Microcontroller and DSP System

Various Applications Using Arduino Microcontroller….

Third Year, 1st Semester

Lecture No.1

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Content of Lectures

Microcontroller

A microcontroller is a small, low-cost computer-on-a-chip which usually includes:

1. An 8- or 16-bit microprocessor (CPU).
2. A small amount of RAM.
3. Programmable ROM and/or flash memory.
4. Parallel and/or serial I/O.
5. Timers and signal generators.
6. Analog to Digital (A/D) and/or Digital to Analog (D/A) conversion.

• Often used to run dedicated code that controls one or more tasks in the operation of a device or a system.

• Also called embedded controllers, because the microcontroller and support circuits are often built into, or embedded in, the devices they control.

• Devices that utilize microcontrollers include car engines, consumer electronics (VCRs, microwaves, cameras, pagers, cell phones ....), computer peripherals (keyboards, printers, modems...), test/measurement equipment (signal generators, multimeters, oscilloscopes …).

• Microcontrollers usually must have low-power requirements (~. 05 - 1 Watt as opposed to ~10 - 50 W for general purpose desktop CPUs) since many devices they control are battery-operated.

The difference between Microprocessor and Microcontroller:

- Microprocessor - A single chip that contains the CPU or most of the computer.
- Microcontroller - A single chip used to control other devices.

Microprocessor	**Microcontroller**
• **CPU is stand-alone, RAM, ROM, I/O, timer is separate.**	• **CPU, RAM, ROM, I/O and timer are all on a single chip.**
• **designer can decide on the amount of ROM, RAM and I/O ports.**	• **Fixed amount of on-chip ROM, RAM, I/O ports.**
• **Expensive.**	• **Inexpensive.**
• **Multipurpose.**	• **Single-purpose.**
• **High processing power.**	• **Low processing power.**
• **High power consumption.**	• **Low power consumption.**
• **Typically, 32/64 – bit.**	• **Typically, 8/16 bit.**
• **Typically, deep pipeline (5-20 stages).**	• **Typically, single-cycle/two-stage pipeline.**

Examples:

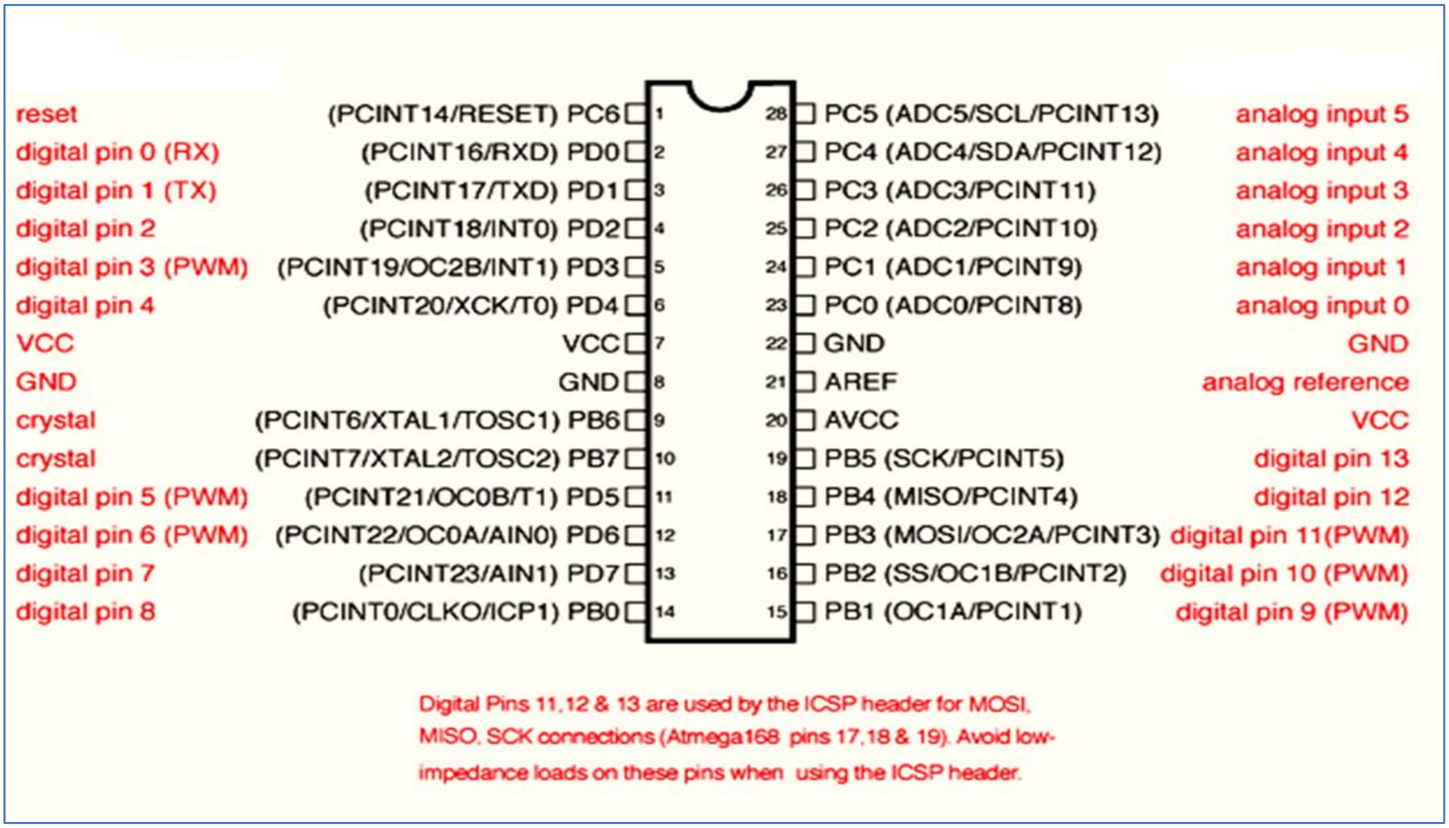
Microprocessor - Pentium, PowerPC chip in your computer.

Microcontroller - 68HC11, 68332, MPC555.

A microcontroller is essentially a microprocessor with several other features embedded onto a single chip

Examples of things that use microcontrollers

Automobiles, Automatic Cameras, CD player, etc.



The pin diagram of Microcontroller

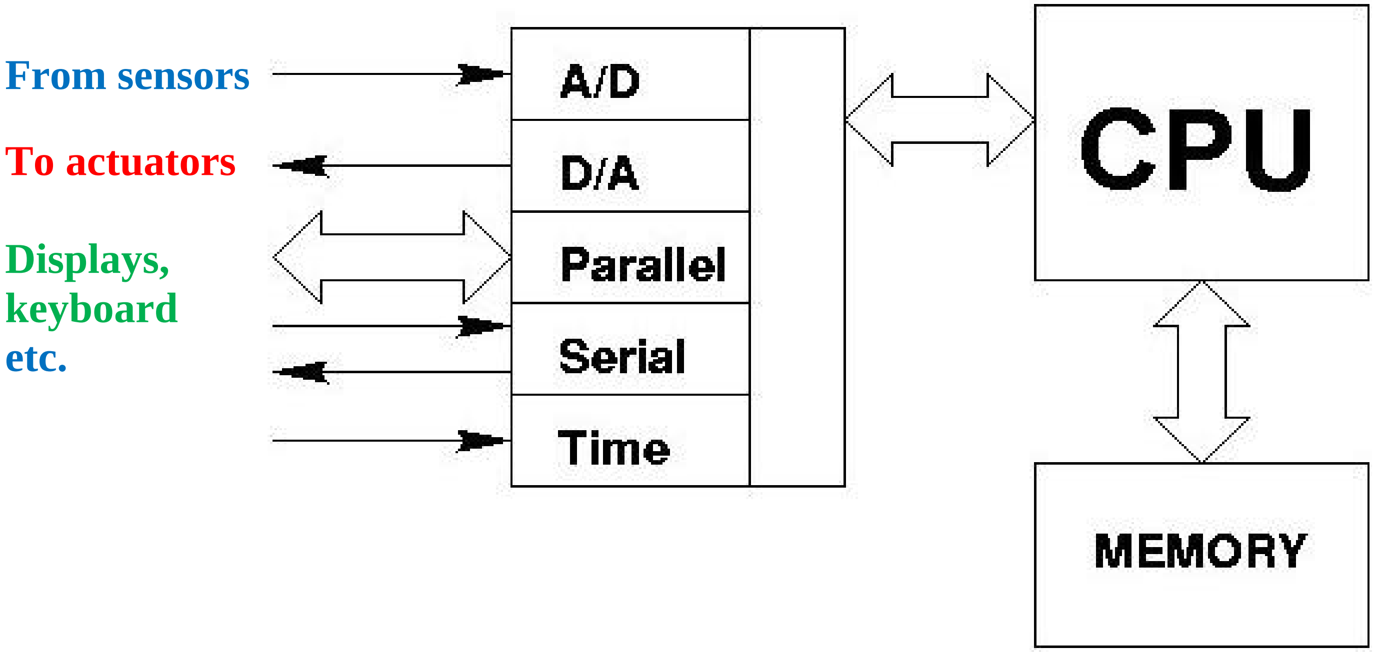
Why uses a microcontroller?

1. Reduce chip count.
2. Many applications do not require as much computing power.
3. Reduced power consumption.
4. Reduced design cost.

❖ In fact, industry sells 10 times as many microcontrollers as microprocessors.

What are the parts of a microcontroller?

1. CPU
2. Memory
3. I/O (Input/Output)



Basic a microcontroller diagram

• CPU

Central **P**rocessing **U**nit

"Smart part" of the computer that processes data and makes decisions Has all the parts of a normal microprocessor.

• Memory

RAM – Random Access Memory – Storing data while microcontroller is running

ROM – Read Only Memory – Store bootup data information

EEPROM or EPROM – Persistent storage of data parameters that can be rewritten

Example: Alarm clock saving the time when the power goes off.

• I/O

Methods to interact with the world outside the microcontroller

A typical CPU takes up only a small portion of the actual silicon real estate of a microcontroller leaving additional space for other features.

Examples:

- A/D – Analog to Digital Converter
- Temperature Sensor
- Display controller
- Timing circuits
- Communication circuits
- Parallel, Serial, Ethernet

All controllers of a family contain the same processor core and hence are code-compatible, but they differ in the additional components like the number of timers or the amount of memory. There are numerous microcontrollers on the market today, as you can easily confirm by visiting the webpages of one or two electronics vendors and browsing through their microcontroller stocks. You will find that there are many different controller families like 8051, PIC, HC, ARM to name just a few, and that even within a single controller family you may again have a choice of many different controllers.

Controller	Flash (KB)	SRAM (Byte)	EEPROM (Byte)	I/O-Pins	A/D (Channels)	Interfaces
AT90C8534	8	288	512	7	8	
AT90LS2323	2	128	128	3		
AT90LS2343	2	160	128	5		
AT90LS8535	8	512	512	32	8	UART, SPI
AT90S1200	1	64		15		
AT90S2313	2	160	128	15		
ATmega128	128	4096	4096	53	8	JTAG, SPI, IIC
ATmega162	16	1024	512	35		JTAG, SPI
ATmega169	16	1024	512	53	8	JTAG, SPI, IIC
ATmega16	16	1024	512	32	8	JTAG, SPI, IIC
ATtiny11	1		64	5+1 In		
ATtiny12	1		64	6		SPI
ATtiny15L	1		64	6	4	SPI
ATtiny26	2	128	128		16	SPI
ATtiny28L	2	128		11+8 In		

Comparison of AVR 8-bit controllers (AVR, ATmega, ATtiny)