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HUMANOID

Introduction

Robots that closely resemble humans in appearance and are equipped with a variety of cutting-edge technology are known as humanoids. Humanoid robots have the potential to revolutionise a number of industries, from manufacturing and personal support to healthcare and entertainment, thanks to their resemblance to humans and their capacity for complex jobs. These robots can navigate challenging settings, communicate with people, and imitate human expressions and movements because to their articulated limbs, advanced sensors, and artificial intelligence systems.

HISTORY

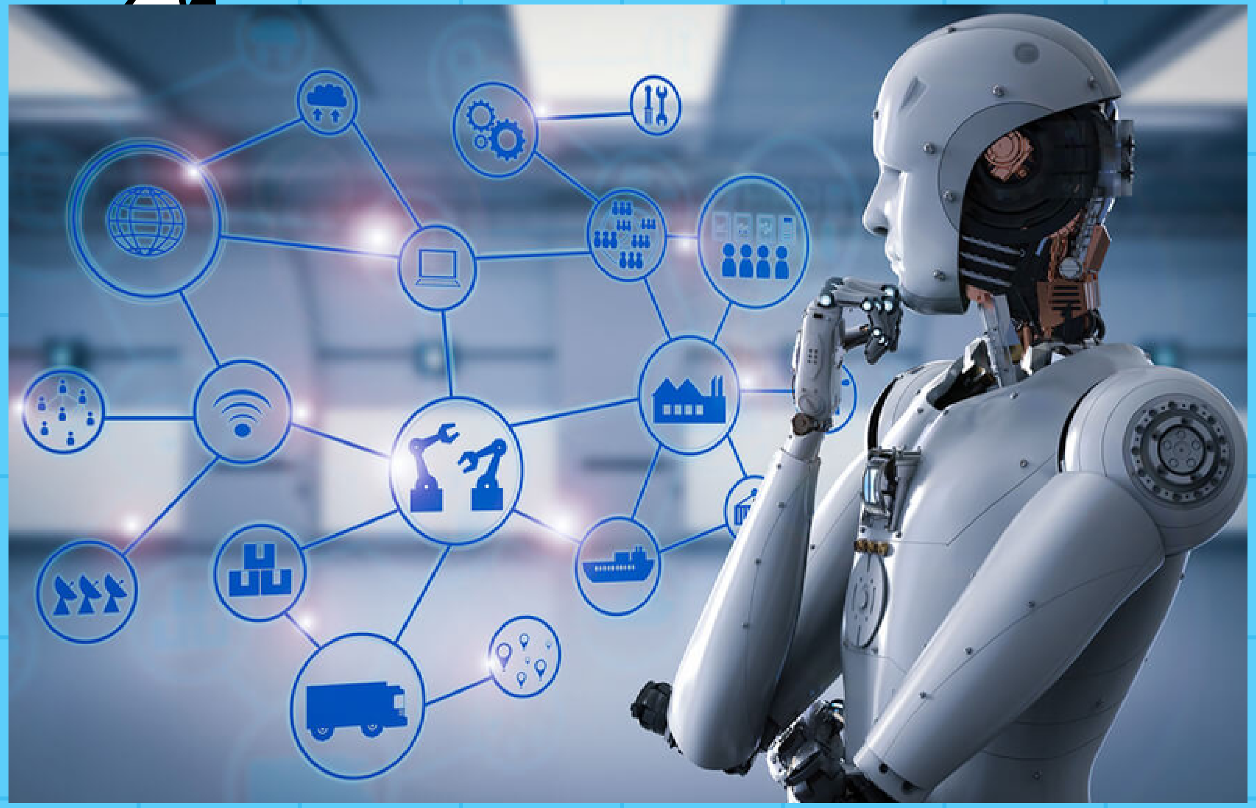
The history of humanoid robots stretches back several decades and has been influenced by various scientific, technological, and cultural developments. Here is an overview of the significant milestones in the history of humanoid robots:

1. **Early Concepts (1920s-1940s):**
   - **Czech writer Karel Čapek introduced the term "robot" in his play "R.U.R." (Rossum's Universal Robots) in 1920, featuring human-like machines.**
   - **Leonardo Torres Quevedo, a Spanish engineer, created the first humanoid chess-playing automaton called "El Ajedrecista" in 1914.**

1. **WABOT Project (1960s-1970s):**
   - **WABOT-1, developed by Ichiro Kato at Waseda University in Japan, was the world's first full-scale humanoid robot. It stood 1.5 meters tall and was capable of basic movements.**

1. **ASIMO (2000s-2018):**
   - **ASIMO, developed by Honda, made its debut in 2000. It was designed to be a versatile, autonomous humanoid robot capable of interacting with humans and navigating its environment.**
   - **ASIMO could walk, run, climb stairs, recognize faces, and perform tasks such as carrying objects and pouring drinks.**

APPLICATION



Assistance and Caregiving	Education and Research	Customer Service and Hospitality
Manufacturing and Industry	Entertainment and Media	Healthcare and Rehabilitation

Body Design (Humanoid)

Overall Structure

Humanoid robots typically have a bipedal structure, with two legs and a torso that houses various internal components such as processors, sensors, and batteries. The body structure is designed to provide stability, balance, and mobility.

Limbs

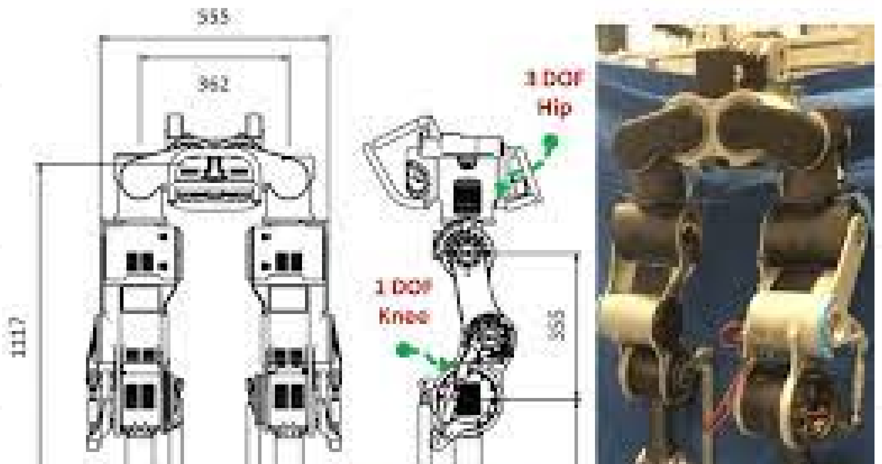
Humanoid robots have two arms with multiple joints, including shoulder, elbow, and wrist joints. The limbs are designed to have a wide range of motion and dexterity, allowing the robot to perform tasks that require precise movements and manipulation.

Hands and Grippers

The hands of humanoid robots are crucial for interacting with objects and the environment. They may be equipped with fingers that can individually move and grasp objects, similar to a human hand. Some humanoid robots also have specialized grippers or tools designed for specific tasks.

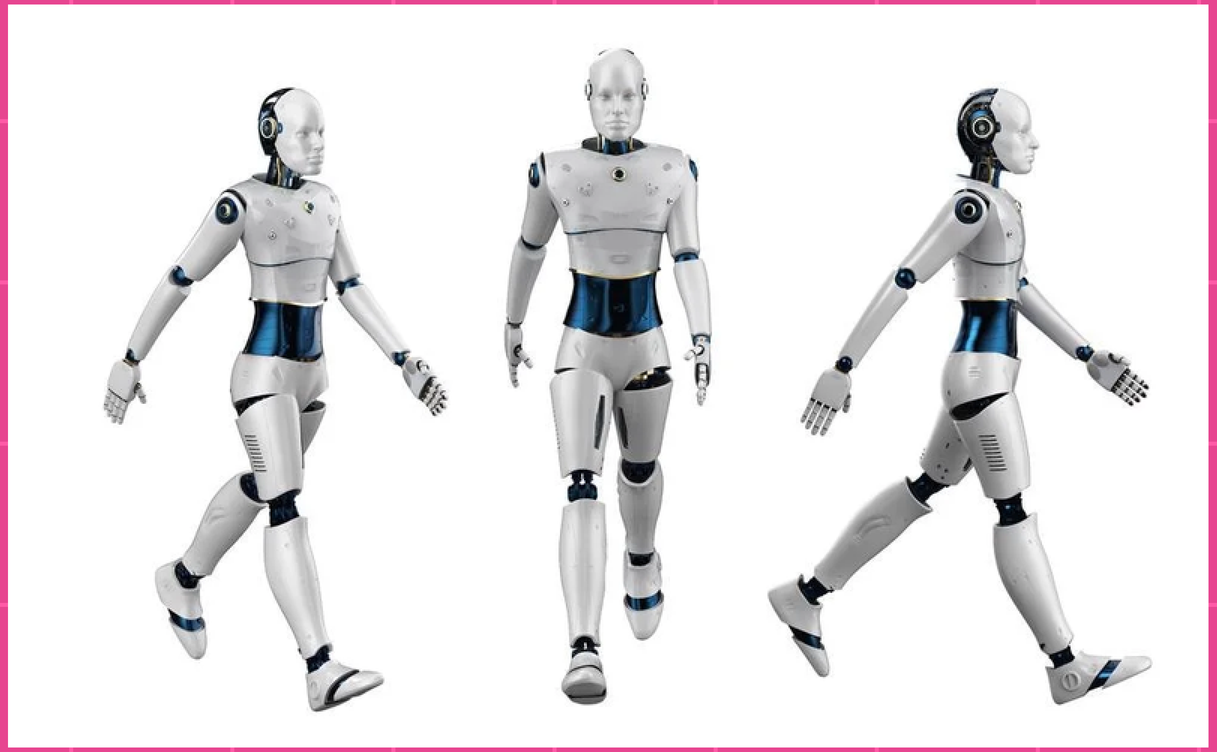
Power and Actuation

Humanoid robots require powerful actuators to drive their joints and enable movement. These actuators can be hydraulic, pneumatic, or electric, depending on the specific design. Power sources, such as batteries or power cables, are incorporated into the body design to provide energy to the robot.

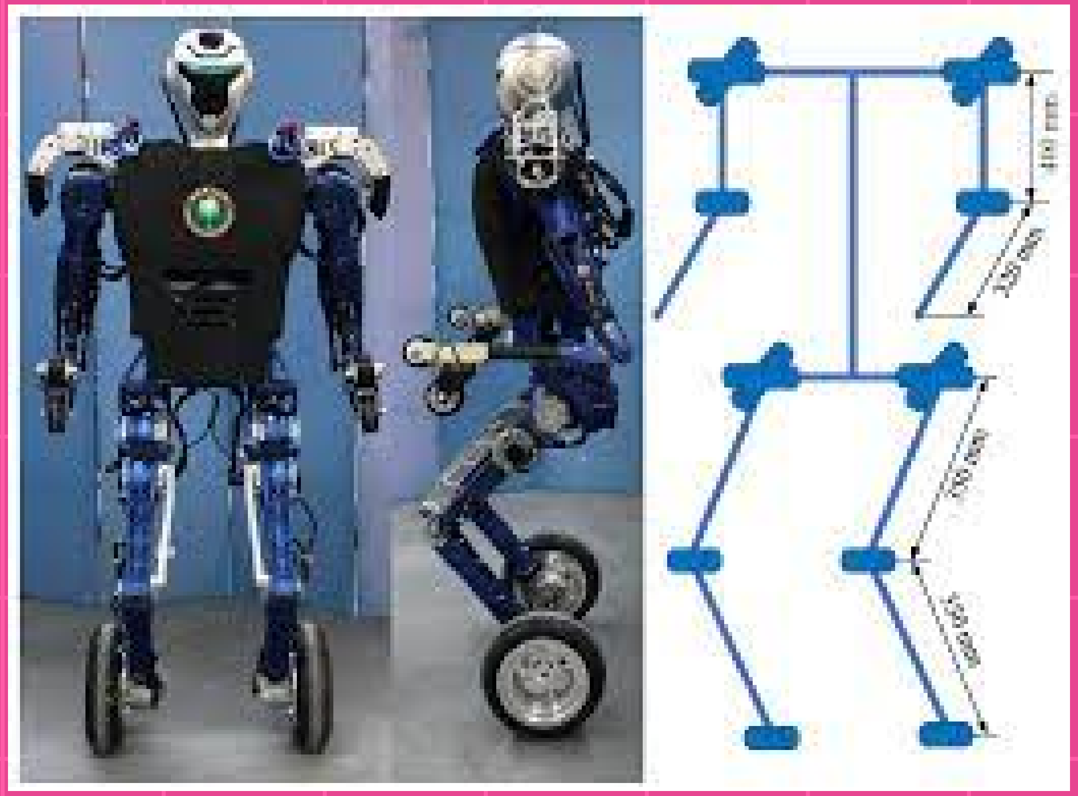


Locomotion

1. Walking: Walking is the most common form of locomotion for humanoid robots. The robot mimics the human gait pattern by moving its legs in a coordinated manner. The walking process involves alternating movements of swinging the legs forward, shifting weight, and maintaining balance. Walking can be further classified into various styles such as heel-toe walking, flat-footed walking, or toe walking, depending on the desired characteristics and requirements of the robot.

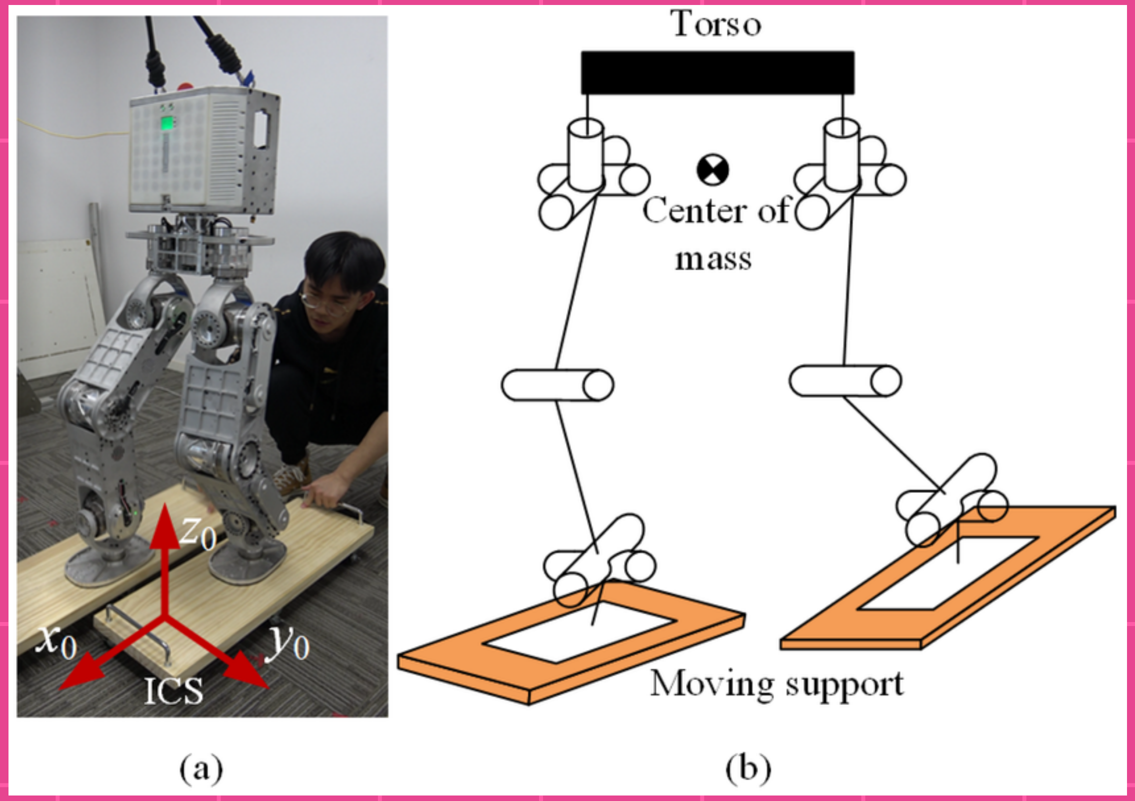


2. Wheel-Based Locomotion: While humanoid robots are primarily designed for bipedal locomotion, some designs incorporate wheels for specific tasks or to enhance mobility. The wheels can be integrated into the feet or other parts of the robot's body to provide additional stability or to navigate on uneven surfaces or challenging terrains.



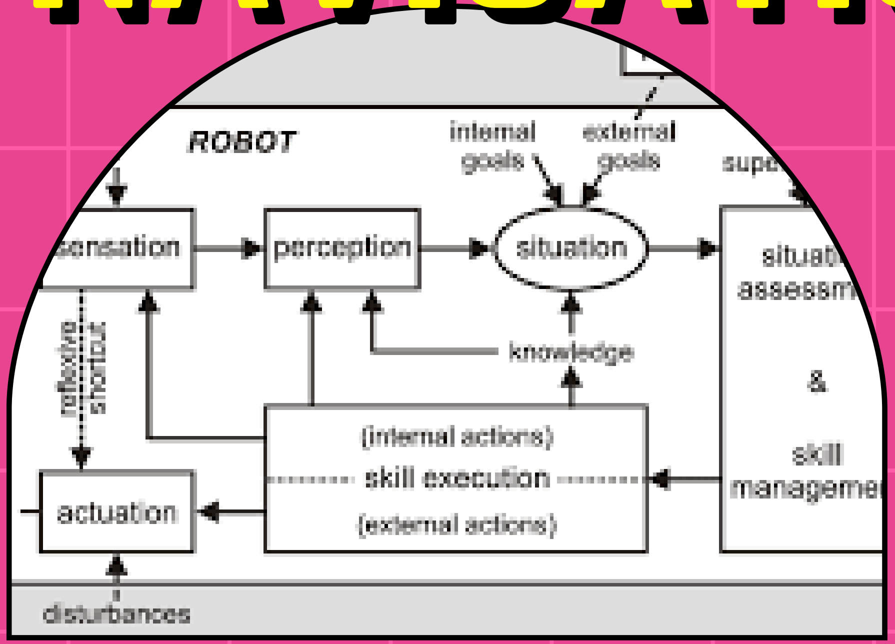
Locomotion

Balancing and Posture Control: Humanoid robots need to maintain balance while walking or performing tasks. They use sophisticated balance control algorithms and sensors to adjust their body posture and ensure stability. Inertial sensors, such as accelerometers and gyroscopes, help detect the robot's orientation and make necessary adjustments to maintain balance.



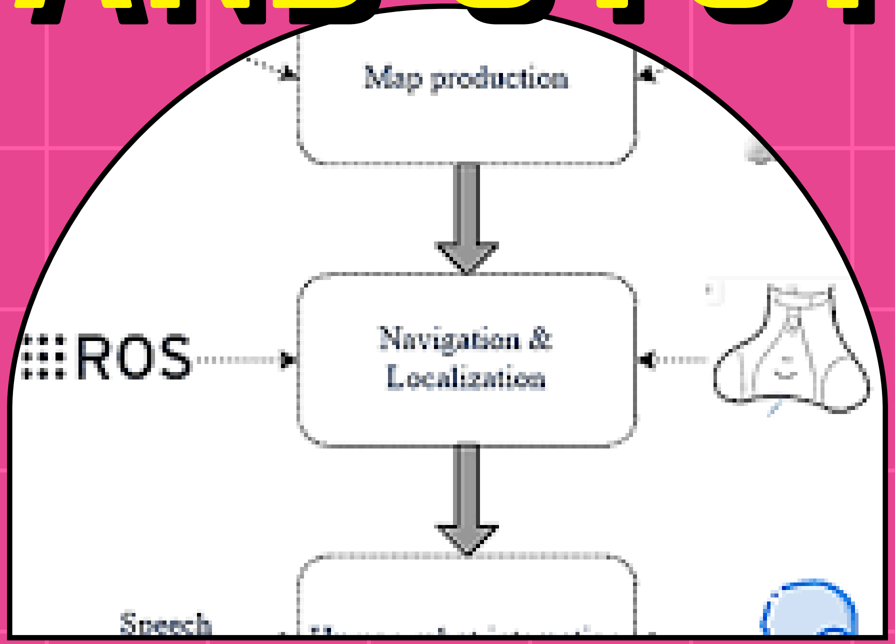
Crawling and Climbing: Some humanoid robots are designed to crawl or climb in environments where walking is not feasible. These robots typically have additional degrees of freedom in their limbs and are equipped with specialized mechanisms or tools to grip surfaces or manipulate objects during climbing.

NAVIGATION AND SYSTEM CONTROL



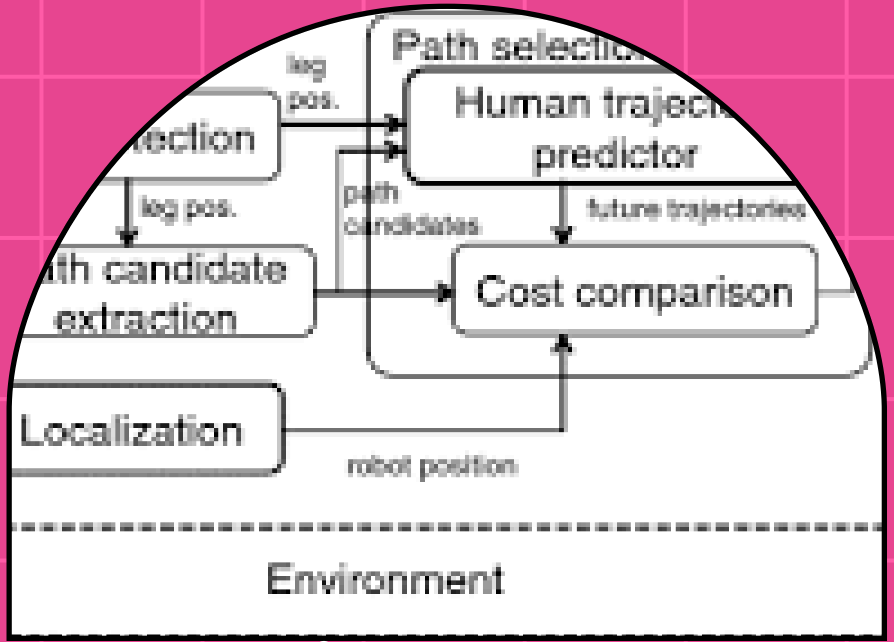
Perception and Sensing

Humanoid robots rely on various sensors, such as cameras, depth sensors, LIDAR, and tactile sensors, to perceive their surroundings. These sensors provide information about the environment, including obstacles, landmarks, and the robot's own position and orientation



Mapping and Localization:

Humanoid robots often build maps of their environment to understand the spatial layout. Simultaneous Localization and Mapping (SLAM) algorithms are commonly used to create maps while estimating the robot's position within the map.



Motion Control

Humanoid robots require precise control over their joints and actuators to execute desired movements. Control algorithms, such as inverse kinematics and PID control, are used to calculate the joint angles and torques necessary for the robot to achieve the desired motion. These algorithms ensure smooth and stable movements during navigation.

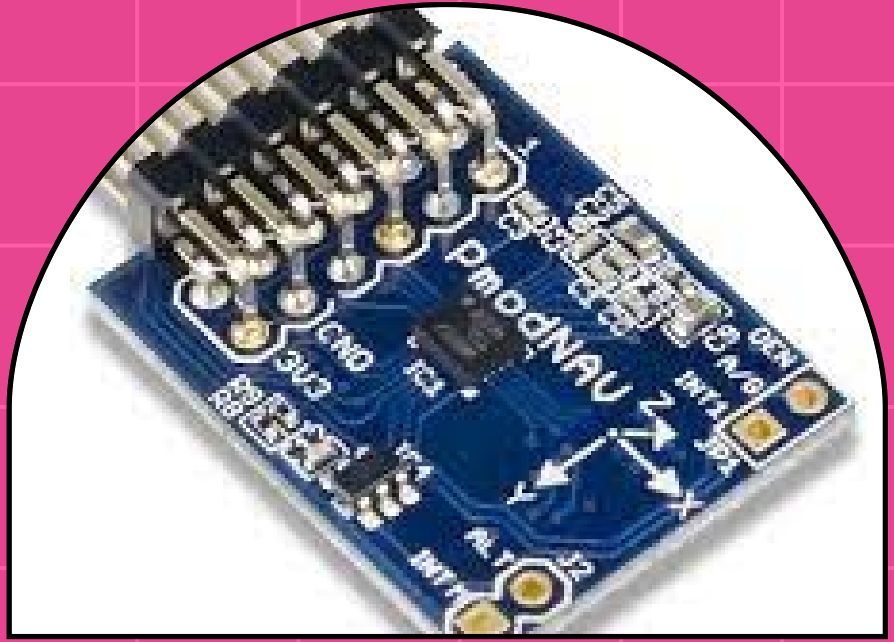
DATA COLLECTION

Camera

Cameras are essential for visual perception in humanoid robots. They capture images or video streams that enable the robot to recognize objects, detect faces, estimate distances, and navigate the environment.

Depth Sensors

Depth sensors, such as Time-of-Flight (ToF) cameras or structured light sensors, provide depth information of the scene. They measure the distance to objects and enable the robot to perceive the 3D structure of the environment.



Inertial Measurement Units (IMUs)

IMUs consist of accelerometers, gyroscopes, and sometimes magnetometers. They provide information about the robot's acceleration, angular velocity, and orientation. IMUs help estimate the robot's position, detect changes in orientation, and enable balance control during walking or dynamic movements.

DATA COMMUNICATION

Data communication is essential for humanoid robots to interact with their environment, exchange information, and perform tasks effectively.

Wireless Communication
Robots use wireless protocols, such as Wi-Fi or Bluetooth, to communicate with external devices or systems.

Sensor Data
Humanoid robots acquire data from cameras, depth sensors, touch sensors, and microphones to perceive the environment.

Control Commands
Robots receive control commands from external sources or internal systems to determine their movements and actions.

Human-Robot Interaction
Robots collect data during interactions with humans, including speech, gestures, and facial expressions, to understand and respond appropriately.

Inter-Module Communication
Communication protocols facilitate data exchange among different modules within the robot, enabling information processing and control.

POWER MANAGEMENT

Humanoid robots typically require high-capacity and rechargeable batteries to power their operations. The specific battery used can vary depending on the size, weight, and power requirements of the robot.

LiPo Battery

LiPo batteries are similar to Li-ion batteries but have a more flexible form factor. They can be manufactured in various shapes and sizes, allowing for better integration into the compact design of humanoid robots. LiPo batteries offer high energy density and are commonly used in small and lightweight humanoid robots.