An embedded system is a computer system designed to perform a specific task within a larger electronic or mechanical system. It's a combination of hardware and software, optimized for a dedicated function, and often operates in real-time. These systems are found in a wide array of devices, from simple digital watches to complex industrial machinery and vehicles.

DEFINITION

An Embedded System is a computer system — a combination of hardware and software — designed to perform a specific task or a set of dedicated functions, often with real-time computing constraints.

Or

Embedded systems are specialized computer systems that are integrated into other devices to control or monitor their functions. They are not general-purpose computers, but rather are designed and programmed for a specific task.

It is “embedded” as part of a larger system (e.g., a washing machine, car, or medical device).

KEY CHARACTERISTICS

Application-specific

Real-time operation

Low power consumption

Compact and reliable

Limited memory and processing power

Often works without human intervention

Examples of Embedded Systems

Category	Example Devices
Consumer Electronics	Smart TVs, Washing Machines, Microwave Ovens
Automotive	Airbag System, ABS, Cruise Control
Medical Devices	ECG Monitors, Infusion Pumps
Industrial	PLCs, CNC Machines, Robotic Arms
Telecommunication	Routers, Modems, Network Switches
Aerospace/Defense	Drones, Missile Guidance Systems

Smart Devices/IoT	Smart Thermostats, Wearables, Sensors

CLASSIFICATION OF EMBEDDED SYSTEMS

Embedded systems can be classified in several ways:

1. Based on Functionality

Type	Description	Example
Real-Time	Operates within strict timing constraints	Anti-lock braking system (ABS)
Stand-alone	Works independently without host system	Digital Camera, Calculator
Networked	Connected to a network to perform tasks	Smart Home Devices
Mobile	Portable, battery-powered	Mobile Phones, MP3 Players

2. Based on Performance and Complexity

Type	Description	Example
Small-Scale	Simple tasks, 8-bit/16-bit MCU	Toy Controllers, Simple Sensors
Medium-Scale	More complex, uses 16/32-bit MCU	Industrial Control Systems
Large-Scale	Highly complex with multiple processors	Aerospace, Automotive ECUs

3. Based on Microcontroller Used

Category	Example Microcontroller
8-bit Systems	8051, ATmega328 (Arduino)
16-bit Systems	MSP430
32-bit Systems	ARM Cortex-M, LPC2148