Introducing Embedded Systems and the Microcontrollers

Some contents are from:

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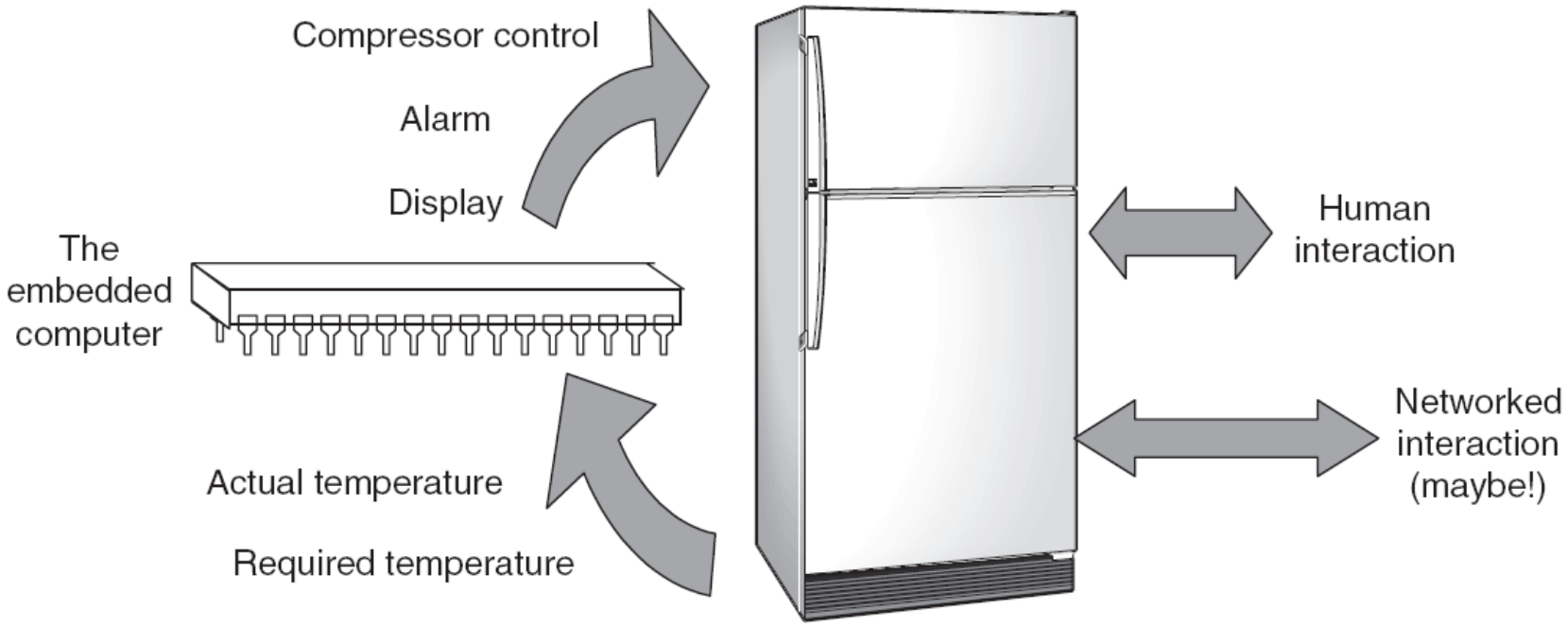
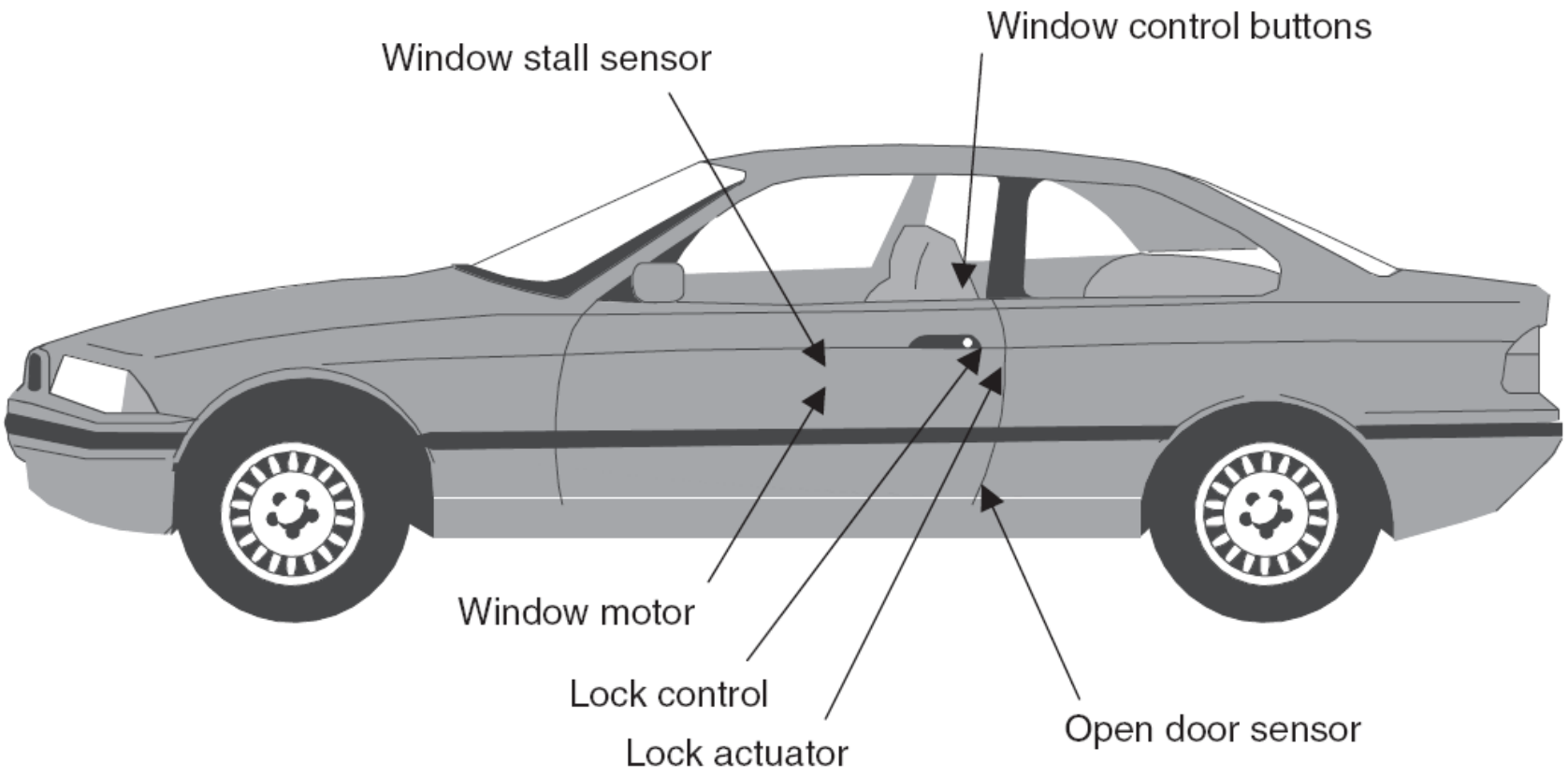
Definition

- **Embedded system**:
  - is a system whose principal function is not computational,
  - but which is controlled by a computer embedded within it.

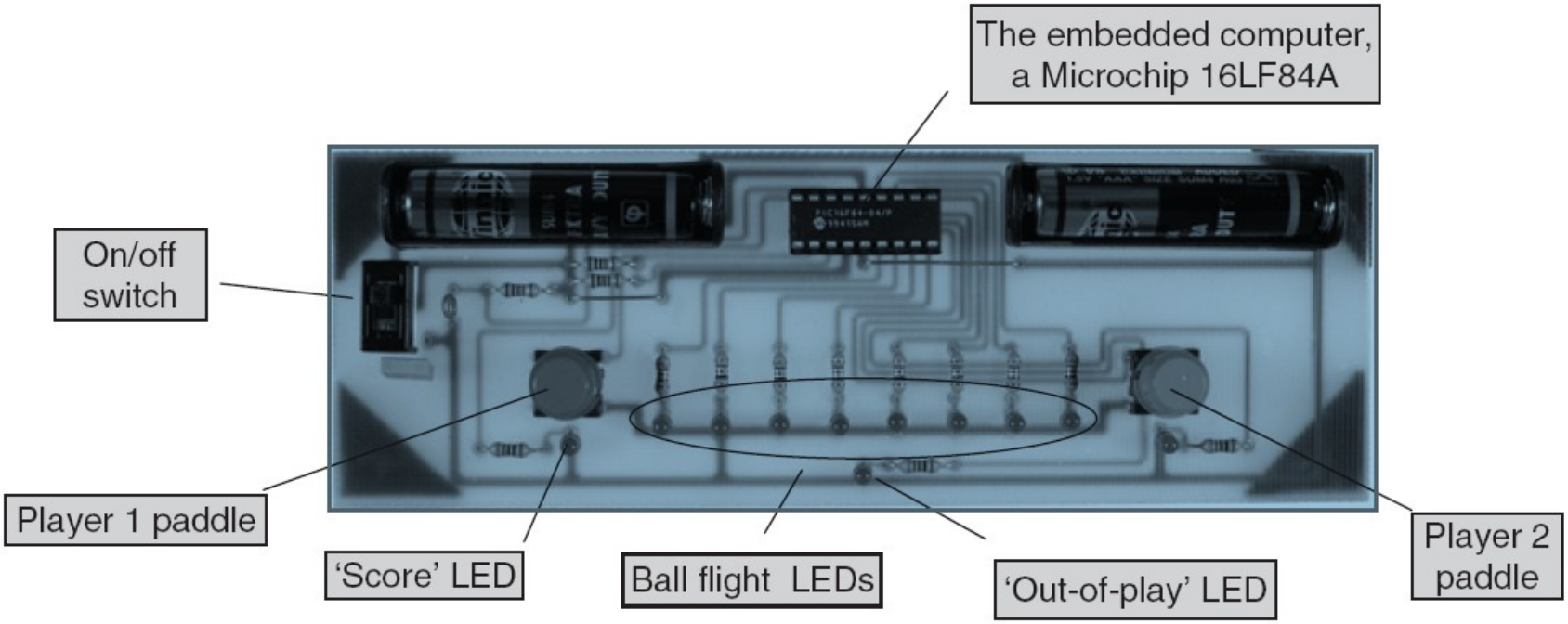
Examples: Refrigerator



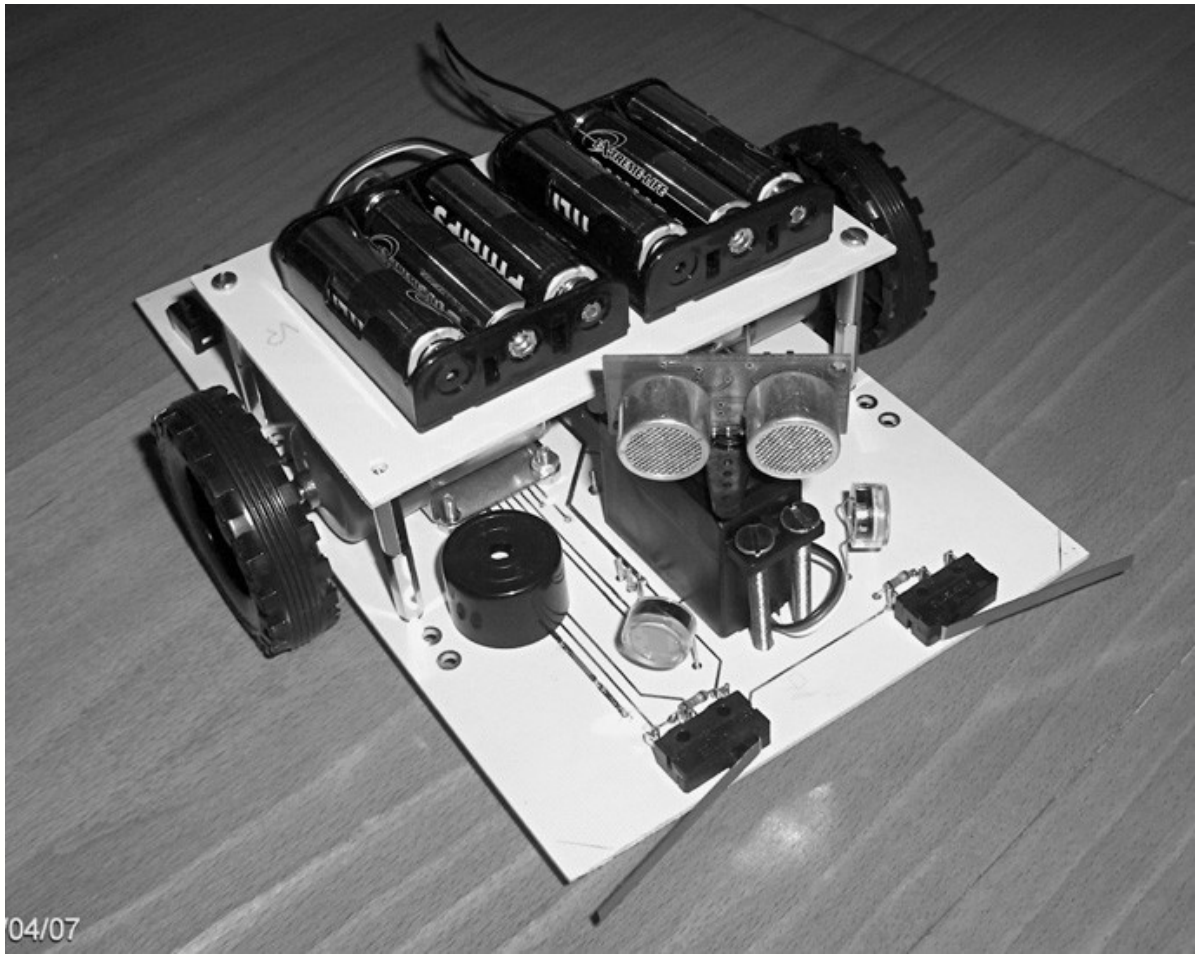
Examples: Car Door



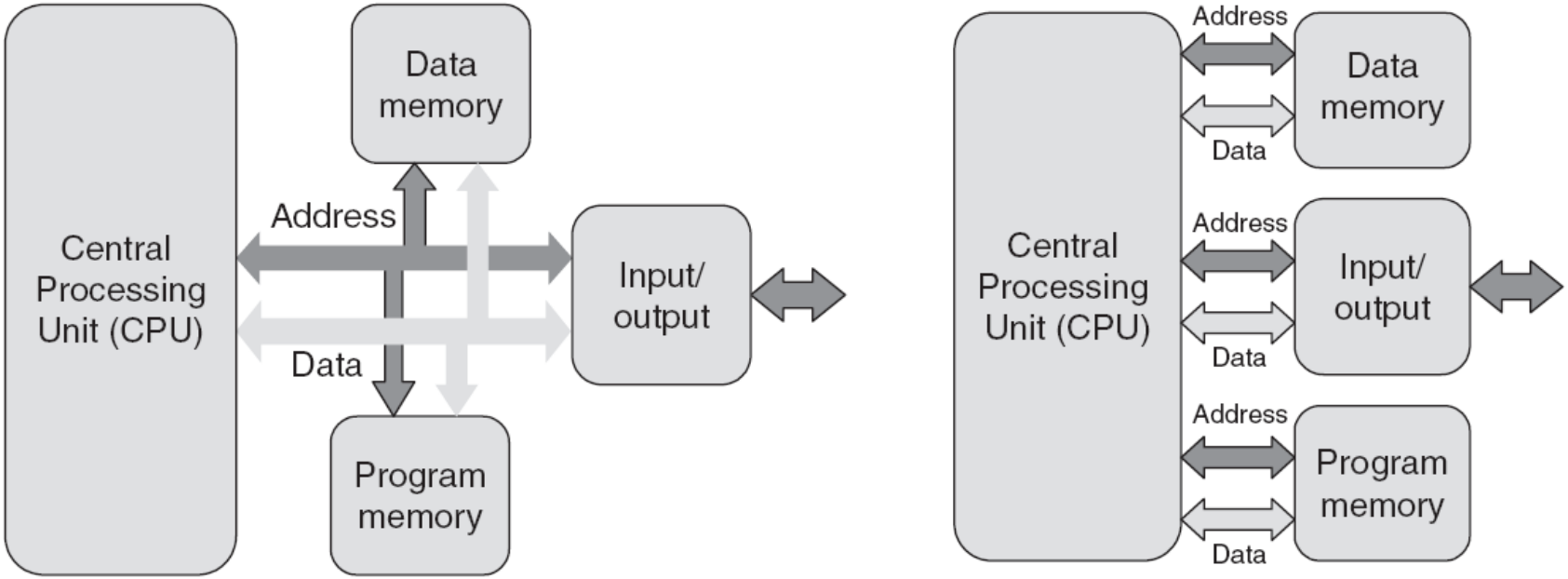
Examples: Electronic Ping-pong



Examples: Autonomous Vehicle



Von Neumann and Harvard Computers



Computer Essentials

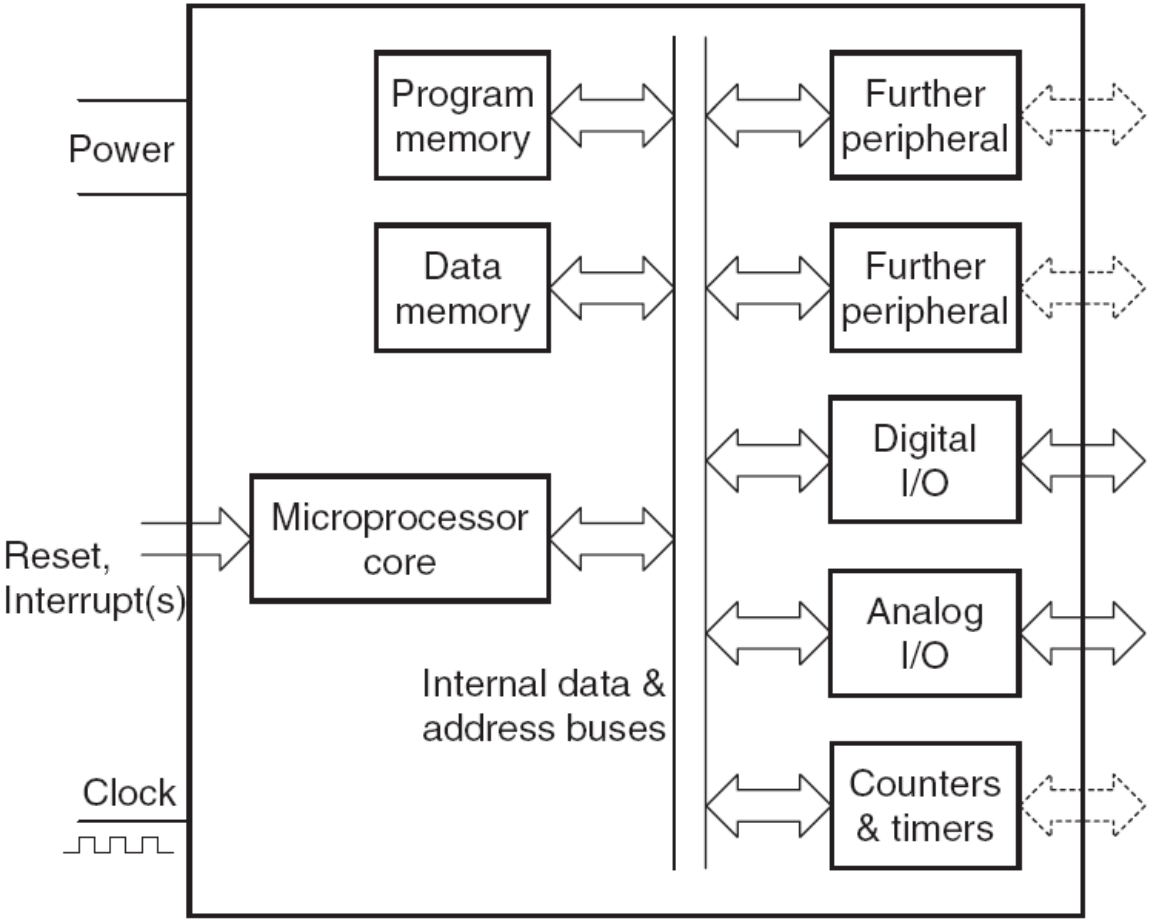
- Instruction Sets
  - CISC: Complex Instruction Set Computer
  - *RISC: Reduced Instruction Set Computer*
- Memory Types
  - Volatile: Random Access Memory (RAM)
  - Non-volatile: Read Only Memory (ROM)

Microprocessors and Microcontrollers

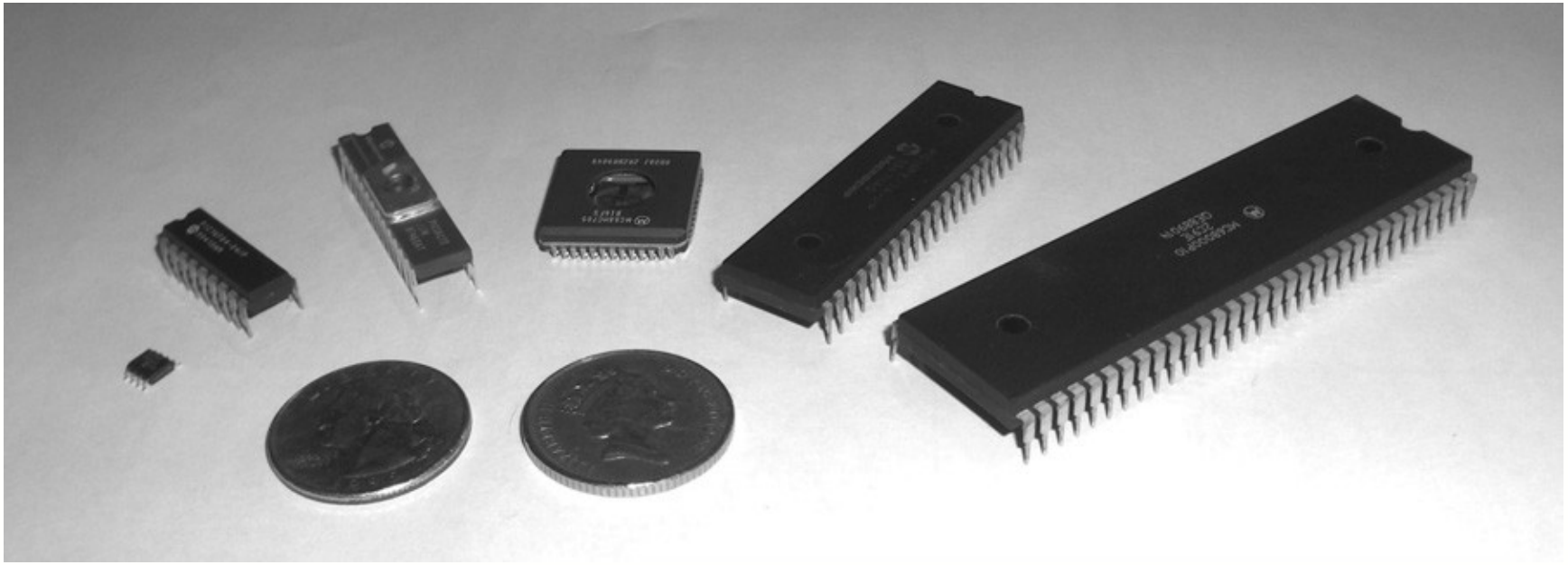
- Microprocessor is:
  - a processor on one silicon chip
  - Von Neumann architecture
  - RISC or CISC
  - Integrated cache memory

- The microcontrollers are microprocessor:
  - used in embedded computig
  - Harvard architecture
  - RISC
  - With integrated RAM, ROM, Flash and eeprom
  - with added integrated peripherals.

Microcontrollers



Microcontroller Packaging and Appearance



From left to right: PIC 12F508, PIC 16F84A, PIC 16C72, Motorola 68HC05B16, PIC 16F877, Motorola 68000

PIC Microcontrollers

- Peripheral Interface Controller (PIC) was originally designed by General Instruments
- In the late 1970s, GI introduced PIC® 1650 and 1655 – RISC with 30 instructions.
- PIC was sold to Microchip
- Features: low-cost, self-contained, 8-bit, Harvard structure, pipelined, RISC, single accumulator, with fixed reset and interrupt vectors.

PIC Families

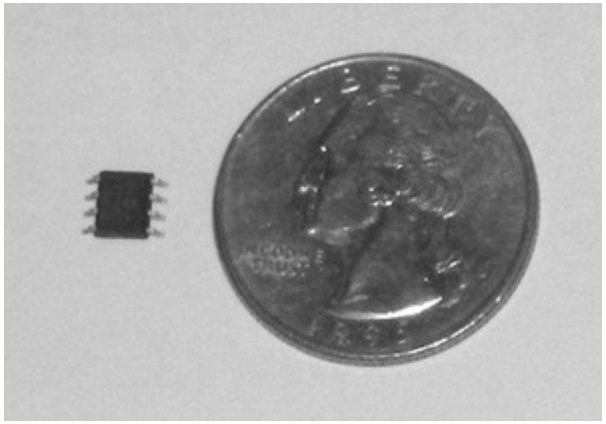
PIC Family	Stack Size	Instruction Word Size	No of Instructions	Interrupt Vectors
12CX/12FX	2	12- or 14-bit	33	None
16C5X/16F5X	2	12-bit	33	None
16CX/16FX	8	14-bit	35	1
17CX	16	16-bit	58	4
18CX/18FX	32	16-bit	75	2

‘C’ implies CMOS technology; Complementary Metal Oxide Semiconductor

‘F’ insert indicates incorporation of Flash memory technology

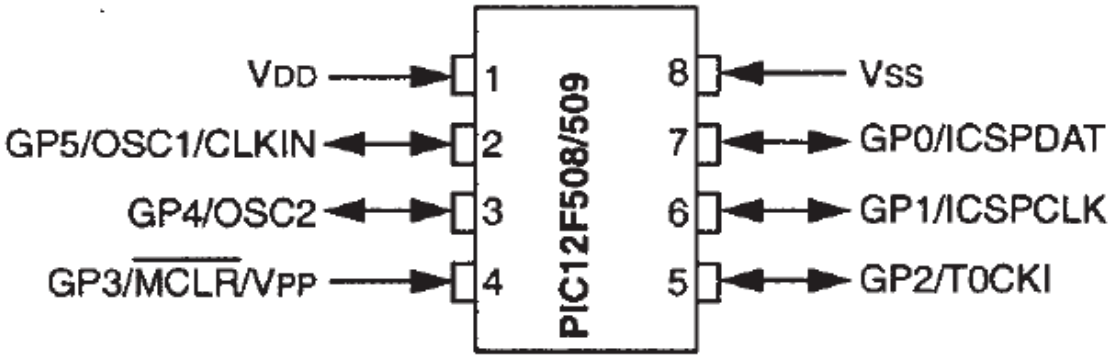
Example: 16C84 was the first of its kind. It was later reissued as the 16F84, incorporating Flash memory technology. It was then reissued as 16F84A.

12 Series PIC



The small 12F508

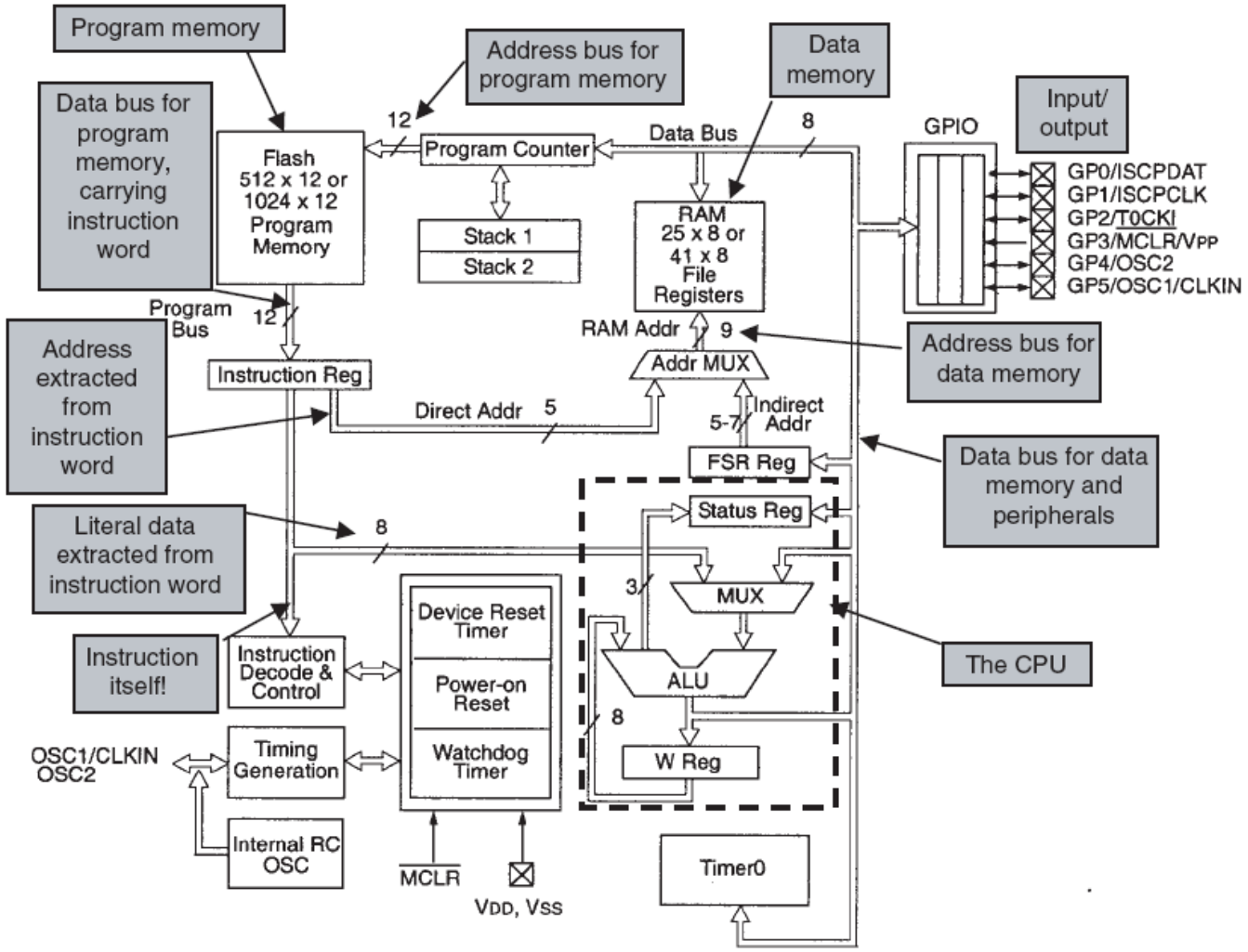
PIC 12F508/509 pin connection diagram



Key

V_{DD}:	Power supply	V_{SS}:	Ground
V_{PP}:	Programming voltage input	MCLR:	Master clear
OSC1, OSC2:	Oscillator pins	CLKIN:	External clock input
GP0 to GP5:	General-Purpose input/output pins (bidirectional except GP3)		
CSPDAT:	In-Circuit Serial Programming™ data pin.		
CSPCLK:	In-Circuit Serial Programming™ clock pin.		

The 12F508 Architecture



Summary

- An embedded system is a product that has one or more computers embedded within it, which exercise primarily a control function.
- The embedded computer is usually a microcontroller: a microprocessor adapted for embedded control applications.
- Microcontrollers are designed according to accepted electronic and computer principles, and are fundamentally made up of microprocessor core, memory and peripherals.
- Microchip offers a wide range of microcontrollers, divided into a number of different families. Each family has identical central architecture and instruction set. However, common features also appear across all their microcontrollers.
- The Microchip 12F508 is a good microcontroller to introduce a range of features of microcontrollers in general and of PIC microcontrollers in particular.