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19MCE304- DESIGN OF EMBEDDED SYSTEMS

An embedded system is a specialized computing system that performs dedicated functions or tasks within a larger mechanical or electrical system. Unlike general-purpose computers, embedded systems are designed to perform specific control functions, often with real-time computing constraints. Here are some key aspects of embedded systems:

1. Components:

- **Microcontroller/Microprocessor:** The central component that processes data and controls the system.
- **Memory:** Both RAM (for temporary data storage) and ROM (for firmware and permanent storage).
- **Peripherals:** Interfaces and devices like sensors, actuators, communication modules, etc.
- **Power Supply:** The source of power, often designed to be highly efficient.

2. Software:

- **Firmware:** Software that is permanently programmed into the system's ROM.
- **Real-Time Operating System (RTOS):** Manages hardware resources and provides a predictable execution environment for tasks.

3. Characteristics:

- **Dedicated Functionality:** Designed for specific tasks.
- **Real-Time Performance:** Capable of responding to inputs or events within a specified time.
- **Resource Constraints:** Limited processing power, memory, and energy consumption.
- **Reliability and Stability:** Often required to run continuously and without failure for long periods.

4. Applications:

- **Consumer Electronics:** Smartphones, smart TVs, washing machines, and microwave ovens.
- **Automotive Systems:** Engine control units, anti-lock braking systems, and infotainment systems.

- **Industrial Automation:** PLCs, SCADA systems, and robotic controllers.
- **Medical Devices:** Pacemakers, MRI machines, and patient monitoring systems.
- **Telecommunications:** Routers, modems, and base station controllers.

5. Design Considerations:

- **Performance:** Meeting the real-time requirements and processing needs.
- **Power Efficiency:** Minimizing energy consumption, especially for battery-powered devices.
- **Cost:** Balancing performance and functionality with cost constraints.
- **Reliability:** Ensuring long-term operation without failure.

Embedded systems are integral to modern technology, providing the control and intelligence behind a wide range of devices and applications.