Topic for today:

An overview of embedded systems

Embedded system

An embedded system is a computer-like processor that has a dedicated purpose as part of a bigger system.

Examples?

How is an embedded system different from a general-purpose processor?

- Division between hardware and software is less obvious
- Awareness of hardware context
- Physical constraints

Hardware context / physical constraints:

- Size
- Power source
- Heat

How is an embedded system different from a general-purpose processor?

- Division between hardware and software is less obvious
- Awareness of hardware context
- Physical constraints
- Timing

Real-Time Systems

Embedded systems are often required to provide ***real-time response***.

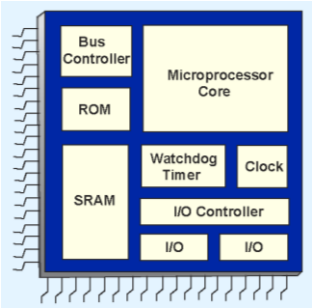
Off-the Shelf Hardware

- Micro-controllers
- SOCs

Microcontroller

- CPU, memory, I/O controller, bus, everything, all on one chip
- Available “off the shelf”
- Limited memory
- Built-in device to re-boot the system if it gets stuck (“watchdog timer”)

Embedded Hardware Overview



Systems on a Chip (SOCs)

Full blown computer systems-- including all supporting circuits-- that are etched on a single die.

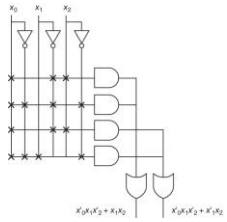
Configurable Hardware

Programmable logic devices (PLDs)

- Programmable array logic (PAL)
- Programmable logic array (PLA)
- Field programmable gate arrays (FPGAs)

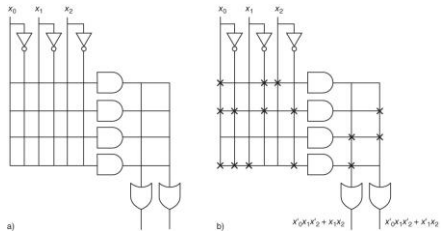
Programmable Array Logic (PAL's)

- Allow you to create your own combinational circuit (*without wiring!*)
- Built on SOP circuit pattern



Programmable Logic Arrays (PLA's)

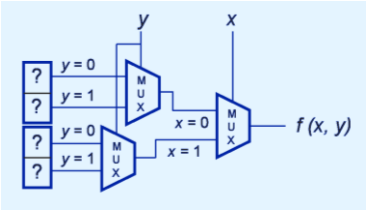
Consist of programmable AND gates connected through programmable OR gates.



a) A programmable logic array b) A PLA reusing a minterm

Field-Programmable Gate Arrays (FPGA)

The behavior of field programmable gate arrays (FPGAs) is controlled through values stored in memory lookup tables rather than by changing connections between logic elements



Custom-designed hardware

- Expensive!
- Real premium for getting the design right *before* going into production

Hardware definition languages

- Allow you to simulate hardware in software easily, by specify components/ circuits/etc.
- Old examples: Verilog, VHDL
- Newer examples: SystemC, SpecC