Embedded Systems Assignment 1

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BN: 2

What are Microcontrollers?

Microcontrollers are small, low-cost, and programmable devices that can control other hardware components, such as sensors, motors, LEDs, and displays. They are often used for embedded systems, which are specialized computers that perform specific tasks within a larger system. Microcontrollers have a CPU, memory, input/output ports, and sometimes other peripherals, such as timers, ADCs, and communication modules.

The different microcontroller families

AVR microcontrollers

Brand: Atmel Corporation

Architecture: Harvard architecture

Features:

1. AVR microcontroller has a bus width of 8 bits and 32 bits.
2. AVR microcontrollers have a clock speed of 1 clock per instruction cycle.
3. AVR microcontrollers have higher processing speed.
4. AVR microcontrollers consume slightly more power than PIC.
5. AVR microcontrollers are expensive than PIC microcontrollers.
6. AVR microcontrollers support less peripherals

AVR is a series of 8-bit and 32-bit microcontrollers developed by Atmel, now owned by Microchip. These microcontrollers use the RISC architecture, which allows for quicker instruction execution compared to other architectures. AVR microcontrollers are particularly popular among hobbyists and beginners, thanks to their ease of programming, debugging, low power consumption, and strong performance. They come in a variety of models, ranging from small to large, with differing features and prices. Despite their advantages, AVR microcontrollers have some limitations, such as smaller memory and peripheral capacity, slower speed, lower resolution, and a higher cost per unit compared to certain other microcontrollers.

PIC microcontrollers

Brand: Microchip Technology Corporation.

Architecture: Von Neumann architecture.

Features:

1. PIC microcontroller has a bus width of 8 bits, 16 bits and 32 bits bus widths.
2. PIC microcontrollers have a clock speed of 4 clocks per instruction cycle.
3. PIC microcontrollers have comparatively low processing speed than AVR.
4. PIC microcontrollers consume less power, making them better suited for low-power applications.
5. PIC microcontrollers are less expensive than AVR.
6. PIC supports more peripherals.

PIC microcontrollers, developed by Microchip, are a series of 8-bit and 32-bit microcontrollers based on the Harvard architecture, which separates memory for data and instructions. Widely used in industrial, automotive, and hobbyist applications, PIC microcontrollers are known for their reliability, robustness, and long lifespan. They feature a rich array of peripherals and modules, including PWM, UART, SPI, I2C, and USB. Their affordability and high availability in the market make them a popular choice. However, PIC microcontrollers can be challenging to program and debug due to their steep learning curve and complex instruction set. Additionally, limited code compatibility and portability can reduce their flexibility in different projects, and they tend to have higher power consumption and lower performance compared to some other microcontrollers.

STM32 microcontrollers

Brand: STMicroelectronics

Architecture: 32-bit ARM Cortex-M

Features:

1. Very high performance
2. Real-time capabilities
3. Digital signal processing
4. Low-power / low-voltage operation
5. Provide many peripherals like: GPIO, I2C, SPI, UART, timers, and USB.

ARM microcontrollers, developed by ARM Holdings, are available in both 32-bit and 64-bit versions, with the company licensing its technology to manufacturers like STMicroelectronics, NXP, and Texas Instruments. Based on RISC architecture, ARM microcontrollers offer a range of features and performance levels, making them ideal for high-end applications such as smartphones, tablets, and wearables. They are known for their high speed, resolution, scalability, compatibility, and energy efficiency. However, their complex instruction set and multi-layered architecture can make them challenging to program and debug. Additionally, ARM microcontrollers tend to be expensive and have limited market availability, which may hinder their compatibility with other microcontrollers, making them less suitable for mixed-system projects.

MSP430 microcontrollers

Brand: Texas instrument

Architecture: 16-bit Von-Neumann architecture

Features:

1. **Low Power Consumption**
2. **Provide many Integrated Peripherals**
3. **Low-Cost**

ARM Cortex-M4 vs PIC16877A microcontrollers

Feature	ARM Cortex-M4	PIC16F877A
Architecture	32-bit Harvard Architecture	8-bit Harvard Architecture
Clock Speed	80 to 120 MHz	20MHz
Power Consumption	High	Low
I/O Ports	168	32
Flash Memory	Up to 1 MB	14 KB
RAM	128 KB	368 Bytes