitoring.

- **Autonomous Tractors** – Used in precision agriculture (*John Deere's autonomous farming*).
- **Pollination Robots** – Artificial bee drones for pollination (*Harvard's RoboBee*).

---

**0.1.3 Classification by Intelligence and Autonomy**

Robots can also be categorized by their level of intelligence and autonomy.

**0.1.3.1 Pre-Programmed Robots** Follow predefined instructions with minimal real-time adaptation (*CNC machines*).

**0.1.3.2 Teleoperated Robots** Controlled remotely by humans (*surgical robots, bomb disposal robots*).

**0.1.3.3 Autonomous Robots** Use AI and sensors to make decisions (*self-driving cars, warehouse robots*).

**0.1.3.4 Collaborative Robots (Cobots)** Designed to work safely alongside humans (*Universal Robots' cobots*).

---

#### **0.1.4 Conclusion**

Robots come in many forms, each optimized for different environments and applications. While industrial robotic arms dominate automation, mobile robots are rapidly expanding into logistics, exploration, and personal assistance. The future of robotics will likely see even more integration of AI, making robots more adaptive and capable in complex environments.