

# INTRODUCTION TO EMBEDDED SYSTEMS

## Definition: What is Embedded System?

- As the name suggests, Embedded means something that is attached to another thing
- An embedded system can be thought of as a computer hardware system having software embedded in it
- Definition:

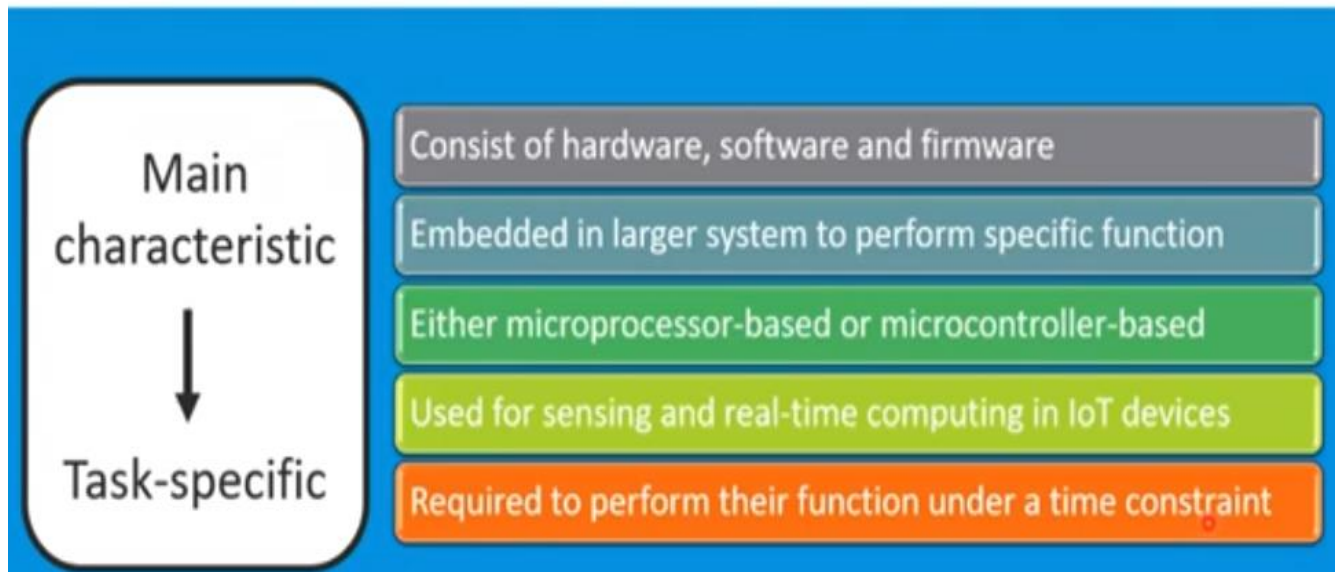
*An embedded system is a combination of computer hardware and software designed for a specific function.*

## Best Example of Embedded System

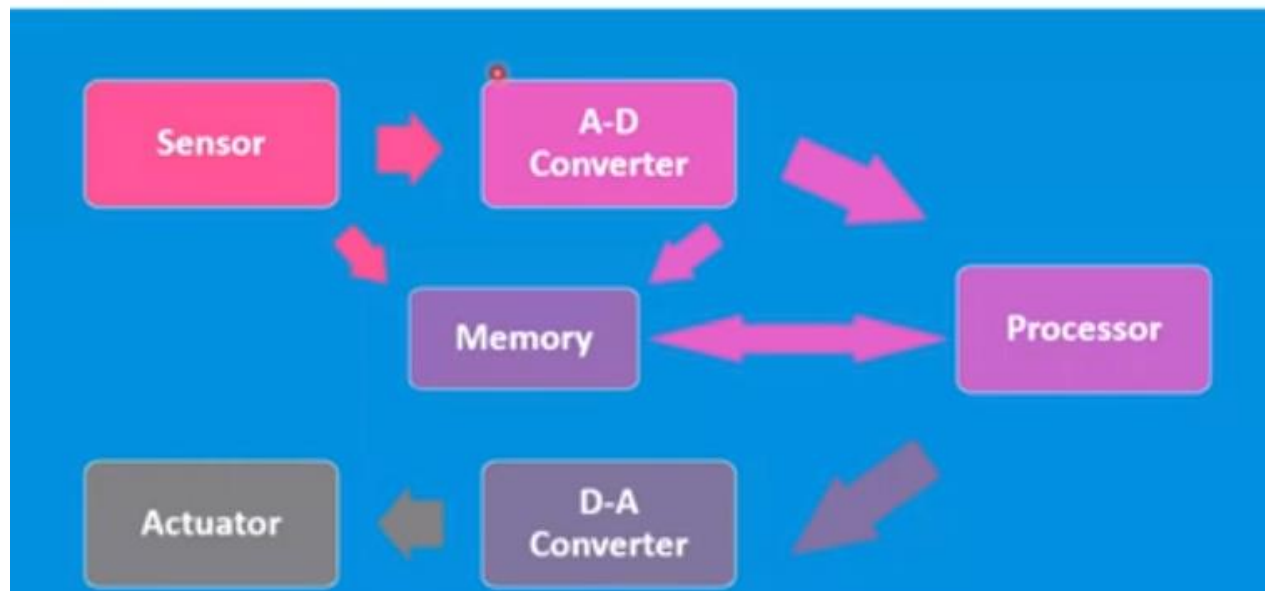


- Mobile Phones consists of
  - GUI (Software and Hardware)
  - Operating Systems (Software)
  - Cameras (Hardware)
  - Microphones (Hardware)
  - Sensors (Hardware)
  - USB I/O modules (Hardware)

# Characteristics of Embedded System



# Components of Embedded Systems



## General Processors in Computer Vs Embedded Processors

### • General-purpose microprocessors

contains

- No RAM
- No ROM
- No I/O ports

### • Microcontroller has

- CPU (microprocessor)
- RAM
- ROM
- I/O ports
- Timer
- ADC and other peripherals

# Microcontroller

- A compact integrated circuit designed to govern a specific operation in an embedded system
- Include processor, memory and input/output (I/O) peripherals on single chip
- Sometimes referred as an embedded controller or microcontroller unit (MCU)
- Found in vehicles, robots, office machines, medical devices, mobile radio transceivers, vending machines and home appliances, etc.
- Essentially simple miniature personal computers (PCs) designed to control small features of larger component, without complex front-end OS

## Components of Microcontrollers

CPU	RAM	ROM
I/O	Timer	Serial COM Port

- Processor (CPU) –
  - Treated as the brain of the device
  - Processes & responds to various instructions that direct the microcontroller's function
  - Involves performing basic arithmetic, logic and I/O operations
- Memory –
  - Used to store the data that the processor receives
  - Uses to respond to instructions that it's been programmed to carry out
- I/O peripherals –
  - Input and output devices are the interface for the processor to the outside world



# Microcontroller Properties



## System-On-Chip

- An integrated circuit ("chip") that integrates all or most components of a computer or other electronic system
- These components can be central processing unit (CPU), memory, I/O ports and secondary storage, graphics processing unit (GPU), etc.
- Integrates microcontroller, microprocessor or several processor cores with peripherals like Wi-Fi and cellular network, etc.
- Used in mobile computing such as tablets, smartphones, smartwatches and netbooks as well as embedded systems and in applications where previously microcontrollers would be used

# Introduction to Embedded Processor

- Type of microprocessor designed into the system to control electrical and mechanical functions
  - Usually simple in design, limited in computational power and I/O capabilities, and have minimal power requirements
  - Basically, embedded processors are the CPU chip placed in a system that it helps control
  - They generally do not have to do computations or be extremely fast, nor do they have to have great input/output capability, so they can be inexpensive
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- Help to control aircraft and industrial automation
  - Common in automobiles and in both large and small household appliances
  - One particular type, digital signal processors (DSP), are used in wireless telephones, digital telephone, cable modems, and some stereo equipment
  - Available in transportable devices like virtual watches, PDAS, digital cameras, GPS gadgets and MP3 players, etc.
  - Also utilized in purchase electronics together with online game consoles, DVD gamers, and printers