

Classification of Robot

- Robots can be classified based on their method of locomotion. There are primarily four types:
 1. Wheeled Robots: These robots move on wheels and are suitable for flat surfaces like floors and roads. They are widely used in industries, homes, and offices for tasks such as material handling and cleaning.
 2. Legged Robots: Inspired by animals, legged robots use legs for locomotion. They can navigate complex terrains and are commonly employed in search and rescue missions, exploration, and military applications.
 3. Flying Robots (Drones): Equipped with rotors or wings, flying robots can hover, fly, and navigate through the air. Drones have diverse applications, including aerial photography, surveillance, and delivery services.
 4. Swimming Robots: Designed to operate underwater, swimming robots are used in marine exploration, oceanography, and underwater inspections.

- Robots can also be classified based on their intended applications. Let's explore some common categories:
 1. Industrial Robots: These robots are employed in manufacturing and production lines to automate repetitive tasks, increasing efficiency and precision. They can handle tasks such as welding, painting, and assembly.
 2. Medical Robots: Medical robots assist healthcare professionals in surgeries, rehabilitation, and diagnosis. They offer improved precision and enable minimally invasive procedures.
 3. Service Robots: Service robots are designed to interact with humans and provide various services. Examples include domestic robots for cleaning and assistance, as well as robots in hospitality and customer service.
 4. Exploration Robots: These robots are utilized in space missions, deep-sea exploration, and other hazardous environments, where human presence is difficult or dangerous.

- Robots can be categorized based on their level of autonomy:
 1. Manual Robots: These robots require continuous human control and guidance to perform tasks. They lack decision-making capabilities and are limited to pre-programmed actions.
 2. Semi-Autonomous Robots: Semi-autonomous robots can perform certain tasks independently but still rely on human intervention for complex decision-making.
 3. Fully Autonomous Robots: These robots can operate independently without human intervention. They utilize advanced sensors, artificial intelligence, and algorithms to adapt to changing environments and execute tasks efficiently.

- According to the **Japanese Industrial Robot Association (JIRA)**, robots can be classified as follows:
- *Class 1: manual handling device* – a device with several DOF's actuated by the operator.
- *Class 2: fixed sequence robot* – similar to fixed automation.
- *Class 3: variable sequence robot* – similar to programmable automation.
- *Class 4: playback robot* – the human performs tasks manually to teach the robot what trajectories to follow.
- *Class 5: numerical control robot* – the operator provides the robot with the sequence of tasks to follow rather than teach it.
- *Class 6: intelligent robot* – a robot with the means to understand its environment, and the ability to successfully complete a task despite changes in the surrounding conditions where it is performed

Classification of Robot II AFR

- *Type A:* Handling Devices with manual control
- *Type B:* Automatic Handling Devices with predetermined cycles
- *Type C:* Programmable, servo controlled robots
- *Type D:* Type C with interactive with the environment

Robotics: Present Status and Future Trends

- Robotics has made significant strides across industries, bringing about transformations in manufacturing, healthcare, transportation, and more.
- Key achievements include increased automation, improved precision, and enhanced safety in various sectors.

Industrial Robotics:

- In manufacturing, robots have revolutionized assembly lines and production processes, leading to higher efficiency and quality.
- Collaborative robots (cobots) are working alongside humans, enhancing productivity and worker safety

Service Robotics:

- In the service sector, robots are being deployed in healthcare, hospitality, and customer service.
- Robots assist in caregiving, patient monitoring, and even conducting mundane tasks, providing support and relief to humans.

Robotics in Daily Life:

- Robotics has entered our homes with smart appliances, robotic vacuums, and AI-powered personal assistants, making our lives more convenient and efficient.

Advancements in AI and Robotics:

- Artificial Intelligence (AI) is a driving force behind the rapid progress in robotics.
- AI enables robots to learn from data, adapt to new situations, and make decisions, leading to more intelligent and versatile machines

Future Trends in Robotics

1. Soft Robotics:

- Soft robots, inspired by natural organisms, offer flexibility and adaptability, making them suitable for delicate tasks and human interaction.
- Applications include medical devices, search and rescue missions, and exploration of challenging environments.

2. Swarm Robotics:

- Swarm robots operate collectively, mimicking the behavior of social organisms like ants and bees.
- They can work collaboratively to accomplish tasks efficiently, from cleaning up oil spills to exploring hazardous areas.

3. Biohybrid Systems:

- Biohybrid robots integrate biological components, such as living tissues or cells, with artificial structures.
- This opens up possibilities for advanced medical treatments, bio-sensing, and environmental monitoring.

4. Robotics in Medicine:

- In the future, robots will play a more significant role in surgery, assisting surgeons with precise procedures and minimal invasiveness.
- Nanorobots may be used for targeted drug delivery within the body, revolutionizing healthcare treatments.

5. Robotics in Exploration:

- Robots will continue to expand their presence in space exploration, assisting astronauts, conducting experiments, and exploring distant planets and moons.

Kinematics Systems in Robotics

- Kinematics is the study of motion, particularly the position, velocity, and acceleration of objects without considering the forces causing that motion.
- In robotics, kinematics deals with understanding the movement of robot limbs, joints, and end-effectors without focusing on the forces involved.

Types of Kinematics Systems

- Forward Kinematics: This type deals with calculating the end-effector's position and orientation based on the joint angles of the robot.
- Inverse Kinematics: This type is the reverse of forward kinematics, where we determine the joint angles required to reach a specific end-effector position and orientation.
- Differential Kinematics: It involves understanding the relationship between joint velocities and the end-effector's linear and angular velocities.
- Statics/Dynamics: Kinematics can be further classified into statics (studying motion at constant velocities) and dynamics (involving motion with acceleration).

Importance of Kinematics Systems in Robotics

- **Precise Motion Control:** Kinematics enable robots to move accurately and efficiently, crucial for tasks requiring precision and repeatability.
- **Path Planning:** Understanding kinematics aids in devising optimal paths for robots to follow, avoiding obstacles and collisions.
- **Real-Time Applications:** Kinematics helps in real-time adjustments of robot movements, making them adaptable to varying environments.
- **Manipulation and Grasping:** Kinematics is vital in designing robotic arms capable of manipulating objects with dexterity and stability

Applications of Kinematics Systems

- Manufacturing: Robots with kinematics systems find extensive use in assembly lines, welding, and material handling tasks.
- Medical Robotics: Surgical robots rely on precise kinematics for performing complex procedures with enhanced accuracy.
- Autonomous Vehicles: Kinematics is employed in designing path-planning algorithms for autonomous cars and drones.
- Entertainment Industry: Animatronics and robotic characters in movies and amusement parks utilize kinematics to achieve lifelike movements.

