

CSE 331

Microprocessor Interfacing and Embedded System

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The Essence of Embedded System

- Definition of Embedded System
- Latest Trends of Embedded System
- Microprocessor
- Microcontroller
- Von Neumann Architecture Vs Harvard Architecture
- RISC Vs CISC
- Competition of Processing Cores of Embedded System

What is an Embedded System?

- *A combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a dedicated function.*
- *Depending on the application, embedded systems can be an independent system or are part of a larger system or product,*
- *Examples range from washing machines, cellular phones to missiles and space shuttles.*

What is an Embedded System?

- Often the user of the device is not even aware that a computer is present.



Microprocessors
are everywhere in
our life.

Where are the embedded devices?



Embedded Rocks!

- Embedded processors account for 100% of worldwide microprocessor production!
- Embedded:desktop = 100:1

- Embedded Systems is a big, fast growing industry
 - \$ 40 billions in 2000
 - \$92.0 billion in 2008
 - \$112.5 billion (estimated) by the end of 2013
- **Embedded hardware** was worth \$89.8 billion in 2008 and is expected to reach \$109.6 billion in 2013
- **Embedded software** generated \$2.2 billion in 2008. This should increase to \$2.9 billion in 2013
- **Microprocessors/Microcontrollers are the core of embedded systems.**

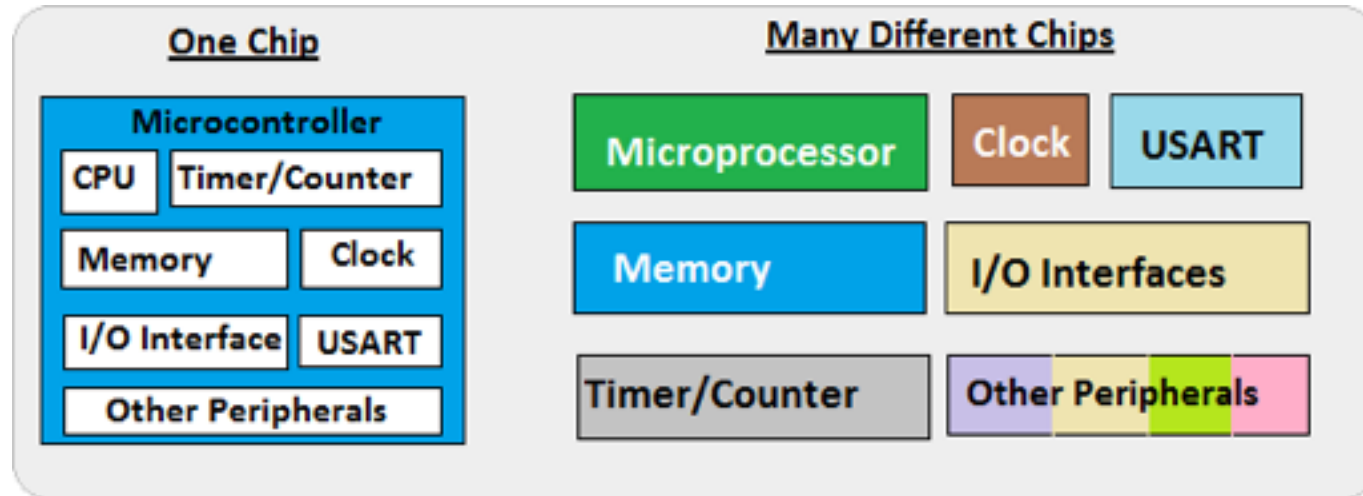
Microcontrollers vs Microprocessors

- A microprocessor is a CPU on a single chip.
- If a microprocessor, its associated support circuitry, memory and peripheral I/O components are implemented on a single chip, it is a microcontroller.
- Example : Run a motor using MCU/MPU?

Microprocessor vs. Microcontroller

Computational capacity of microprocessor is very high	Less computational capacity when compared to microprocessors. Usually used for simpler tasks.
Microprocessors have integrated Math Coprocessor . Complex mathematical calculations which involve floating point can be performed with great ease.	Microcontrollers do not have math coprocessors. They use software to perform floating point calculations which slows down the device.
The overall cost of a system built using a microprocessor is high.	Cost of a system built using a microcontroller is less
Generally power consumption and dissipation is high because of the external devices. Hence it requires external cooling system.	Power consumption is less.
The clock frequency is very high usually in the order of Giga Hertz.	Clock frequency is less usually in the order of Mega Hertz.

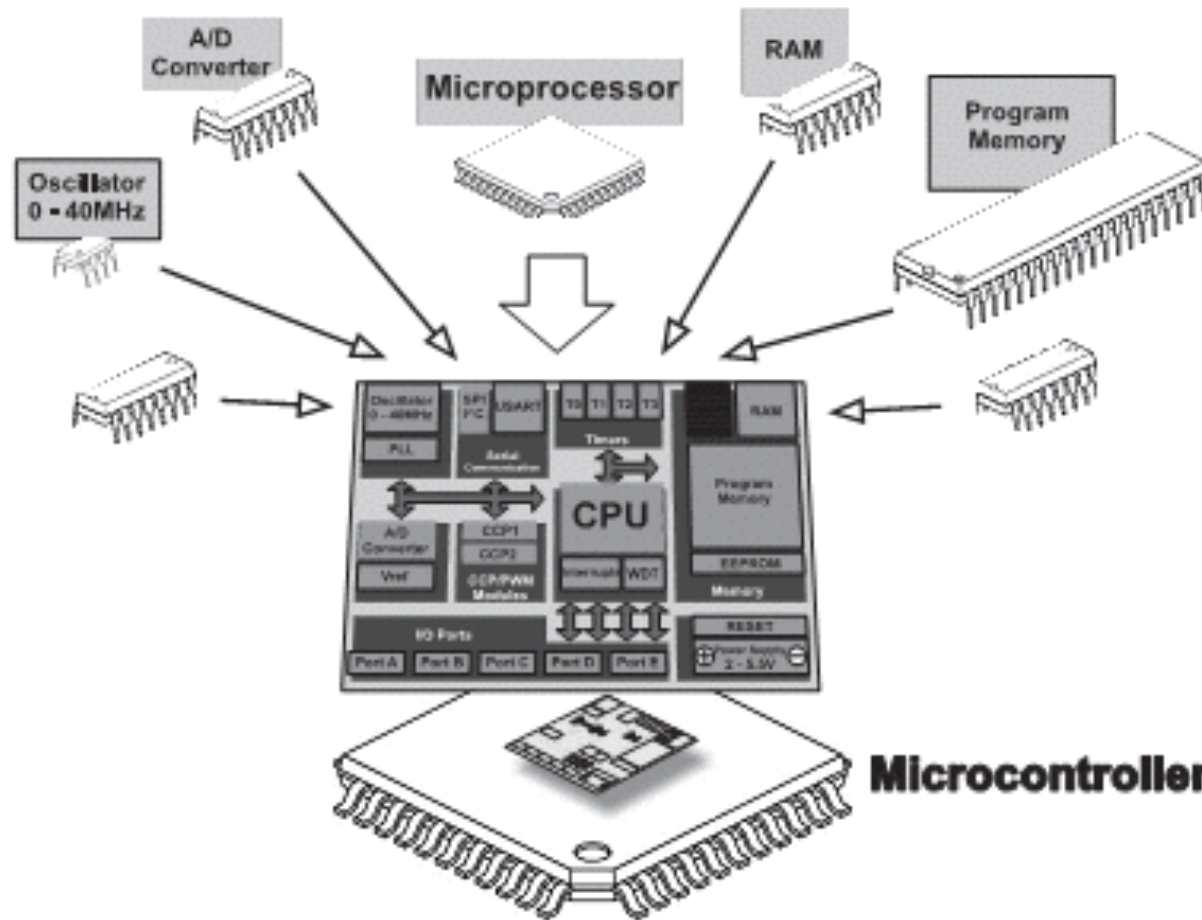
Microcontroller vs Microprocessor



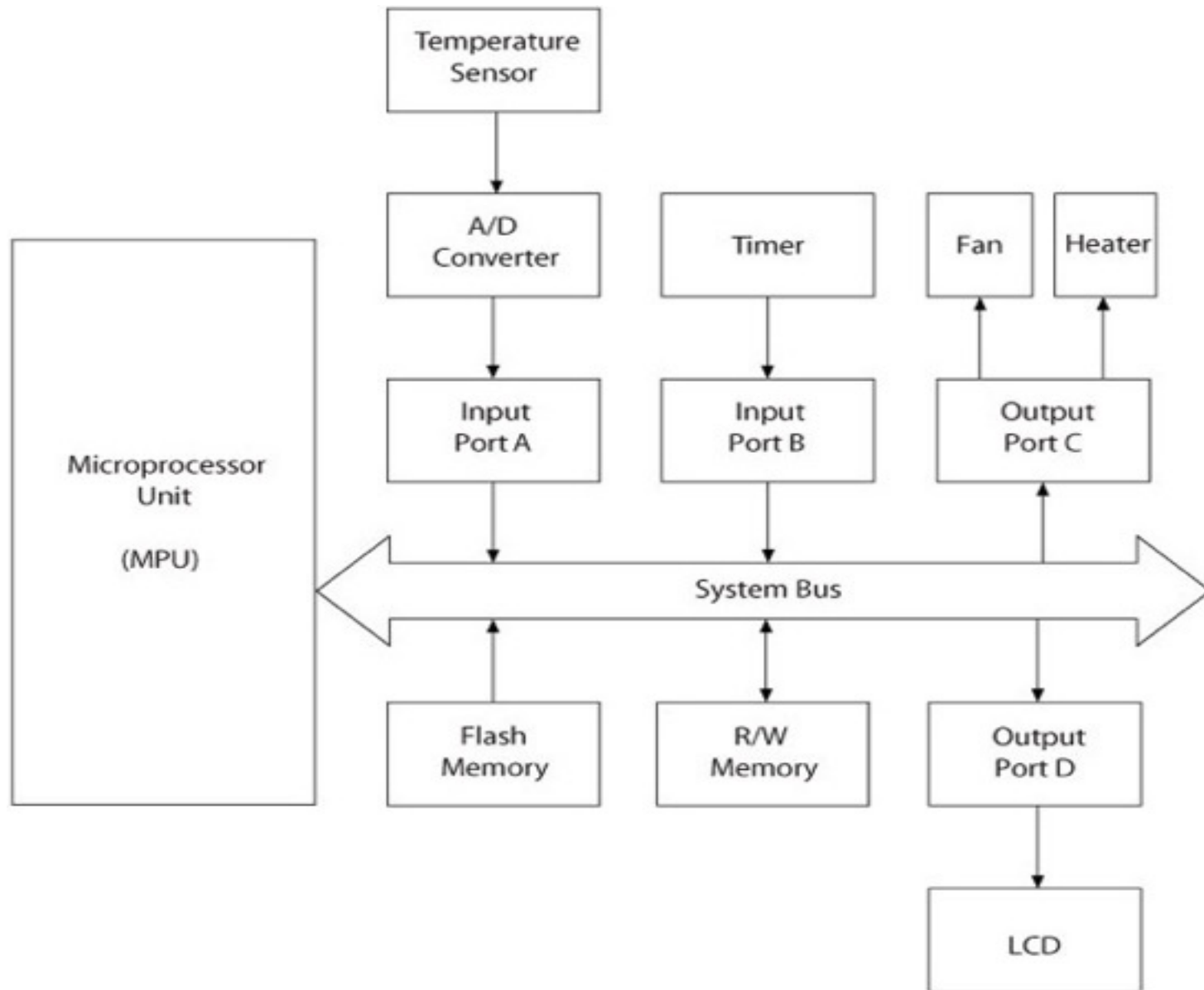
AVR Tutorials Diagrams
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A **Microprocessor** is just a CPU. One has to add externally memory, clock, input/output interfaces, timer and all other needed peripheral. This is the reason a microprocessor has so many pins.

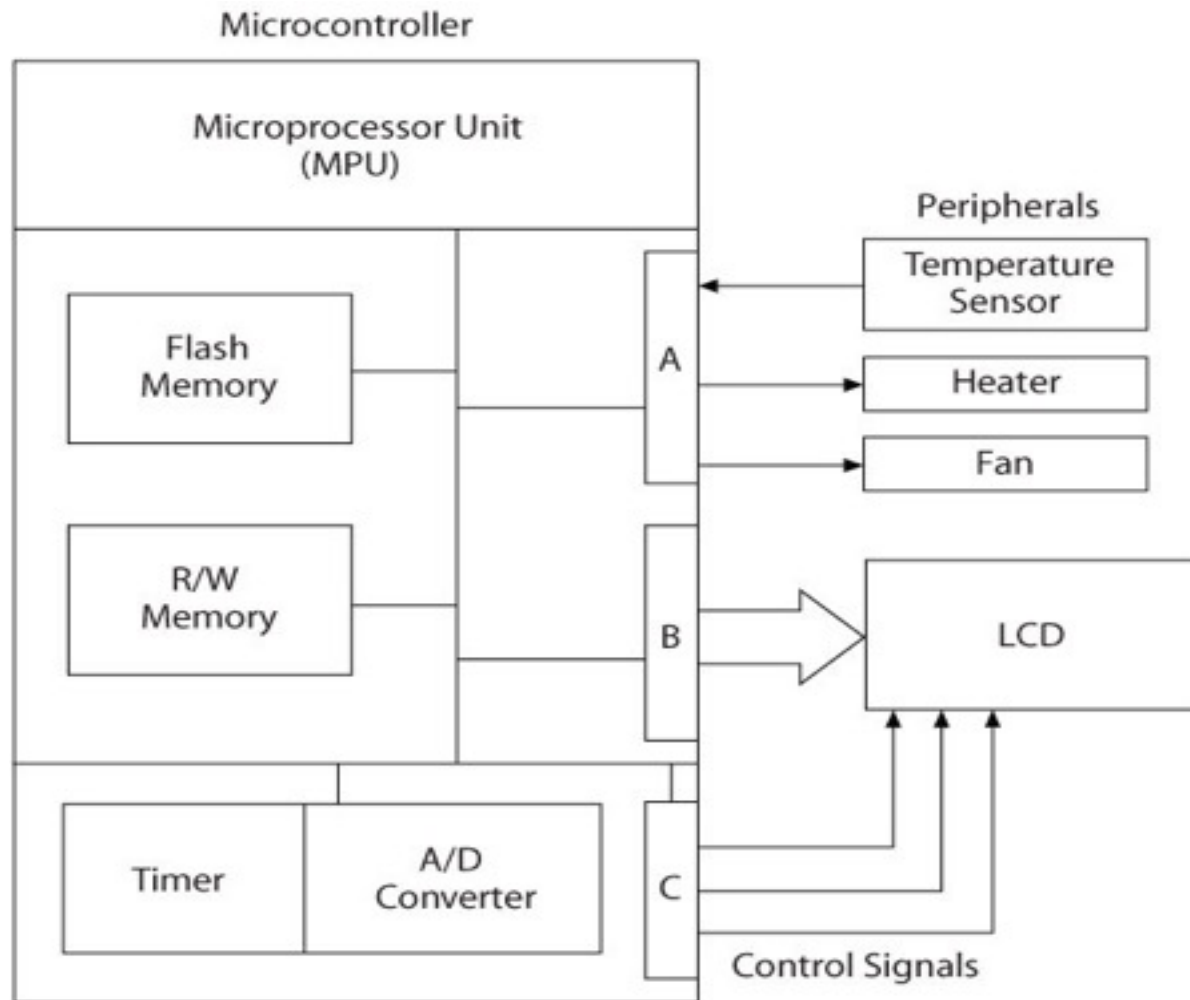
Microcontroller vs Microprocessor



MPU-Based Time and Temperature System



MCU-Based Time and Temperature System



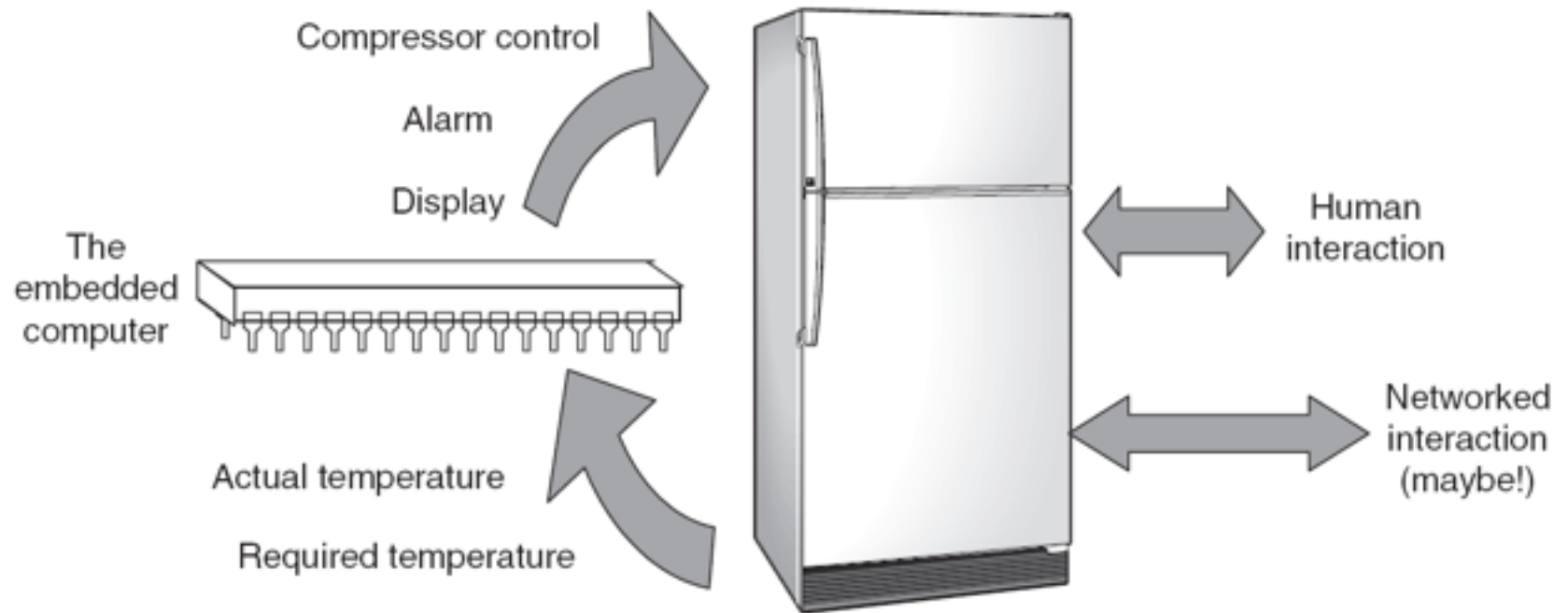
Appli!

- **Application** of microcontrollers are numerous.
 - Domestic applications such as in washing machines, TVs, air-conditioners,
 - Automobiles, process control industries, cell phones, electrical drives, robotics and in space applications.
 - Biomedical instruments
 - Communication systems
 - Controller, Control systems
 - Instrumentations, etc.

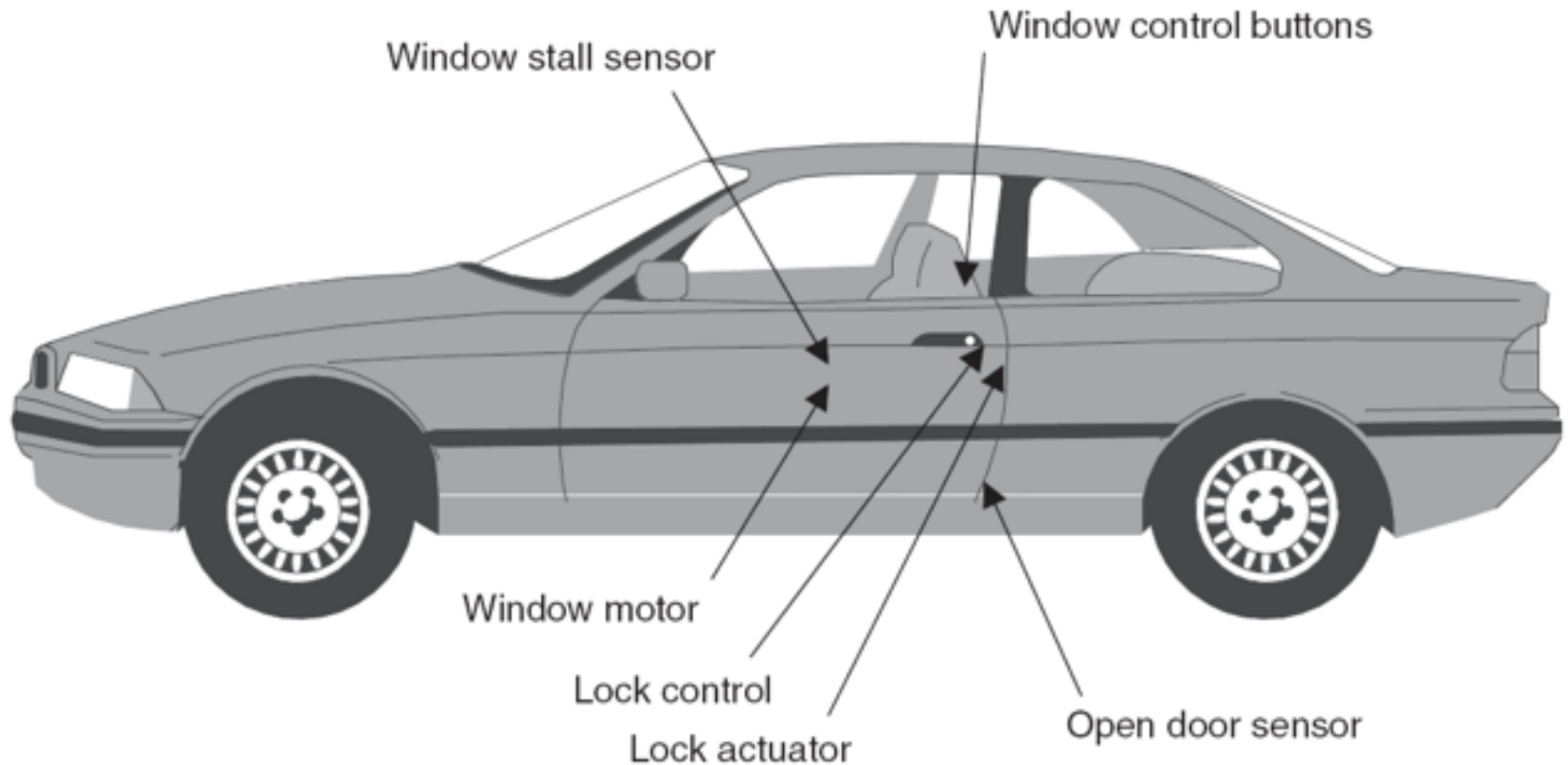
Appli.

- Instrumentations: Data collection, oscilloscopes, signal generators, signal analyzers, power supplies.
- Industrial: Elevator controls, surveillance systems, robots.
- Home: Dishwashers, microwave ovens, VCRs, televisions, stereos, fire/security alarm systems, lawn sprinkler controls, thermostats, cameras, clock radios, answering machines.
- Printers, scanners, keyboards, displays, modems, hard disk drives, CD-ROM drives.

Examples: Refrigerator



Examples: Car Door



What is your take?

- Identify an embedded system?
- Identify a microcontroller?
- Understand the difference between a microcontroller and a microprocessor