Advanced Microcontrollers & Applications (EC-506)

(Class: ECE- 5th Semester, Academic session: July-Dec, 2020)

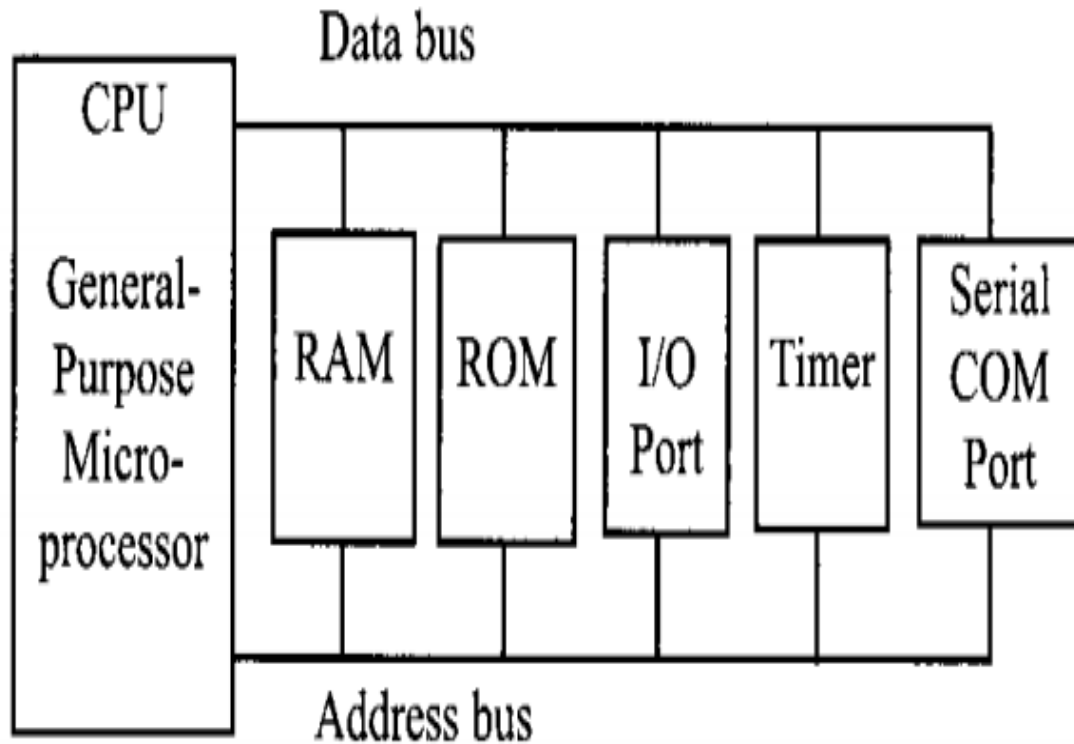# 8-bit AVR Microcontrollers(Atmega 8)
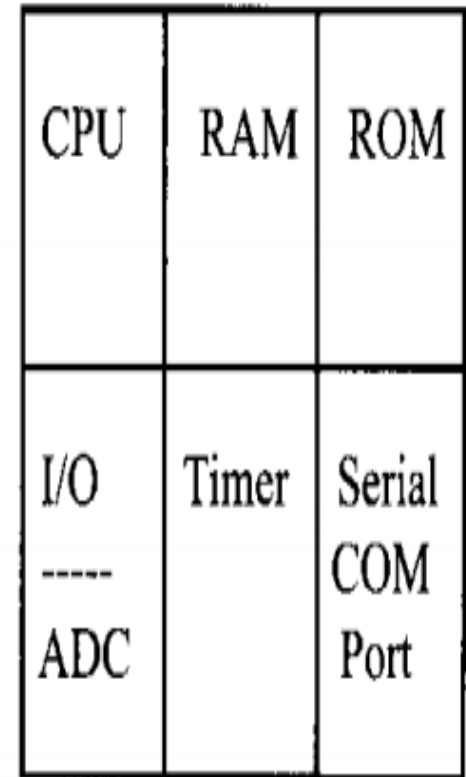
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Microcontroller versus General purpose microprocessor

(a) General-Purpose Microprocessor System

(b) Microcontroller

High End Embedded Processors

- When microcontrollers are inadequate for the task

- General purpose microprocessors optimized for embedded systems are known as high end embedded processors.

- ARM (Advanced RISC Machine) microprocessor chip is widely used in high end of the embedded system design.

- In high performance embedded processors, more and more functions are integrated on CPU chip.

Comparison of Microcontrollers used for Embedded System Design

PIC	AVR	ARM
Peripheral Interface Controller (PIC) is microcontroller developed by a **Microchip**	Advanced Virtual RISC / Alf-Egil Bogerin -Vegard Wollan RISC (AVR) deves its name from its developers.	Family of CPUs based on the RISC arch developed by **Advanced RISC Machines (ARM).**
Easy to program and simple to interface with other peripheral	-Produced by **Atmel Corporation**. -AT90S8515 (initial MC based on AVR architecture), AT90S1200 is the first to hit the market in 1997	Widely used in customer electronic devices : smartphones, tablets, wearables, multimedia players.
Consists of RAM, ROM, CPU, TIMER, Counter, ADC and DAC		

Comparison of Microcontrollers used for Embedded System Design

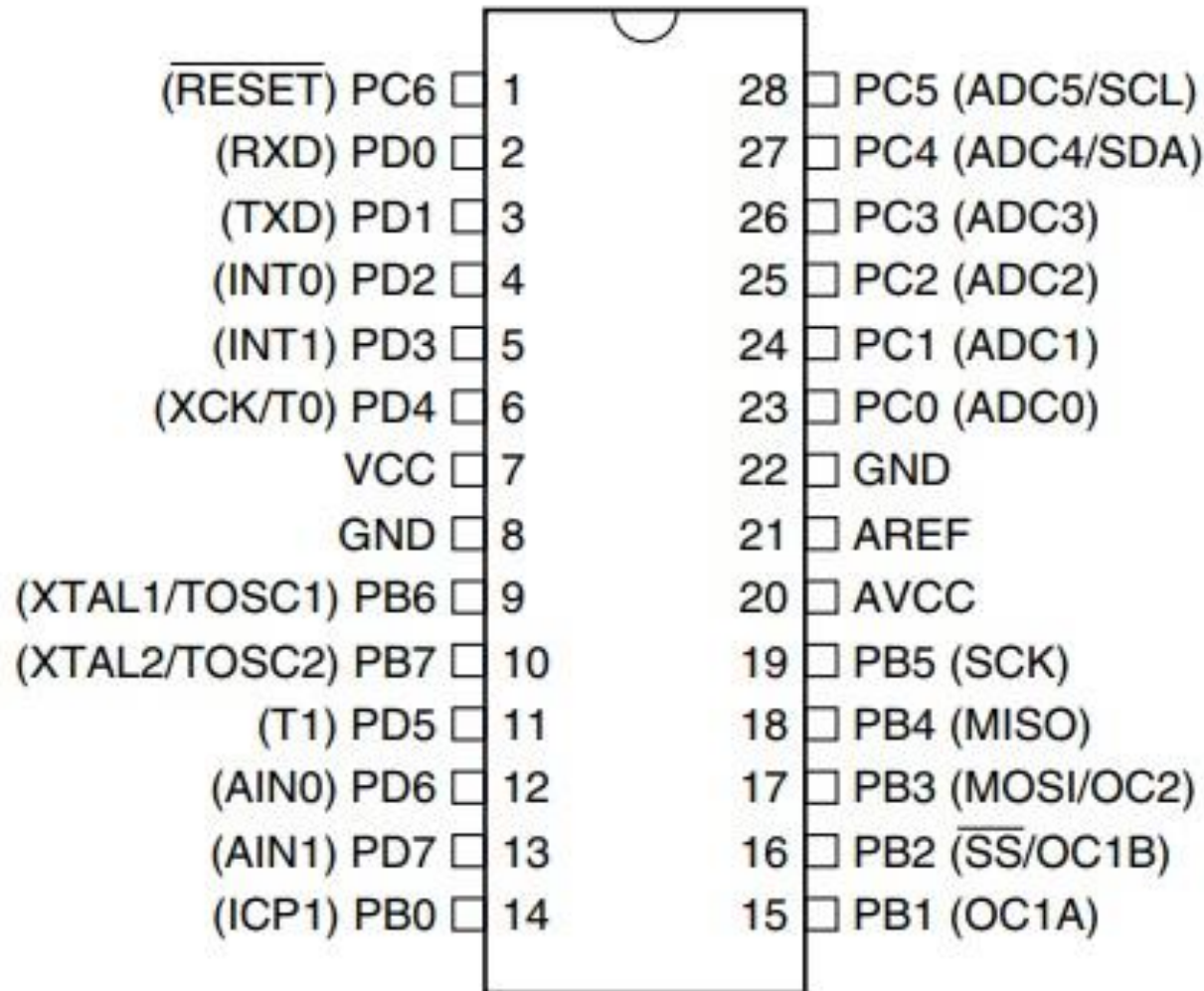| PIC	AVR	ARM
Applications: PWM fan controller, parking management system.	Three categories of AVR MC. 1. TinyAVR: Less memory, small size, appropriate just for simpler applications. 2. MegaAVR: popular, good memory (upto 256KB), higher no of inbuilt peripherals and appropriate for modest to complex applications. 3. XmegaAVR: Large program memory, high speed, used in commercial complex applications.	Reduced Instruction set, means few transistors, lead to small die size of IC. ARM processors used for miniaturized devices.

Comparison of Microcontrollers based on features

Feature	PIC	AVR	ARM
Word Size	8/16/32 bit	8/32 bit	32/64 bit
Communication Protocols	PIC, UART, USART, LIN, CAN, Ethernet, SPI, I2S	UART, USART, SPI, I2C, (special purpose AVR support CAN, USB, Ethernet)	UART, USART, LIN, I2C, SPI, CAN, USB, Ethernet, I2S, DSP, SAI (serial audio interface), IrDA
Speed	4 Clock/instruction cycle	1 Clock/instruction cycle	1 Clock/instruction cycle
Memory	SRAM, FLASH	Flash, SRAM, EEPROM	Flash, SDRAM, EEPROM

Comparison of Microcontrollers based on features

Feature	PIC	AVR	ARM
ISA	Some features of RISC	RISC	RISC
Memory Architecture	Harvard Architecture: different memory spaces for program and data .	Modified Harvard	Modified Harvard
Power consumption	Low	Low	Low
Families	PIC16,PIC17, PIC18, PIC24, PIC32	Tiny, Atmega, Xmega, special purpose AVR	ARMv4,5,6,7 and series
Manufacturer	Microchip	Atmel	Apple, Nvidia, Qualcomm, Samsung Electronics, and TI etc.
Popular Microcontroller	PIC18fXX8, PIC16f88X, PIC32MXX	Atmega8, 16, 32, Arduino Community	LPC2148, ARM Cortex-M0 to ARM Cortex-M7, etc.

AVR ATmega8 Microcontroller

(RESET) PC6	1	28 PC5 (ADC5/SCL)
(RXD) PD0	2	27 PC4 (ADC4/SDA)
(TXD) PD1	3	26 PC3 (ADC3)
(INT0) PD2	4	25 PC2 (ADC2)
(INT1) PD3	5	24 PC1 (ADC1)
(XCK/T0) PD4	6	23 PC0 (ADC0)
VCC	7	22 GND
GND	8	21 AREF
(XTAL1/TOSC1) PB6	9	20 AVCC
(XTAL2/TOSC2) PB7	10	19 PB5 (SCK)
(T1) PD5	11	18 PB4 (MISO)
(AIN0) PD6	12	17 PB3 (MOSI/OC2)
(AIN1) PD7	13	16 PB2 ($\overline{SS}$/OC1B)
(ICP1) PB0	14	15 PB1 (OC1A)

Pin Diagram

Pin Description and main features

- **Main feature** : All pins of microcontroller supports two signals except 5 -pins.

- Atmega8 microcontroller consists of 28 pins.

- PORT B: 9,10,14,15,16,17,18,19. (total 8 pins)

- PORT C: 23,24,25,26,27,28 and 1. (total 7 pins)

- PORT D: 2,3,4,5,6,11,12,13.(total 8 pins)

Pin description of Atmega8

- Pin -1 is the RST (Reset) pin and applying a low-level signal for a time longer than the minimum pulse length (Threshold voltage Vrst = 0.2 (min) and 0.9 (max))will produce a RESET.

- Pin-2 and Pin-3 are used in USART (universal synchronous asynchronous Receiver- Transmitter) for serial communication.

- Pin-4 and Pin-5 are used as an external interrupt. One of them will activate when an interrupt flag bit of the status register is set and the other will activate as long as the first interrupt condition succeeds.

Pin description of Atmega8

- Pin 6: (XCK/T0): T0(Timer0 External Counter Input)
  XCK (USART External Clock I/O).

- Pin7: (Vcc) Supply voltage

- Pin8: (GND) Ground

- Pin 9 : XTAL1 (Chip Clock Oscillator pin 1 or
  External clock input)
  TOSC1 (Timer Oscillator pin 1)

- Pin 10: XTAL2 (Chip Clock Oscillator pin 2)
  TOSC2 (Timer Oscillator pin 2)

Pin description of Atmega8

- Pin11 (T1): T1(Timer1 External Counter Input)

- Pin 12 (AIN0): AIN0(Analog Comparator Positive I/P)

- Pin 13 (AIN1) :AIN1(Analog Comparator Negative I/P)

- Pin 14(ICP1): (Timer/Counter1 Input Capture Pin)

- Pin 15 (OC1A):OC1A (Timer/Counter1 Output Compare

    Match A Output)

Pin description of Atmega8

- Pin16((SS/OC1B):**SS** (SPI Slave Select Input). This pin is low when controller acts as slave.

  [Serial Peripheral Interface (SPI) for programming]

  OC1B (Timer/Counter1 Output Compare Match B Output)

Pin description of Atmega8

- **Pin17(MOSI/OC2):**

  MOSI (Master Output Slave Input). When controller acts as slave, the data is received by this pin.

  OC2 (Timer/Counter2 Output Compare Match Output)

- **Pin 18(MISO):**

  MISO (Master Input Slave Output). When controller acts as slave, the data is sent to master by this controller through this pin.

Pin description of Atmega8

- **Pin19(SCK):**SCK (SPI Bus Serial Clock).

This is the clock shared between this controller and

other system for accurate data transfer.

- **Pin20 (AVcc):**Vcc for Internal ADC Converter.

- **Pin21(AREF):**Analog Reference Pin for ADC.

- **Pin22 (GND):** GROUND.

Pin description of Atmega8

- **Pin23 (ADC0):**ADC0 (ADC Input Channel 0)

- **Pin 24(ADC1):**ADC0 (ADC Input Channel 1)

- **Pin25(ADC2)**:ADC0 (ADC Input Channel 2)

- **Pin26(ADC3):**ADC0 (ADC Input Channel 3)

Pin description of Atmega8

- **Pin 27(ADC4/SDA):**

    ADC4 (ADC Input Channel 4)

    SDA (Two-wire Serial Bus Data Input/output Line)

- **Pin 28(ADC5/SCL):**

    ADC5 (ADC Input Channel 5)

    SCL (Two-wire Serial Bus Clock Line)

ATmega8 Block diagram/ Internal Architecture