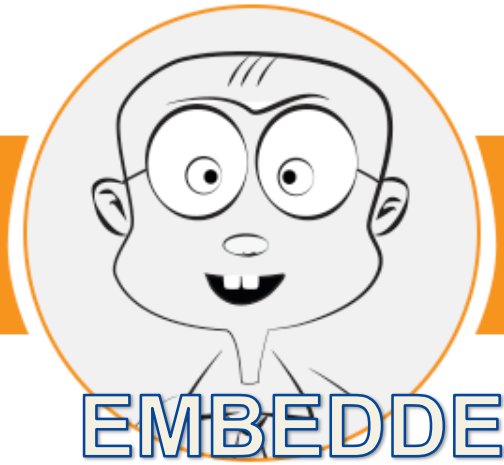

EMBEDDED SYSTEM COURSE

LECTURE 1: GETTING STARTED

Learning Goals

- Understanding about the embedded system and its products in real world
- Understanding about the microcontroller: a microprocessor and common architectures nowadays.

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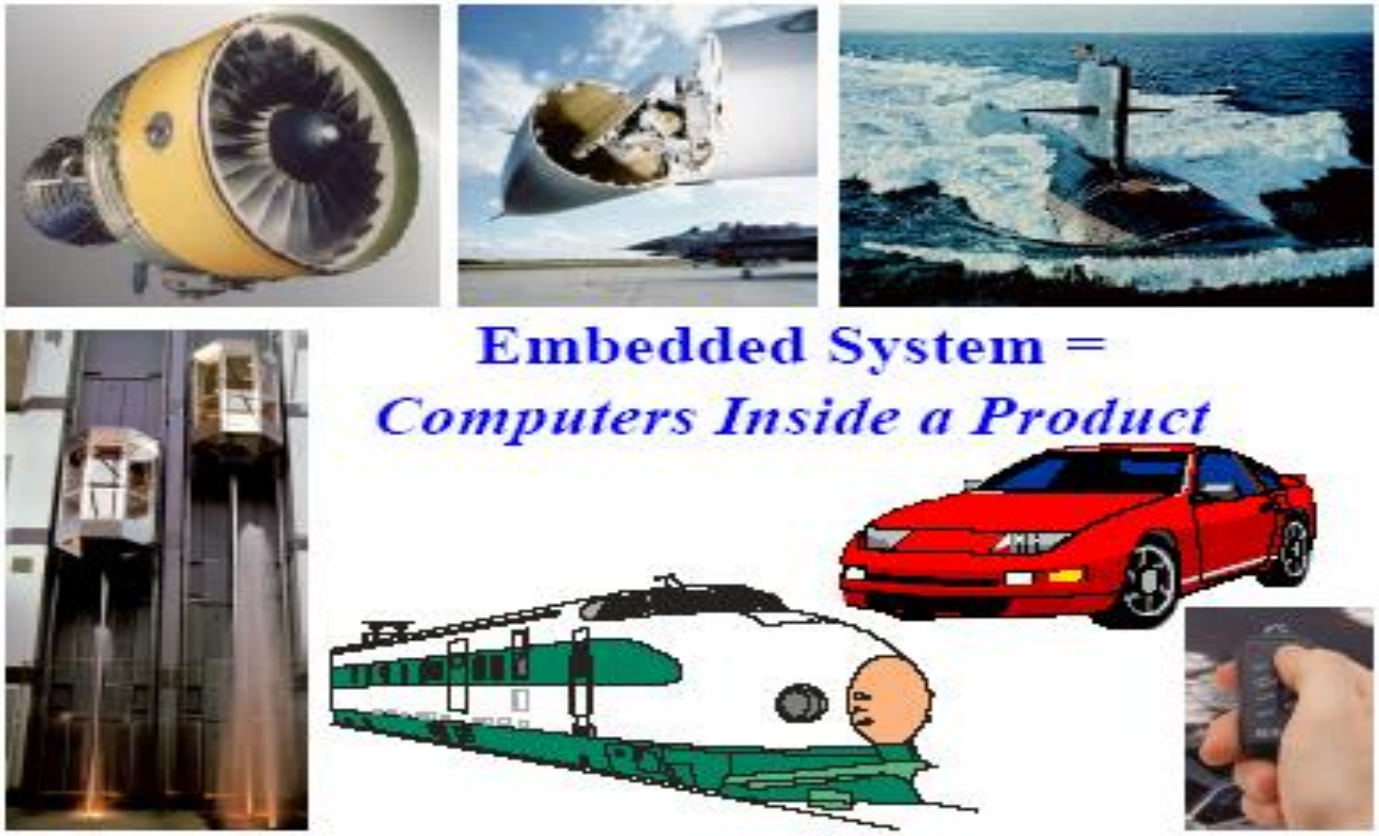
Embedded system Introduction

Definition



Embedded system Introduction

Definition

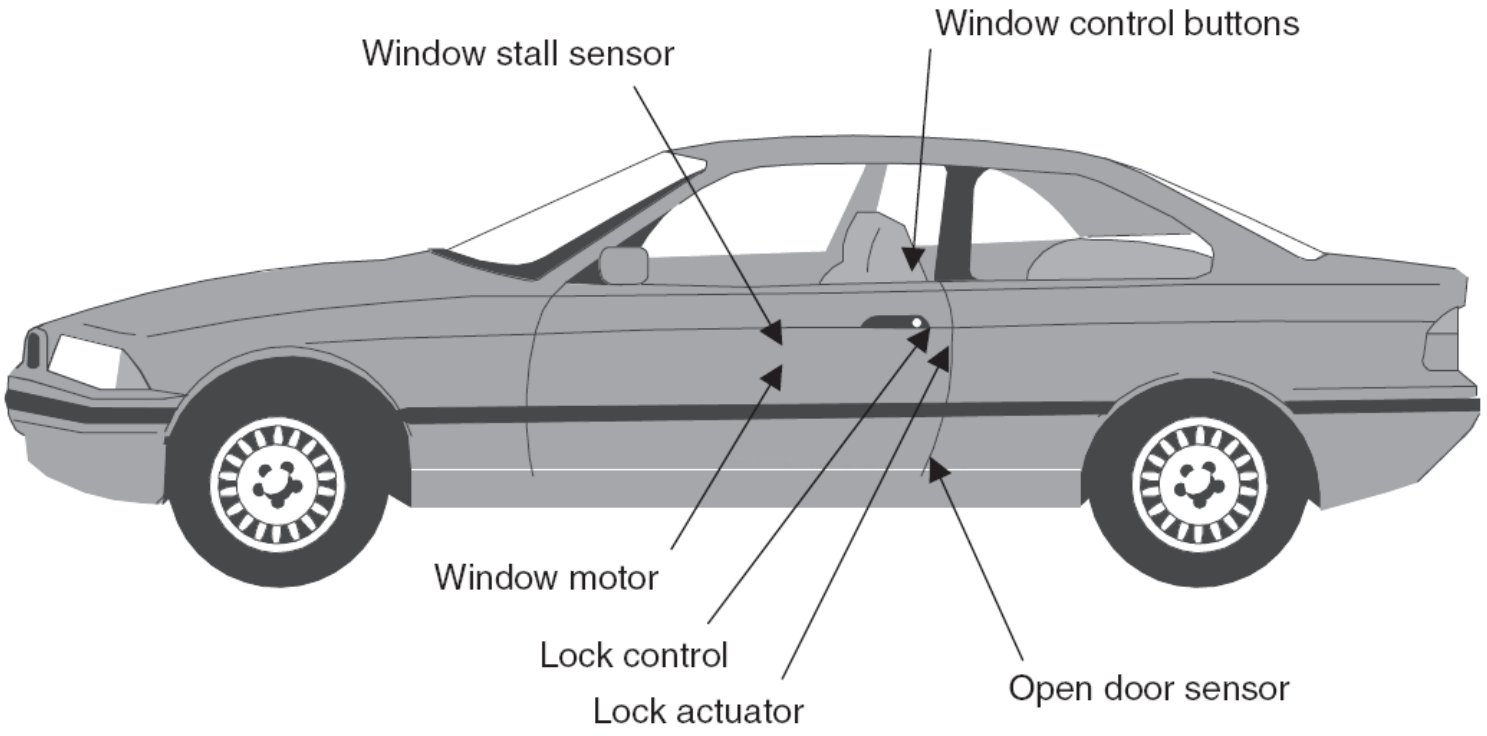
- An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts.

(wikipedia)

Embedded system Introduction

Example:

Embedded system used in Car Door



Embedded system Introduction

Application Area

- General Computing
  Video games, set-top boxes, wearable computer

- Control System
  Vehicle engine, nuclear power, fight control

- Signal Processing
  Radar, Sonar, video compression.

- Communication & Network
  Telephone system, router

Embedded system Introduction

Features:

- Embedded system is designed to perform some specific tasks.

- The program written for embedded system is called “firm-ware”, and usually stored in persistence memory (rom/flash)

- The firm-ware can run with limited hardware resourced.

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Microprocessors and Microcontrollers

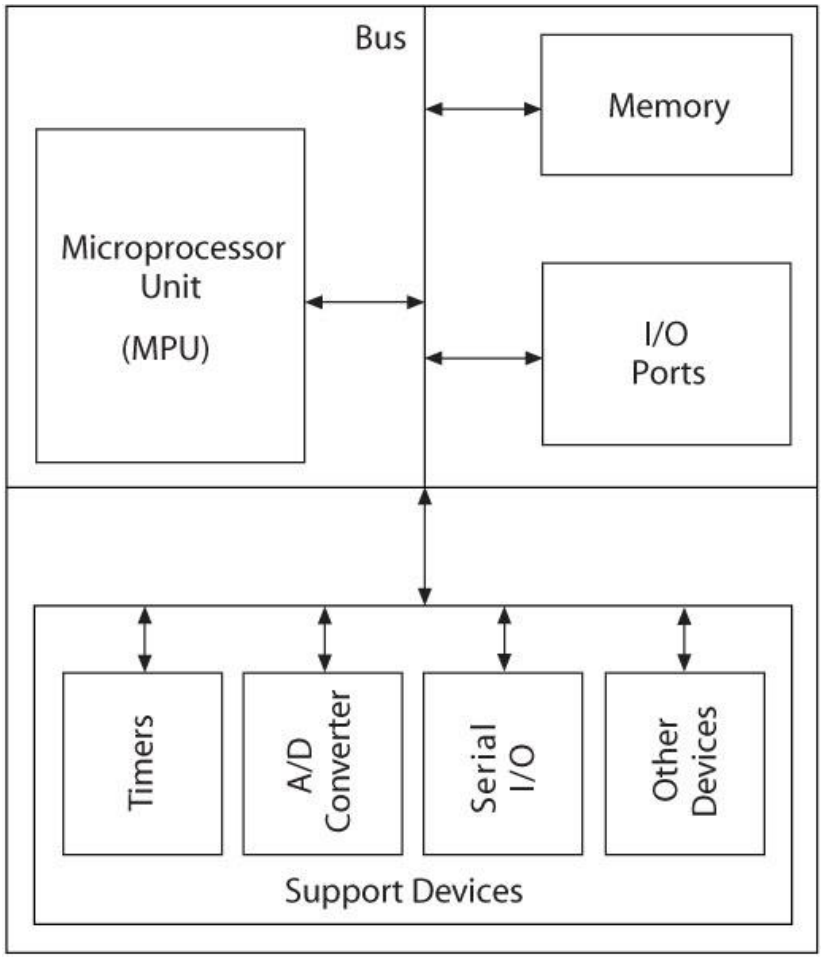
- The microprocessor is a processor on one silicon chip.
- The microcontrollers are used in embedded computing.
- The microcontroller is a microprocessor with added circuitry.

Microcontroller overview

- **Definition**

  MCU is integrated electronic computing device that includes three major components on a single chip:

  - Microprocessor
  - Memory
  - I/O ports

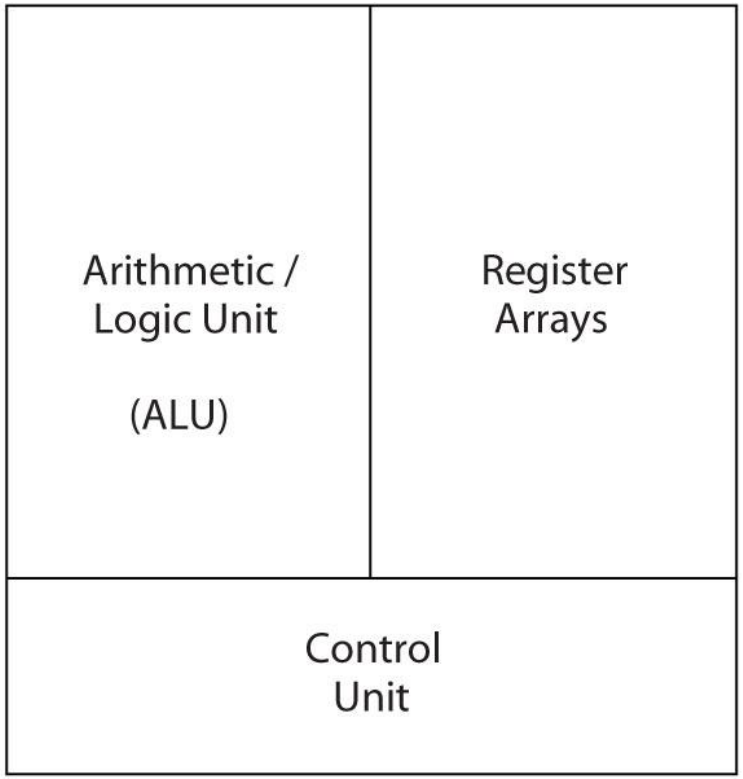


Microprocessor overview

- **Definition**

The microprocessor is a multipurpose, programmable device that accepts digital data as input, processes it according to instructions stored in its memory, and provides results as output.

(Wiki)



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Microprocessor architecture

- Communicates with Memory and I/O using the System Bus:

  Address bus

  - Unidirectional
  - Memory and I/O Addresses

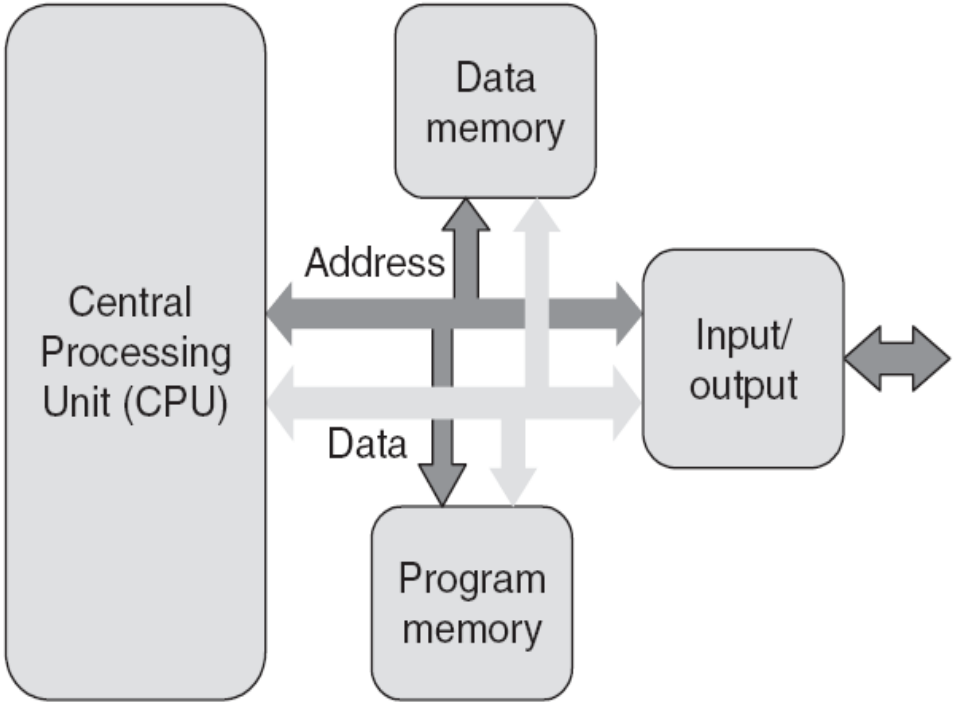
  Data bus

  - Bidirectional
  - Transfers Binary Data and Instructions

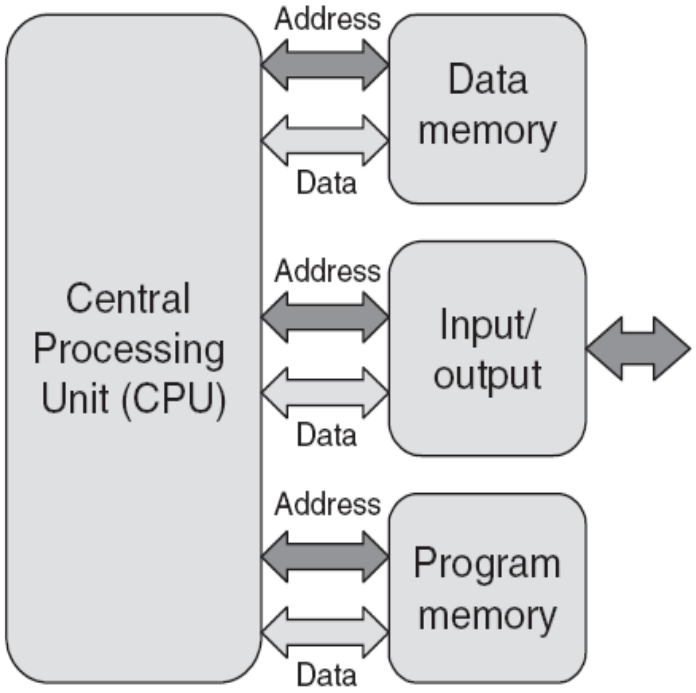
  Control lines

  - Read and Write timing signals

Microprocessor architecture



Von Neumann



Harvard

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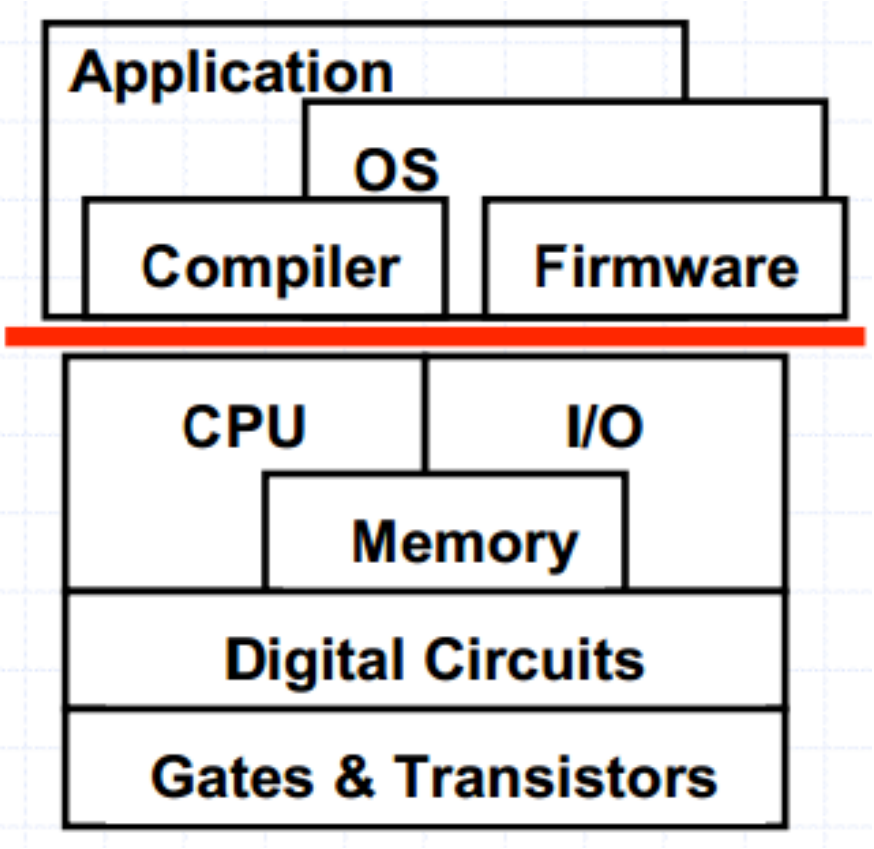
Instruction Set Architecture

How to talk to computers



Instruction Set Architecture

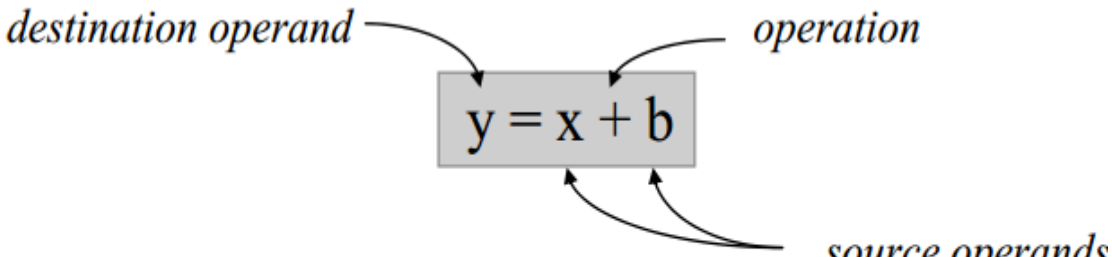
- **Definition**

ISA is the part of the computer architecture related to programming, including the native data types, instructions, registers, addressing modes, memory architecture, interrupt and exception handling, and external I/O.

(wiki)

How to design ISA

1. **Operations**
   - how many
   - which ones
2. **Operands**
   - how many
   - location
   - types
   - how to specify
3. **Instruction format**
   - Size
   - how many formats



(add r1, r2, r5)

CISC & RISC

CISC

- Fewer instructions to execute a given task than RISC
- Programs for CISC take less storage space than programs for RISC
- Arithmetic or other instructions may read their operand from memory and could write the result in memory

RISC

- Simpler instructions, faster execution speeds per instruction
- Cheaper to implement
- Load/Store architecture – only load and store are used to access the external memory

Summary

- An embedded system is a product that has one or more computers embedded within it.
- The embedded computer is usually a microcontroller: a microprocessor adapted for embedded control applications.
- There are two kinds of microprocessor architectures: Harvard & Von Neumann
- The ISA serves as the boundary between software and hardware

Question & Answer

Thanks for attention !

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