

# Robotics and Embedded Systems

**Shaping the Future of Automation and Intelligence**

Organization: GDGOC & AdAstra

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# Robotics

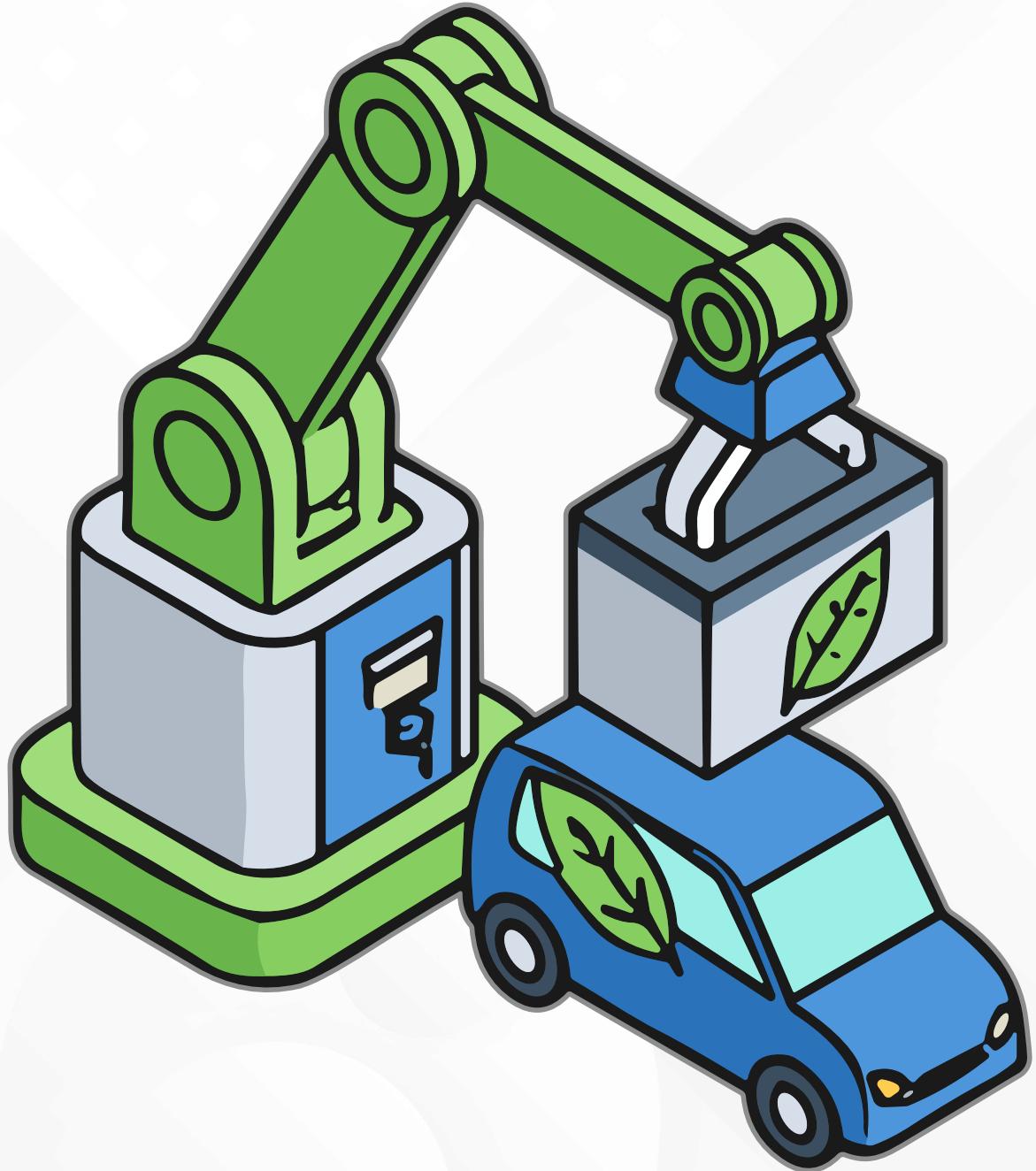
Robotics is the field of engineering that focuses on **designing, building, programming, and operating robots to perform tasks autonomously or semi-autonomously.**

Core parts:

- Mechanical system
- Electronics (embedded control)
- Software (logic & algorithms)

Examples:

Line follower robot  
Industrial robotic arm  
Drones

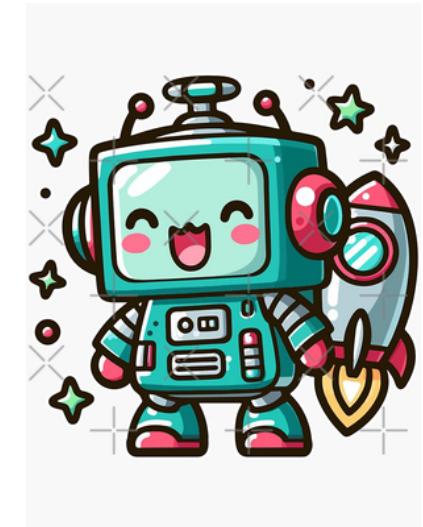




# Robots

A robot is an **autonomous or semi-autonomous machine** designed to perform specific tasks by **interacting with the physical world** through a **continuous Sense-Think-Act loop**.

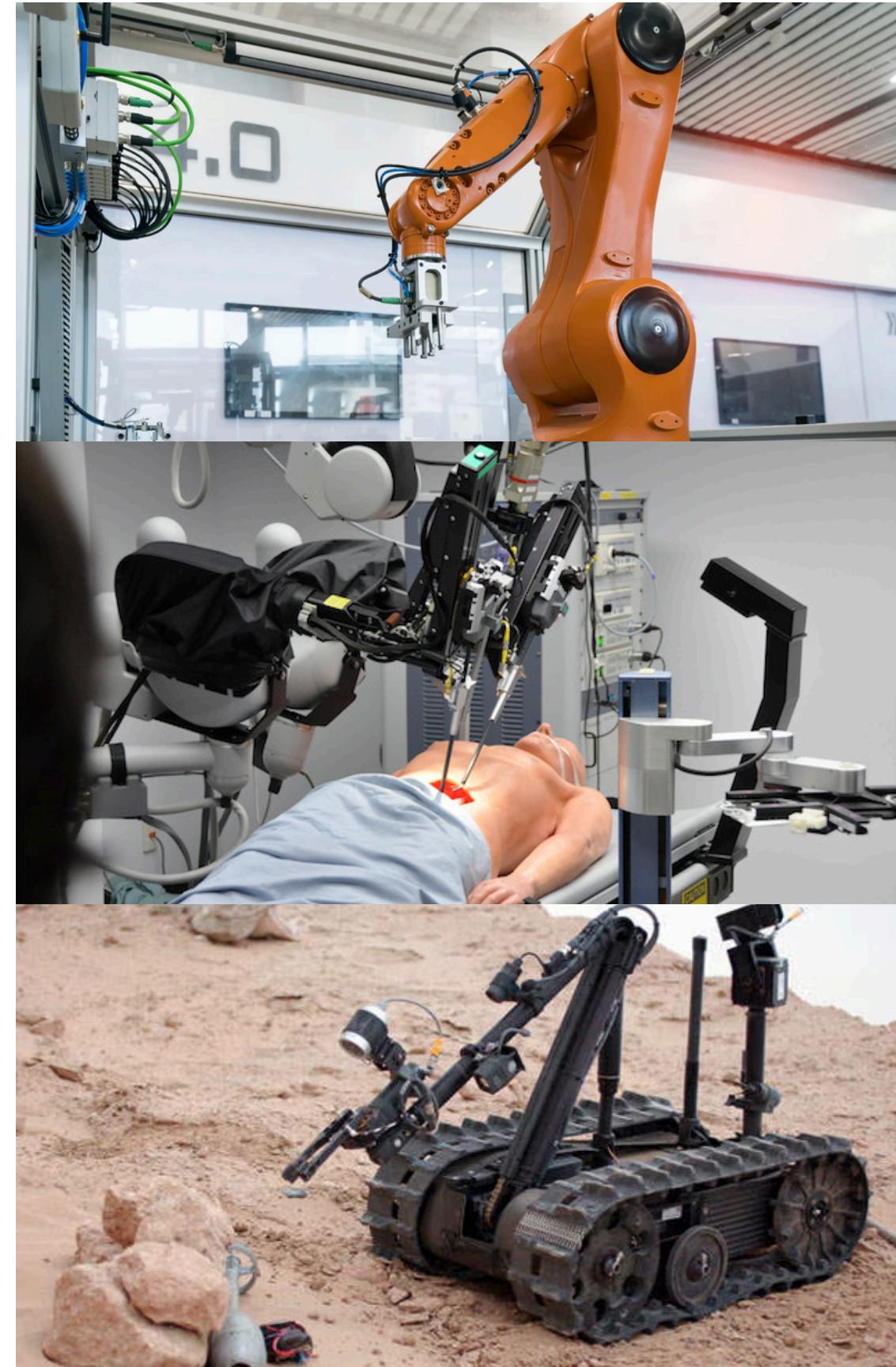
**Unlike simple machines** that only **extend human effort** (like a power drill), **robots replace human effort** by making independent decisions based on their programming.



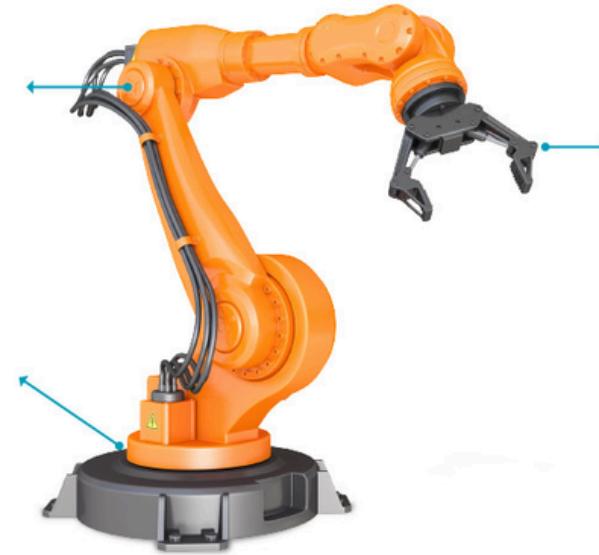
# Types of Robots

Based on application:

- Industrial robots (welding, assembly)
- Medical robots (surgery assistance)
- Military robots (surveillance, bomb disposal)



# Types of Robots



Fixed/Stationary



Legged robots



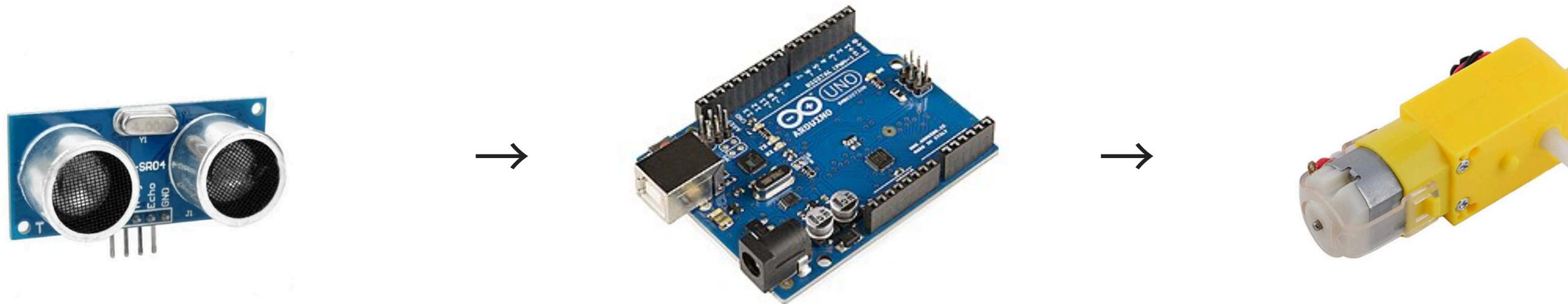
Aerial robots



Wheeled robots

# Basic Robot Architecture

Sensors → Controller → Actuators

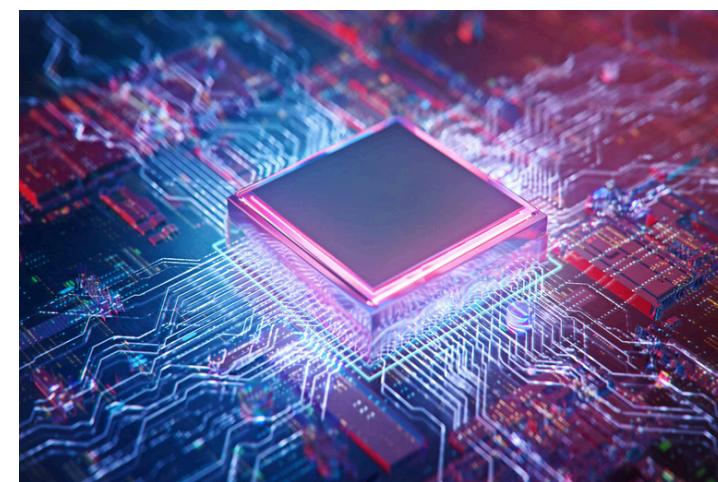


Sensors → IR, ultrasonic, gas  
Controller → Arduino UNO  
Actuators → Motors, servos

# Control & Intelligence in Robots



Input

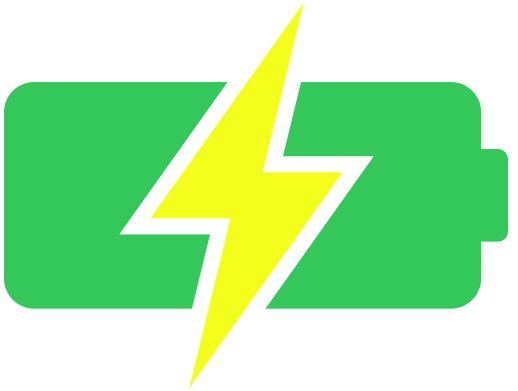


Processing



Output

# Power Supply



**MANDATORY**

# Embedded Systems

A small computer designed to perform one specific task, inside a larger product.

## Simple Examples

- Washing machine controller
- Car airbag system
- Microwave oven
- Robot brain
- Embedded System = Hardware + Software + Purpose

**Embedded systems are the brain behind smart machines**



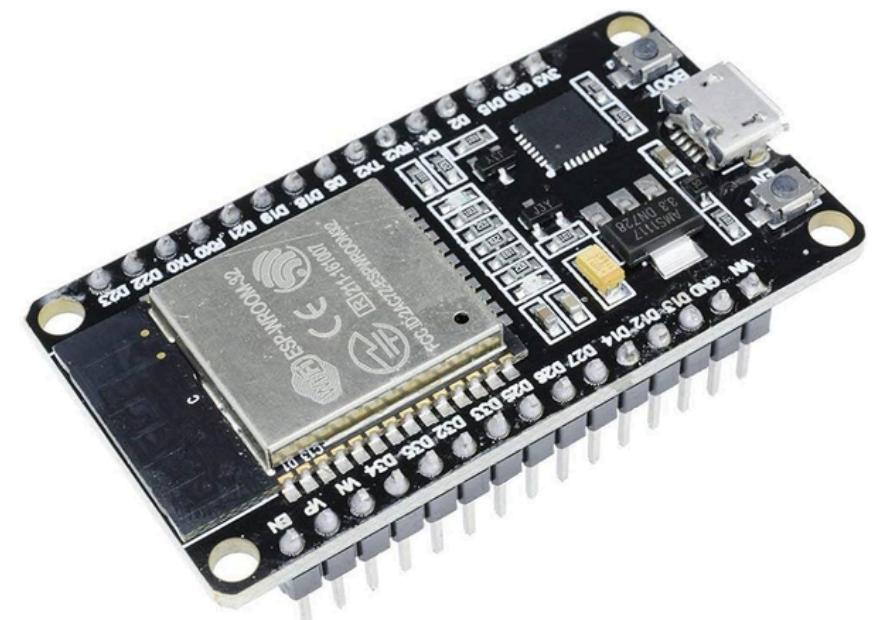
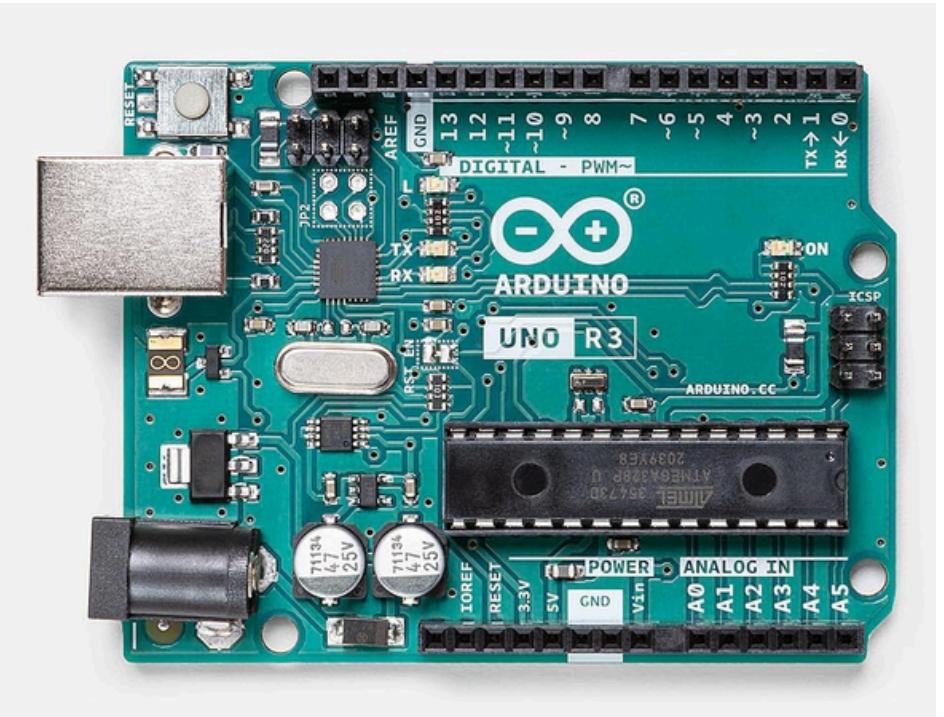
# Microcontrollers (MCU)

**Microcontroller is a "Computer on a Chip."**

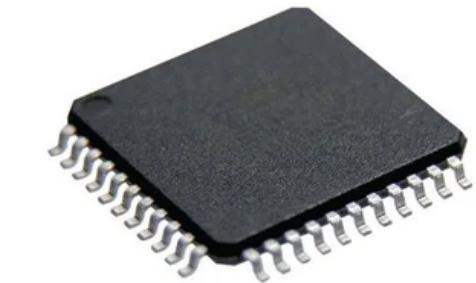
While a computer like your laptop has many different parts (a separate CPU, separate RAM sticks, and a hard drive) connected on a big motherboard, a microcontroller crams all of those things into one single tiny square.

It is not a general-purpose computer like a PC or laptop.

- ◆ Key Characteristics
  - Designed for one dedicated function
  - Works continuously
  - Responds in real time
  - Uses limited resources
  - Very reliable



# Whats inside a Microcontroller



## 1. The "Brain" (**CPU**)

Role: The Central Processing Unit executes the code.

Action: It performs math (Arithmetic) and makes decisions (Logic) based on sensor data.

The "Clock": Acts as a heartbeat, timing every instruction.

## 2. The "Memory" (**RAM & ROM**)

Flash (ROM): Permanent storage. This is where your Program Code is saved (doesn't disappear when power is off).

RAM: Temporary storage. This is where Variables and sensor readings are kept while the power is on.

## 3. The "Interface" (**I/O & Peripherals**)

Digital I/O: Pins used to read sensors (Inputs) or control motors (Outputs).

ADC: A translator that turns analog sensor signals into digital numbers for the CPU.

Timers: Used for creating delays or controlling motor speed (PWM)

# Core Building Blocks of an Embedded System

Microcontrollers (MCU)

All-in-one chip

Designed for control tasks

Used in robots, appliances, IoT

Microcontroller = Brain + Memory + I/O on one chip

Example: Arduino, ESP32, STM32

Microprocessors (MPU)

CPU only

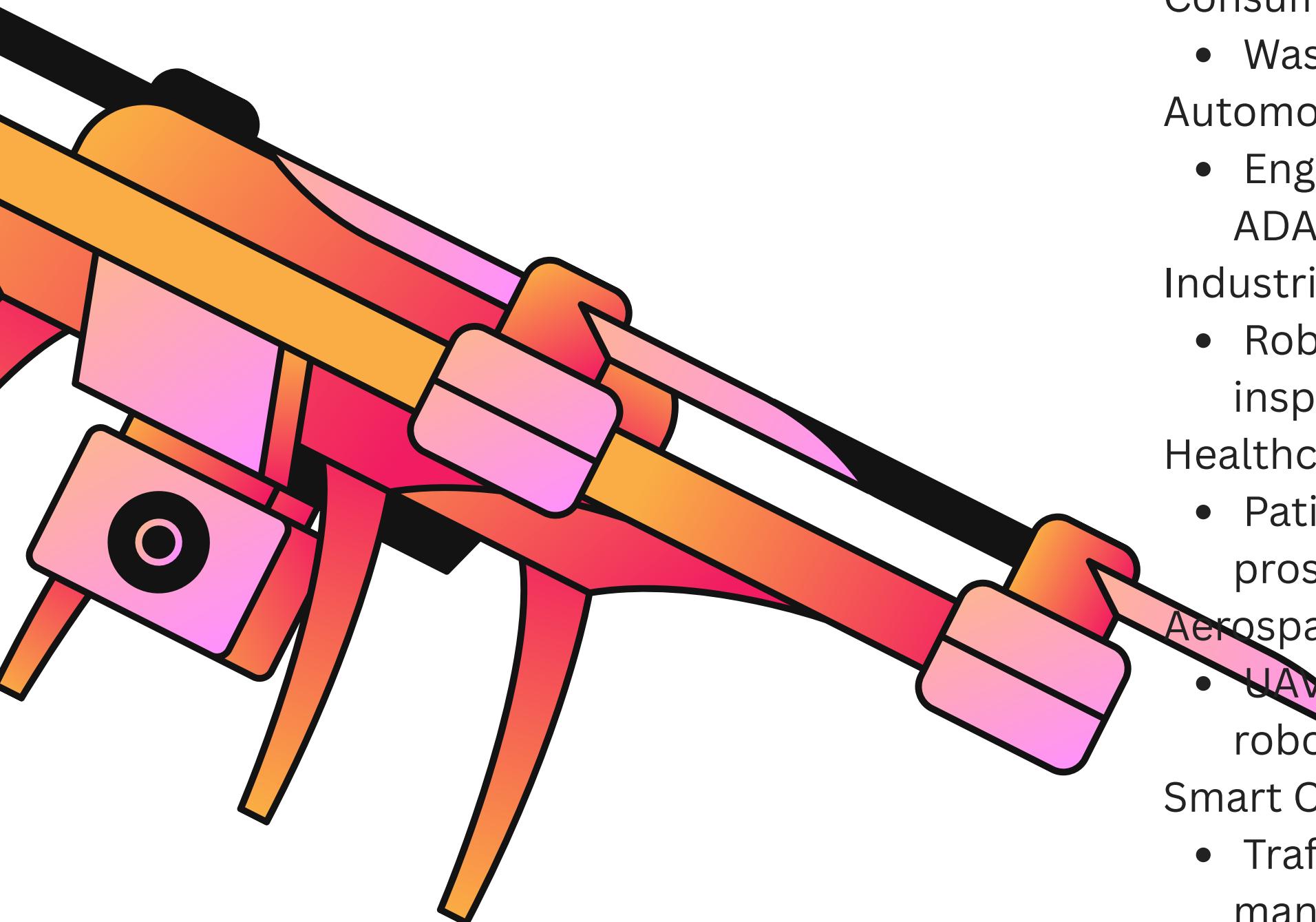
Designed for computing tasks

Used in PCs, laptops, phones

Microprocessor = Brain only

Example: Intel i3, Ryzen, ARM Cortex-A

# Applications



## Consumer & Home Appliances

- Washing machines, air conditioners, smart fans, vacuum robots

## Automotive & Electric Vehicles

- Engine control units (ECU), battery management systems (BMS), ADAS, autonomous driving

## Industrial Automation & Manufacturing

- Robotic arms, conveyor systems, PLC-based control, quality inspection

## Healthcare & Biomedical Systems

- Patient monitoring devices, infusion pumps, surgical robots, prosthetics

## Aerospace & Defence

- UAVs (drones), navigation systems, guidance & control, surveillance robots

## Smart Cities & Infrastructure

- Traffic control systems, smart lighting, surveillance, energy management

## Agriculture & Farming

- Automated irrigation, soil monitoring, crop spraying robots

## Energy & Power Systems

- Solar inverters, smart meters, grid monitoring systems

# Career Options



Career Options in Embedded Systems & Robotics -

1. Embedded Systems Engineer – Develops firmware for microcontrollers and hardware control
2. Robotics Engineer – Designs and programs robots using sensors, motors, and controllers
3. Firmware Engineer – Writes low-level software that runs directly on hardware
4. IoT Engineer – Builds smart devices using WiFi, Bluetooth, and cloud connectivity
5. Automation Engineer – Works with industrial robots and control systems
6. Autonomous Systems Engineer – Develops drones, self-driving robots, and intelligent machines
7. Industries: Automotive, Aerospace, Defence, Medical, Consumer Electronics, Robotics Startups