
AVR Architecture and Applications

CSE-425

Lecture-4

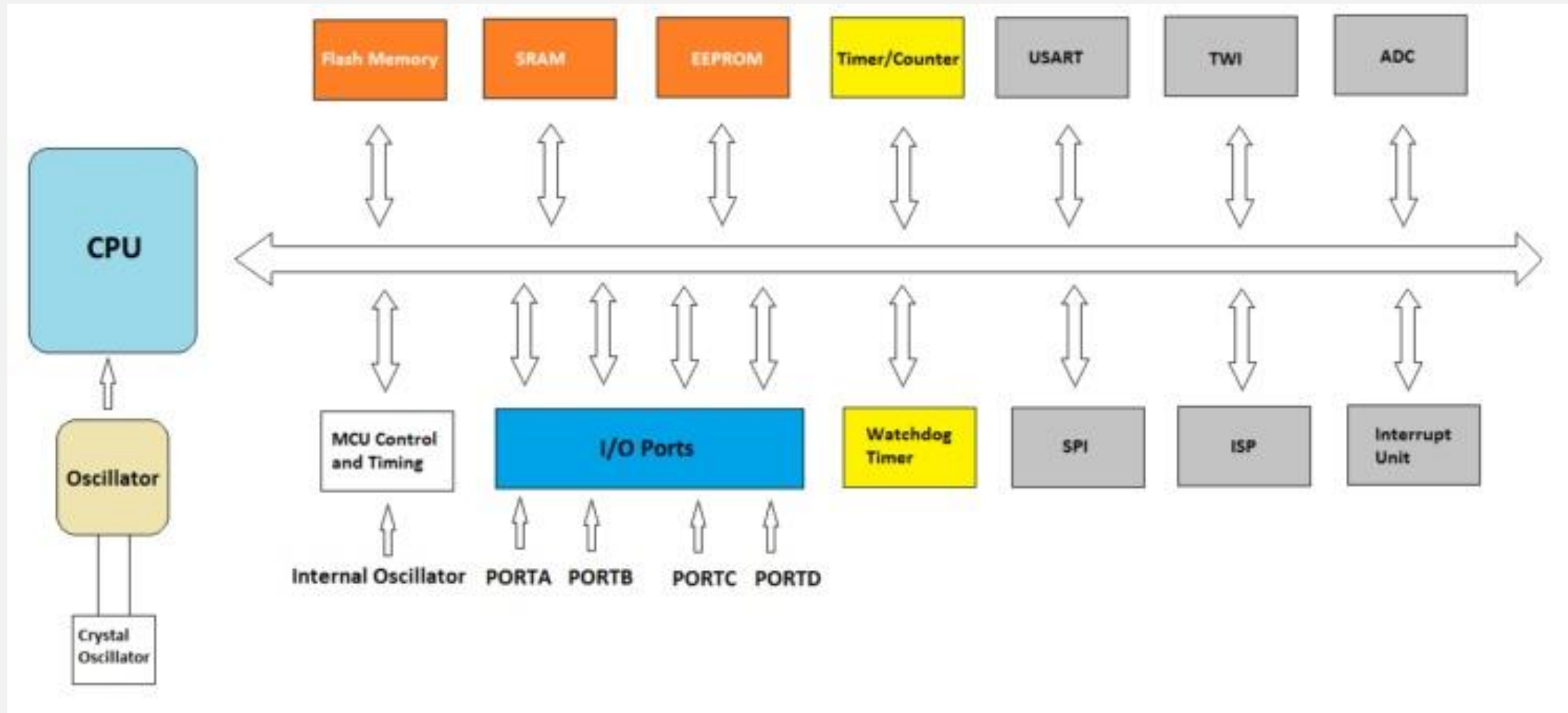
Reference: Third chapter of textbook

Acknowledgment: Some websites and Shayban Nasif Tonmoy Sir

Sections

- AVR architecture overview
- Classification of microcontroller
- Application of AVR microcontroller

AVR architecture overview



1. CPU

CPU is like a brain of the controller which helps in executing a number of instructions. It can handle interrupts, perform calculations and control peripherals with the help of registers. Atmega series comes with two buses called instruction bus and data bus.

The CPU reads the instructions in the instruction bus while data bus is used to read or write the corresponding data. The CPU mainly consists of the program counter, general purpose registers, stack pointer, instruction register and an instruction decoder.

2. ROM

The controller program is stored in ROM, also known as non-volatile programmable flash memory. The flash memory comes with a resolution of at least 10,000 write/erase cycles. Flash memory is mainly divided into two parts known as Application flash section and booth flash section.

Program of the controller is stored in the applications flash section. While booth flash section is optimized to work directly when the controller is powered up.

3. RAM

The SRAM (static random access memory) is used for storing information temporarily and comes with 8-bit registers. This is just like a regular computer RAM which is used to supply data through the runtime.

4. EEPROM

The EEPROM (Electrically Erasable Read Only Memory) is non-volatile memory used as a long time storage. It has no involvement in executing the main program. It is used for storing the configuration of the system and device parameters which continues to work in the reset of the application processor.

EEPROM comes with a limited write cycle up to 100,000 while read cycles are unlimited. While using EEPROM, write minimum instructions as per requirement, so you can get benefit from this memory for a longer time.

5. Interrupt

The interrupt is used for an emergency which puts the main function on hold and executes the necessary instructions at that time. Once the interrupt is called and executed the code switches back to the main program.

6. Analog and Digital I/O Modules

Digital I/O modules are used to set a digital communication between the controller and external devices. While analog I/O modules are used for transferring analog information. Analog comparators and ADC fall under the category of analog I/O modules.

7. Timer/Counter

Timers are used for calculating the internal signal within the controller. Atmega16 comes with two 8-bit timers and one 16-bit timer. All these timers work as a counter when they are optimized for external signals.

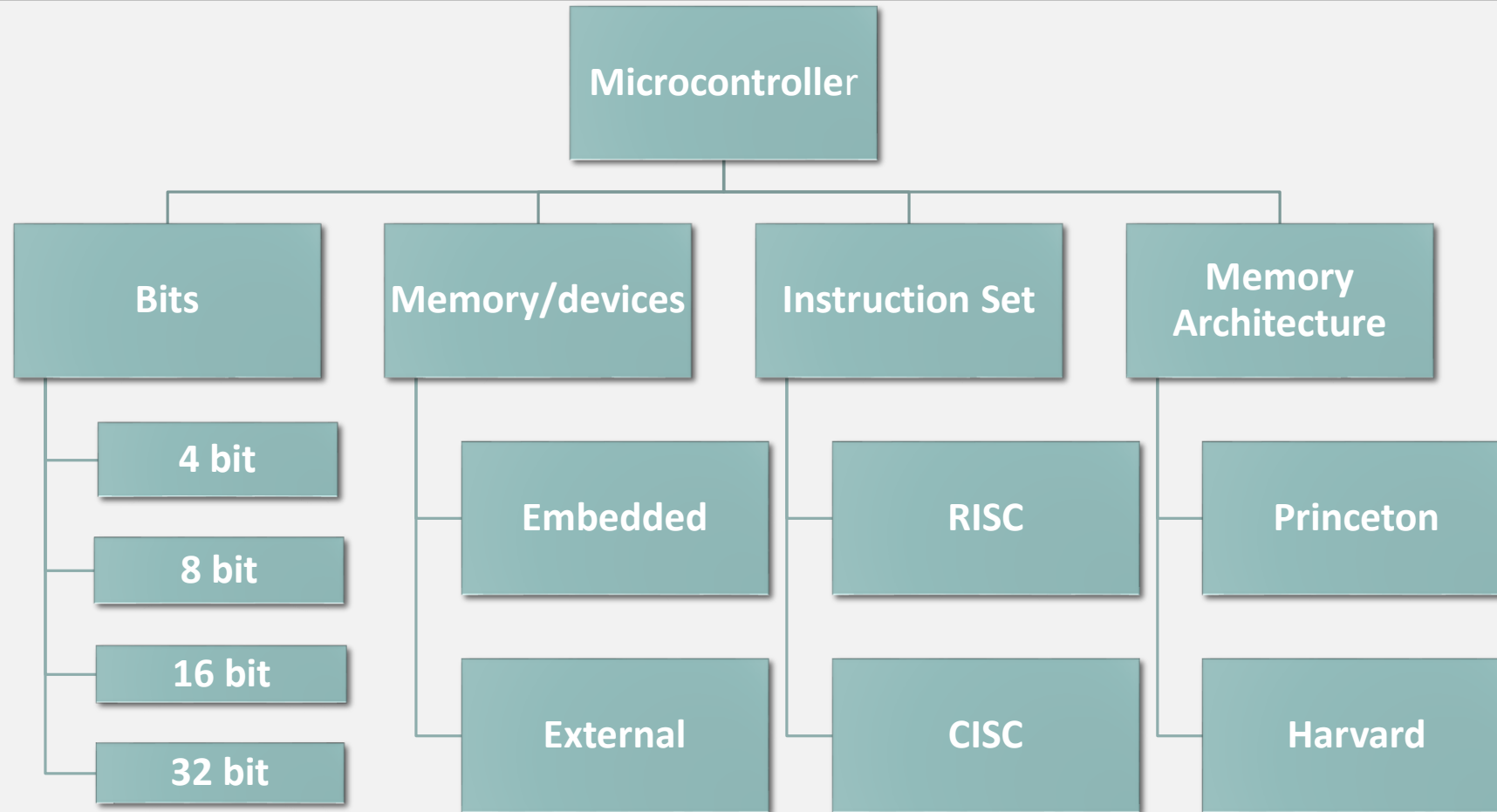
8. Watchdog Timer

The watchdog timer is a remarkable addition in this controller which is used to generate the interrupt and reset the timer. It comes with 128kHz distinct CLK source.

9. Serial Communication

Atmega16 comes with USART and SPI units that are used for developing serial communication with the external devices.

Classification of microcontroller



Microcontrollers are broadly classified into four types based on:

- Semi-conductor technology adopted in their design
- Width of data format
- Instruction set
- Data types they can handle

- **Semi-conductor technology adopted in their design:**

Most commonly employed semiconductor technologies are:

- TTL (Transistor –transistor logic)
- CMOS (Complimentary type Metal-oxide semiconductor)
- ECL (Emitter Coupled Logic)

TTL is commonly used, CMOS consumes low power. ECL is fast processor

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- **Width of data format:** It means the size of the operand upon which processor can operate. Based on this we have 4-bit, 8-bit, 16-bit, and 32-bit microcontrollers.
 - 32-bit microcontroller are faster-Intel 80960 family and Motorola M683xx.
 - 16-bit microcontroller are greater precision compare to 8-bit microcontroller - are Intel 8096 family and Motorola MC68HC12 and MC68332 families
 - 8-bit is commonly used microcontroller -8051 family.
 - 4-bit can used in domestic application -4004.
 - If data format width is more, faster will be the processor and expensive.

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- **Instruction set:** Microcontrollers are of two types based on instruction set.
 - They are Complex Instruction Set Computing (CISC) and Reducing Instruction Set Computing (RISC).
 - CISC are slower compare to RISC but easy to program.

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- **Types of data handled:** Microcontrollers are of two types based on instruction set.
 - There are two types: Floating point and Fixed point.
 - The main difference in between these is architecture of ALU.
 - Another is floating point microcontroller can handle data directly using floating point format whereas additional software is required for fixed point microcontroller to handle floating point data.

Application of AVR microcontroller

AVR controllers come with a wide range of applications where automation is required.

- Medical equipment
- Home automation
- Embedded systems
- Arduino Projects
- Used in automobiles and industrial automation
- Home appliances and security systems
- Temperature and pressure control devices

Application of microcontroller

The global economies are booming and microcontrollers have a role to play in almost every gadget present on earth. The list of applications for these microcontrollers are:

1. **Energy Management:** Technology for energy management is in great demand due to government initiatives that focus on energy. Efficient metering systems help in controlling energy usage in homes and industrial applications. These metering systems are made capable by incorporating microcontrollers.
2. **Touch screens:** A touch screen is accepted as the most efficient method to implement user control. They enable dynamic user interfaces and allow increased productivity. Touch screen controller implementation is microcontroller-based and therefore, ample opportunities lie ahead for microcontroller providers that incorporate touch-sensing capabilities in their designs. Portable electronics such as home appliances, cell phones, media players, gaming devices are some of the domains where microcontroller-based touch screens will be in demand.

Application of microcontroller

3. Automobiles: Microcontrollers find wide usage in hybrid vehicles, especially to ensure smooth and simultaneous functioning of electric and petrol engines. Additionally, almost every car manufacturer uses microcontrollers to control functions within their vehicles and to ensure error-free rides for their customers.
4. LED Lighting: Microcontrollers are used for led lighting in residential and industrial locations to enable greater control and power savings.
5. Personal Medical Devices: The rise and popularity of portable medical devices such as blood pressure and glucose monitors have ensured that microcontrollers will have a role in the medical industry. Microcontrollers are used to display date and increase reliability in providing medical results.

Have a Wonderful Journey with **Microcontroller** !