COMPLEX SYSTEM & MICROPROCESSORS

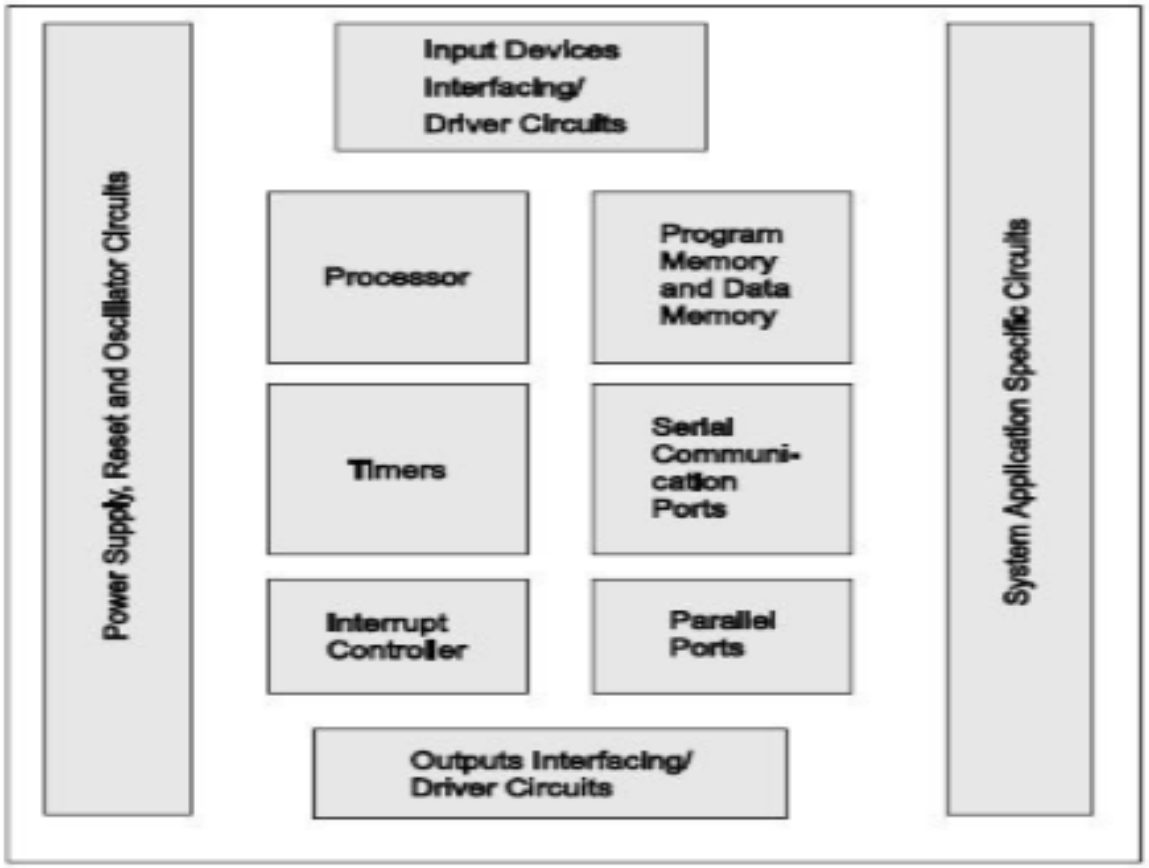
What is the embedded system

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

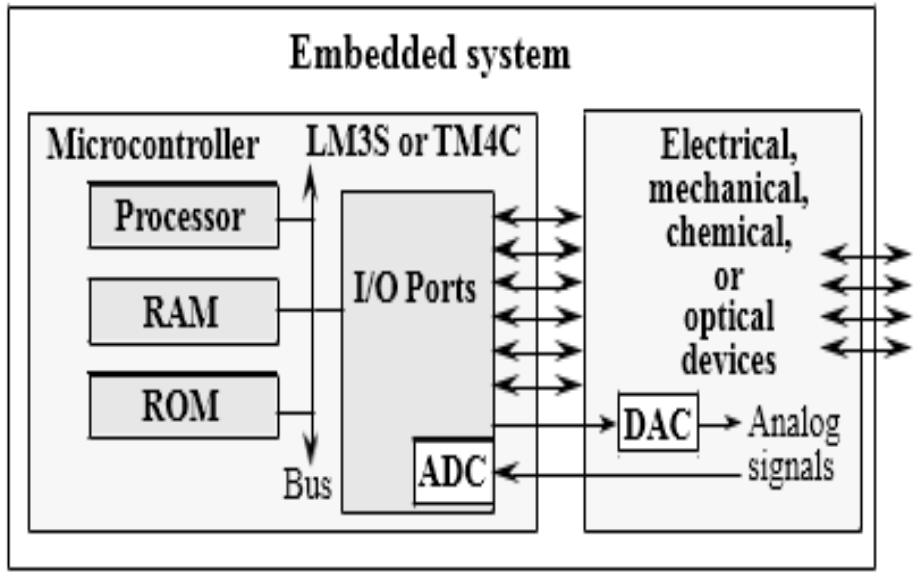
An embedded system has three main components

- 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
    - Dedicated purpose
      - MicroProcessor
    - Intel: 4004, ..8080,.. X86
    - Freescale: 6800, .. 9S12,..
    - PowerPC, Natl. Semi.,…

MicroControllerProcessor+Memory
I/O Ports(Interfaces)
PowerPC
ARM, DEC, SPARC, MIPS,

- 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 base stations

Cordless phones Cruise control

Curbside check-in systems

Digital cameras Disk drives

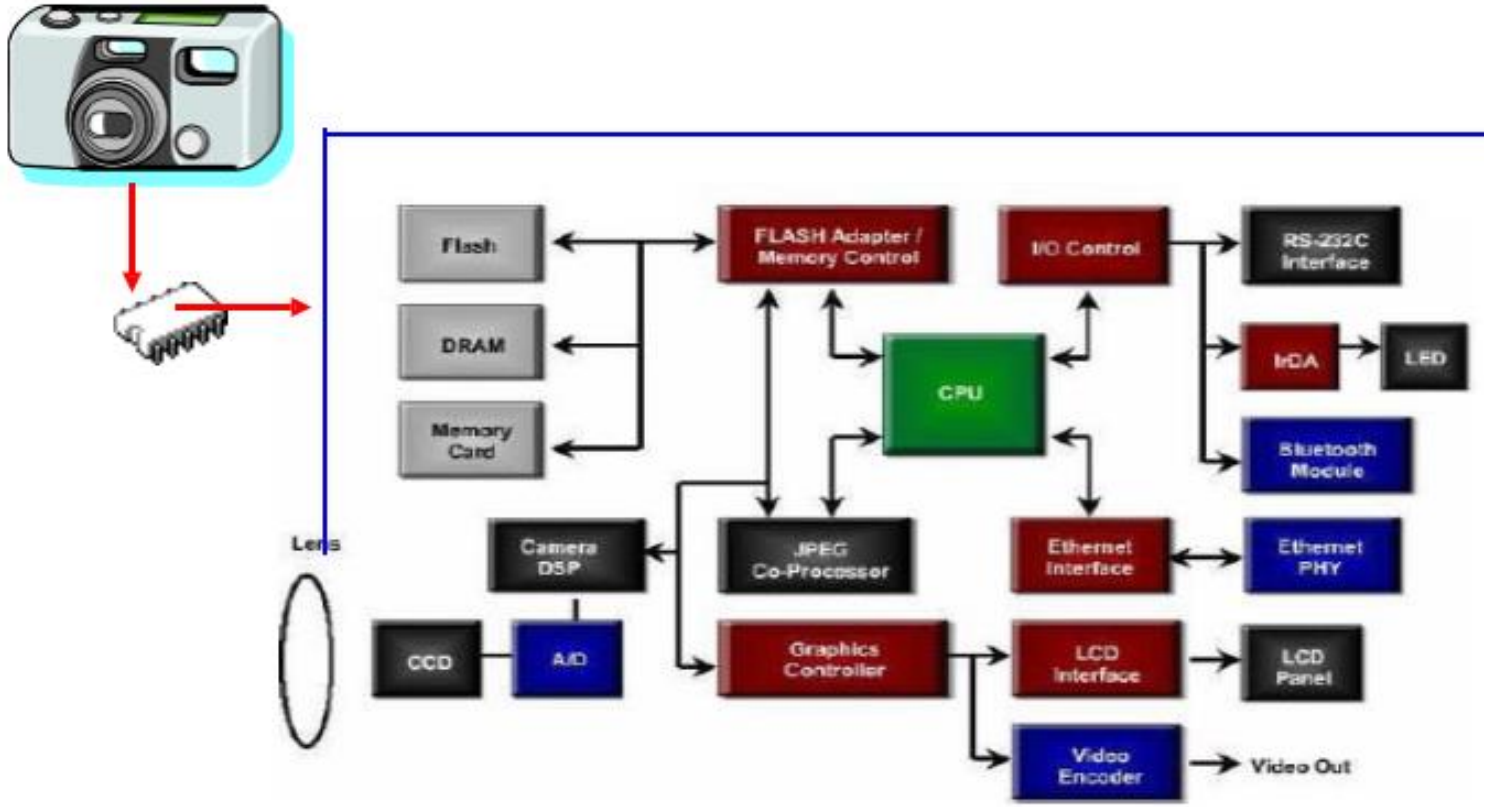
Electronic card readers Electronic instruments Electronic toys/games

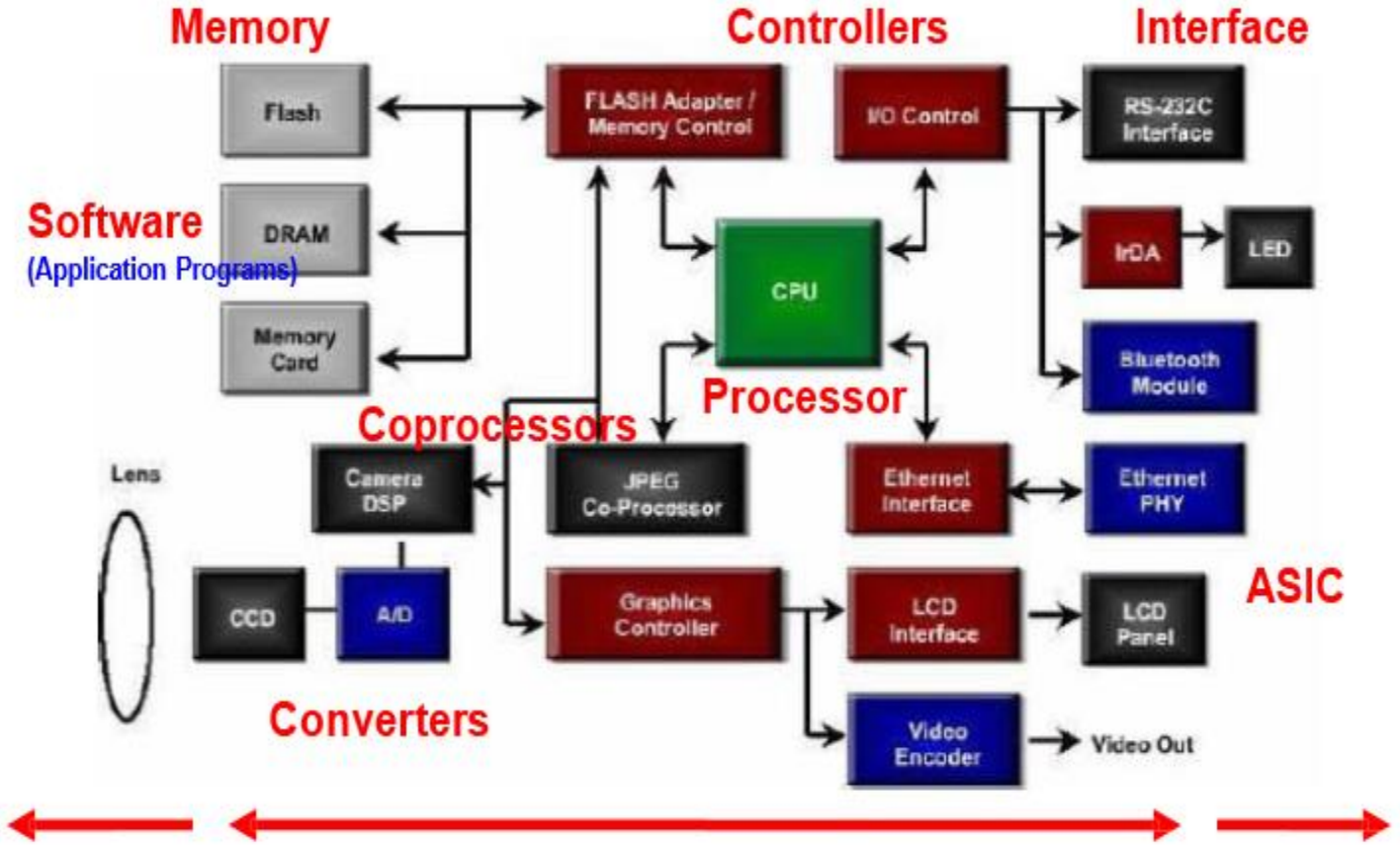
Factory control

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 and dryers


Flash
DRAM
Memory Card
FLASH Adapter / Memory Control
I/O Control
RS-232C Interface
IrDA
LED
CPU
Bluetooth Module
Lens
Camera DSP
JPEG Co-Processor
Ethernet Interface
Ethernet PHY
CCD
A/D
Graphics Controller
LCD Interface
LCD Panel
Video Encoder
Video Out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(Application Programs)
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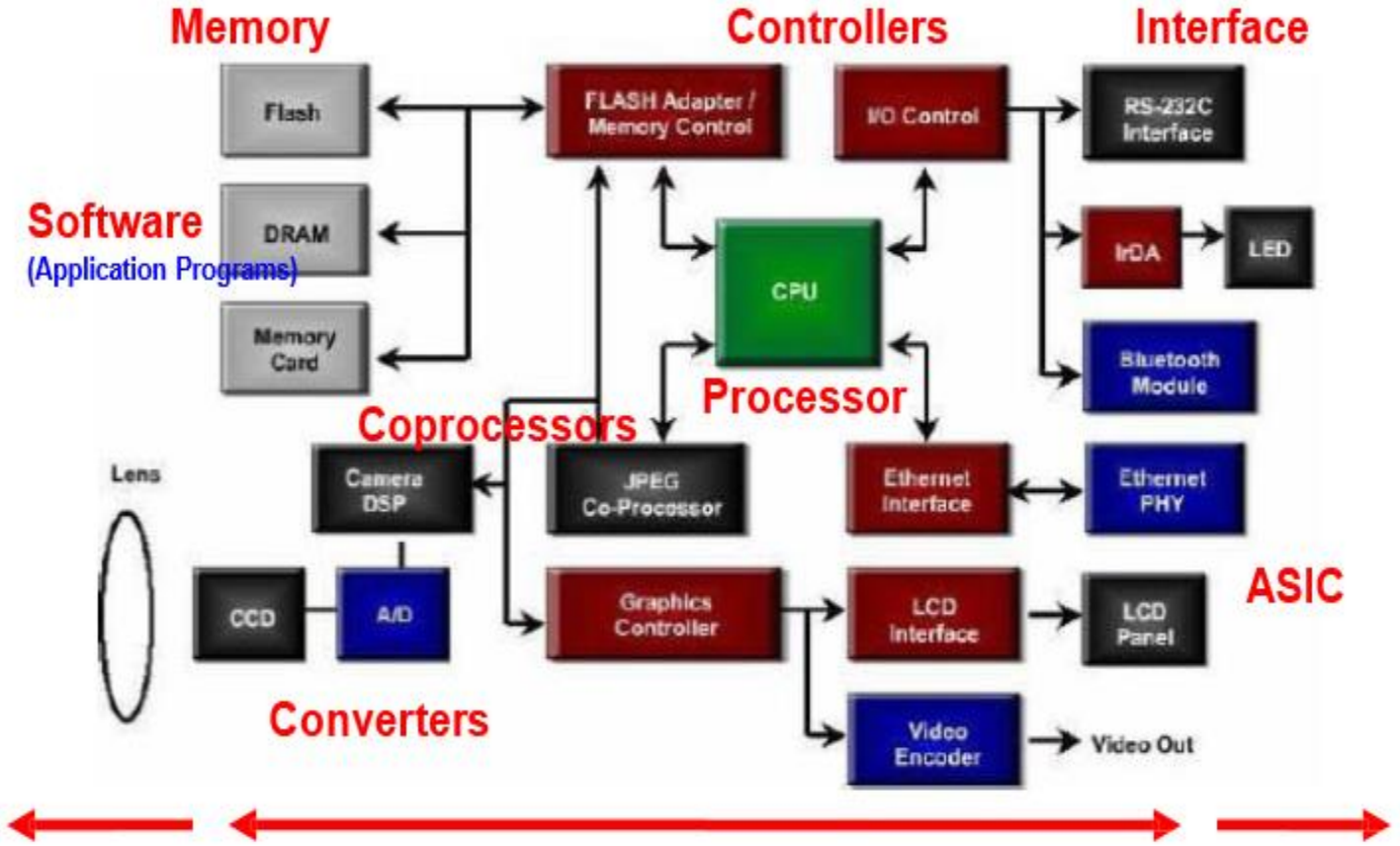
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- Analog Components
  - Sensors, Actuators, Controllers, …
- Digital Components
  - Processor, Coprocessors
  - Memories
  - Controllers, Buses
  - Application Specific Integrated Circuits (ASIC)
- Converters – A2D, D2A,…
- Software
  - Application Programs
  - Exception Handlers

- Analog Components
- Sensors, ActuToday'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
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