Robotics

Title: Introduction to Robotics | ESP32

What is Robotics?

Robotics is a branch of engineering and science that involves the design, construction, operation, and use of robots. It integrates:

- Mechanical engineering (structure, movement)
- Electrical/electronics engineering (power and control)
- Computer science (programming, logic, AI)

A robot is a programmable machine that can sense its environment, process information, and act to achieve specific tasks.

Why Learn Robotics?

- Industry 4.0 – Automation in manufacturing.
- Agriculture – Automated harvesting.
- Healthcare – Robotic surgeries.
- Defense – Drones, bomb disposal robots.
- Home Automation – Cleaning robots, personal assistants.

Difference Between a Machine and a Robot

Feature	Machine	Robot
Automation	Performs fixed tasks	Can make decisions based on inputs
Sensors	Usually none	Uses sensors to sense environment
Adaptability	Cannot adapt	Can adapt to changes (with programming)

Anatomy of a Robot

A robot is made of several essential components:

4.1 Power System

- Source: Battery (Li-ion, LiPo, Lead Acid).
- Regulators: Step-down (buck) converters, LDOs.
- Safety: Fuses, overcurrent protection.

4.2 Controller (The Brain)

- In this course: ESP32 (Wi-Fi, BLE, multiple GPIOs, PWM).
- Responsible for executing code, reading sensors, controlling actuators.

4.3 Sensors (Input Devices)

- Ultrasonic sensor: Distance measurement.
- IR sensor: Line following or obstacle detection.
- IMU (MPU6050): Orientation and tilt detection.
- Encoders: Motor speed and position feedback.

4.4 Actuators (Output Devices)

- DC motors: Continuous rotation.
- Servo motors: Controlled angle.
- Stepper motors: Precise movement in steps.

4.5 Communication System

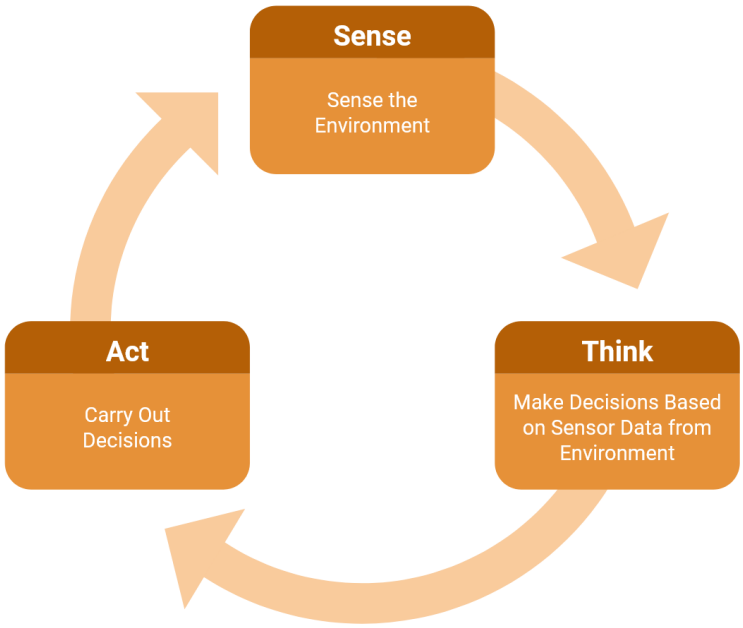
- Bluetooth: Short-range wireless control.
- Wi-Fi: Web-based control and telemetry.
- Serial (UART): For debugging and sensors.

4.6 Mechanical Structure (Chassis)

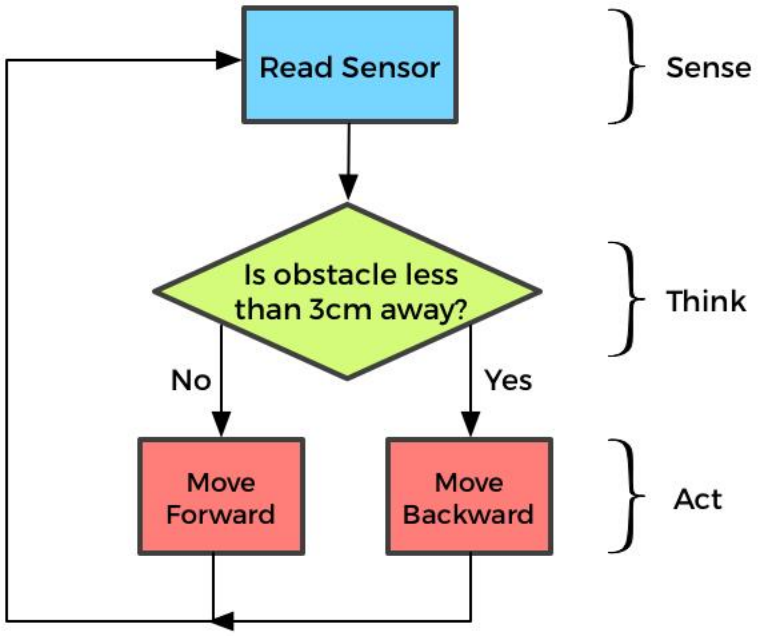
- Wheels, body frame, brackets, mounts.

The Robotics Cycle

Every robot follows Sense → Think → Act:



- Sense: Collect data from sensors (ultrasonic, IR, IMU).
- Think: Process data in the controller (ESP32 in our course).
- Act: Move actuators (motors, servos) based on logic.



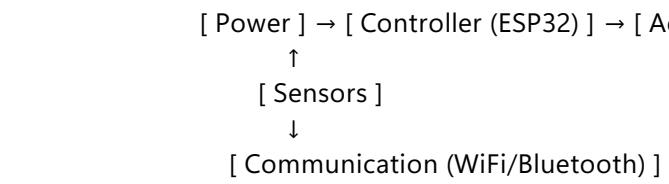
Types of Robots

1. Mobile Robots: Can move around (e.g., delivery bots).
2. Industrial Robots: Robotic arms for welding, assembly.
3. Service Robots: Vacuum cleaners, medical assistants.
4. Humanoid Robots: Robots that resemble humans (e.g., Sophia).
5. Aerial Robots: Drones, UAVs.
6. Autonomous Vehicles: Self-driving cars.

Real-World Examples

- Boston Dynamics Spot – Quadruped robot for industrial inspection.
- Amazon Scout – Delivery robot.
- Surgical Robots – Used in healthcare for precision operations.
- Mars Rover – Space exploration robot.

Diagram: Block Representation of a Robot



Key Takeaways

- Robots = Sense → Think → Act.
- Core parts: Power, Controller, Sensors, Actuators, Communication, Chassis.
- Robotics is used in almost every field: Industry, Space, Medical, Military, Household.
