COMPLEX SYSTEM & MICROPROCESSORS

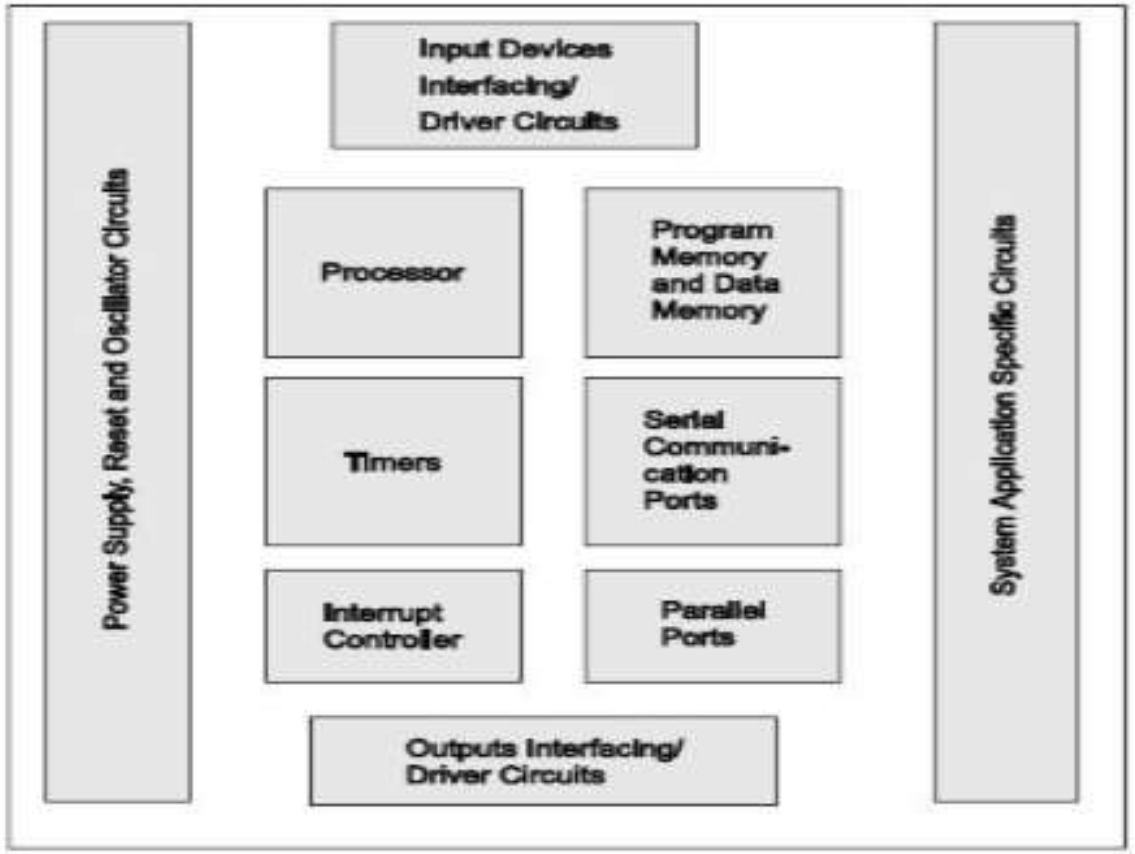
What is the embedded system?

An embedded system is one that has computer-hardware with software embedded in it as one of its most important component

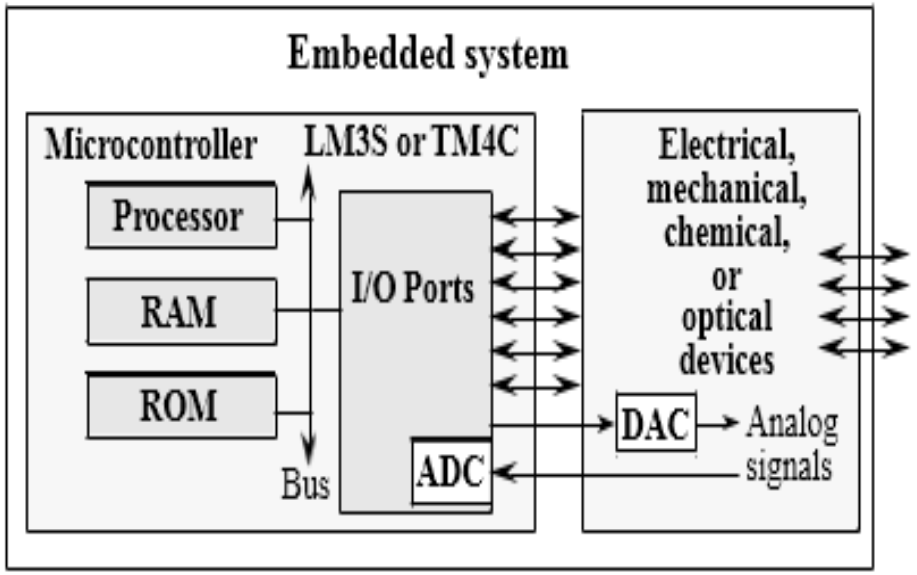
An embedded system has three main components

- Hardware
- Application software
- RTOS

COMPONENTS OF EMBEDDED SYSTEM HARDWARE



- Embedding Computers
- Characteristics of Embedded Computing Applications
- Why use microprocessors?
- Challenges in Embedded Computing System Design
- Performance in Embedded Computing



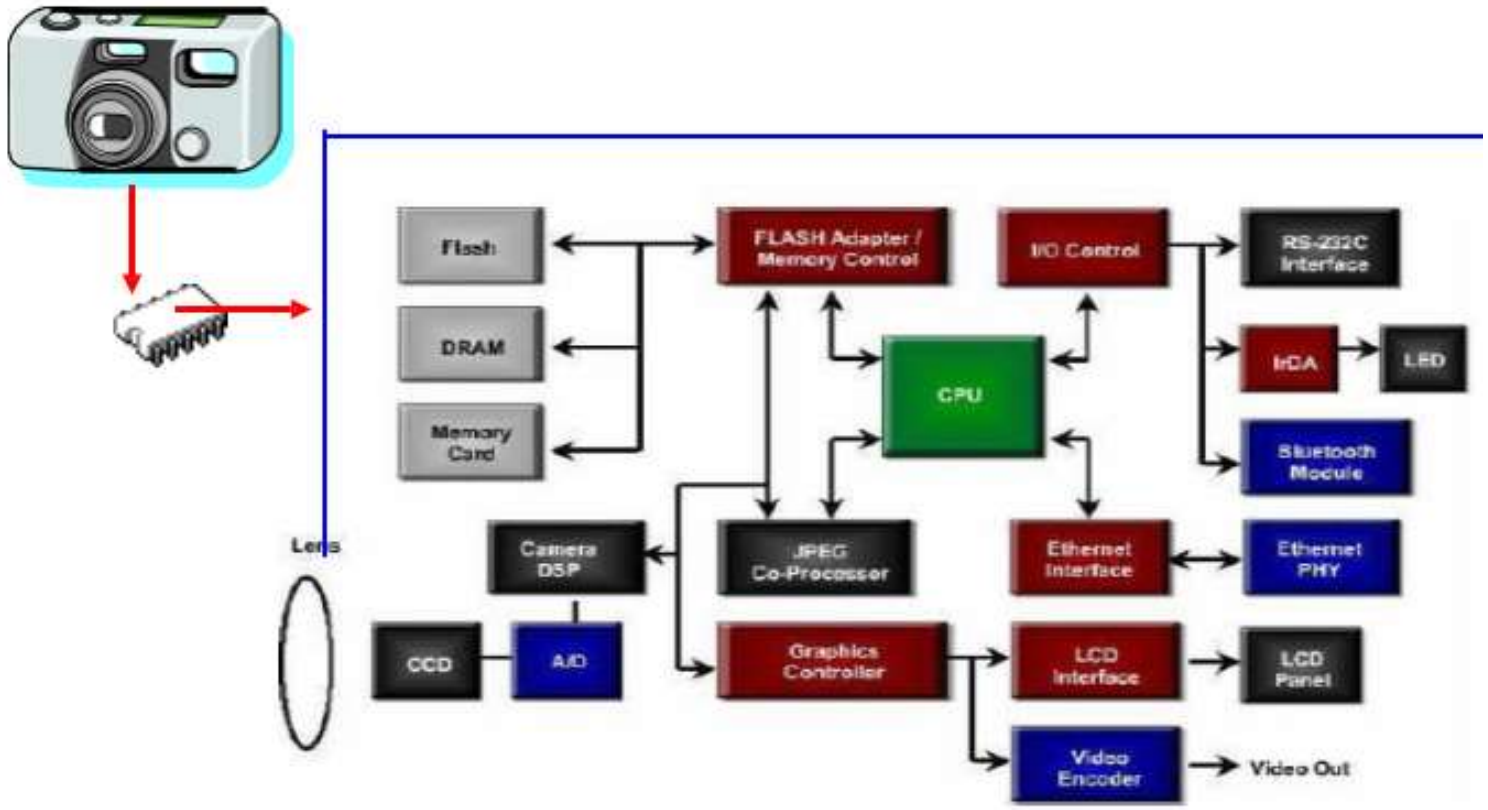
- Embedded Systemsare everywhere
  - Ubiquitous, invisible
  - Hidden (computer inside)
  - Dedicated purpose
- MicroProcessor
  - Intel: 4004, ..8080,.. x86
  - Freescale: 6800, .. 9S12,.. PowerPC
  - ARM, DEC, SPARC, MIPS, PowerPC, Natl. Semi.,…
- MicroControllerProcessor+Memory
- I/O Ports(Interfaces)

- Late 1940's: MIT Whirlwind computer was designed for real- time operations.
  - Originally designed to control an aircraft simulator.
- First microprocessor was Intel 4004 in early 1970's.
- HP-35 calculator used several chips to implement a microprocessor in 1972.
- Automobiles used microprocessor-based engine controllers starting in 1970's.
  - Controlfuel/air mixture, engine timing, etc.
  - Provides lower emissions, betterfuel efficiency.

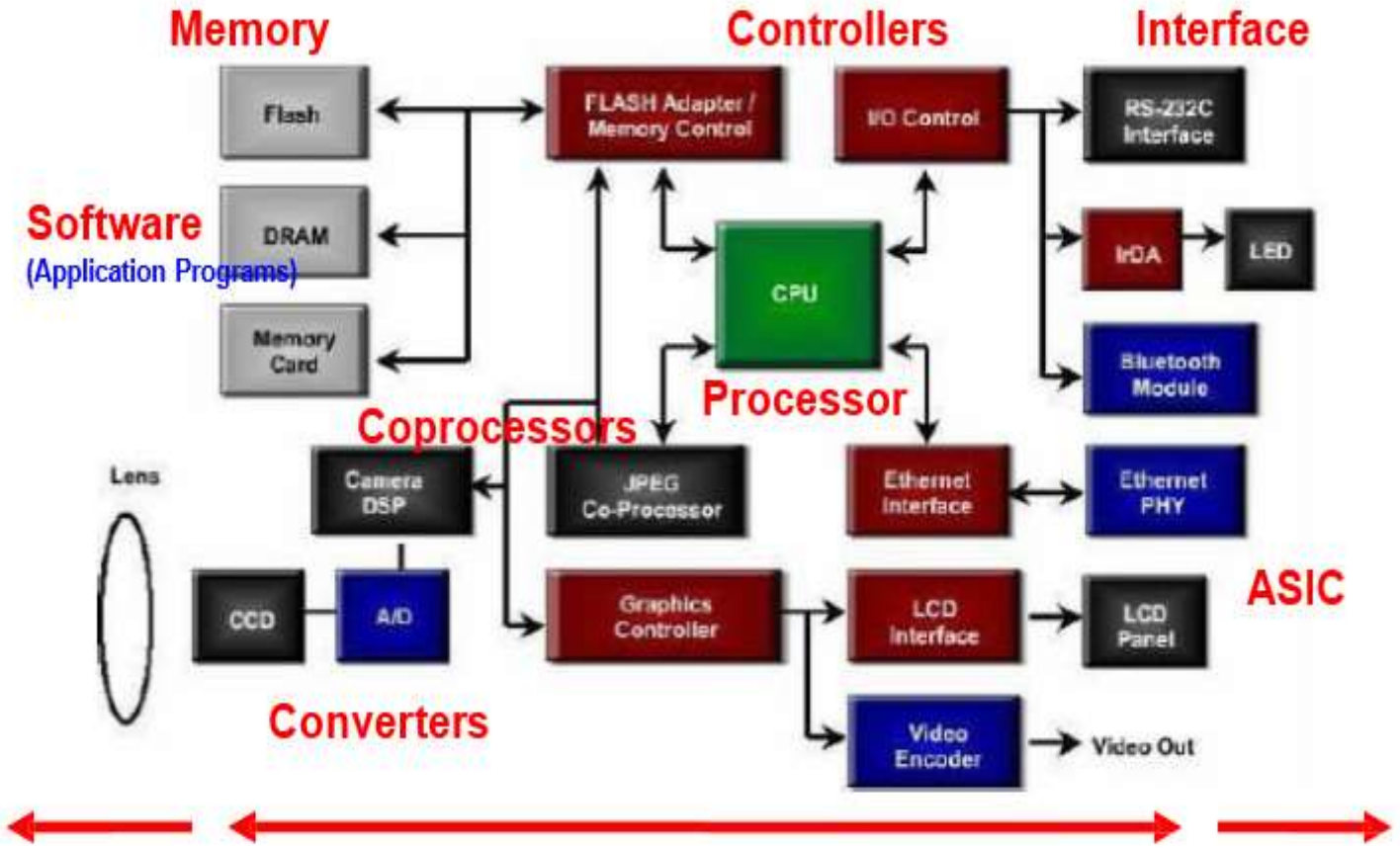
Anti-lock brakes
Auto-focus cameras
Automatic teller machines
Automatic toll systems
Automatic transmission
Avionic systems
Battery chargers
Camcorders
Cell phones
Cell-phone basestations
Cordless phones
Cruise control
Curbside check-in systems
Digital cameras
Disk drives
Electronic card readers
Electronic instruments
Electronic toys/games
Factory control
Fax machines
Fingerprint identifiers
Home security systems
Life-support systems
Medical testing systems

Modems
MPEG decoders
Network cards
Network switches/routers On-board navigation Pagers
Photocopiers
Point-of-sale systems
Portable video games
Printers
Satellite phones
Scanners
Smart ovens/dishwashers
Speech recognizers
Stereo systems
Teleconferencing systems
Televisions
Temperature controllers
Theft tracking systems
TV set-top boxes
VCR's, DVD players
Video game consoles
Video phones
Washers anddryers

DIGITAL CAMERA BLOCK DIAGRAM



COMPONENTS OF EMBEDDED SYSTEMS



- Analog Components
  - Sensors, Actuators, Controllers, …
- Digital Components
  - Processor, Coprocessors
  - Memories
  - Controllers, Buses
  - Application Specific Integrated Circuits (ASIC)
- Converters – A2D, D2A,…
- Software
  - Application Programs
  - Exception Handlers

- Today's high-end automobile may have 100 microprocessors:
  - 4-bit microcontroller checks seat belt;
  - microcontrollers run dashboard devices;
  - 16/32-bit microprocessor controls engine.
- Customer's requirements
  - Reduced cost
  - Increased functionality
  - Improved performance
  - Increased overall dependability