Assignment 1

Different Microcontroller Types

Introduction About Microcontrollers:

A microcontroller can be considered as small computer ,it is a device that can execute series of pre-programmed tasks and interact with external hardware devices and it is packed in a small IC Many Microcontrollers contains memory to store the program in it to be executed and lot of input/output lines to be used with other devices that can be controlled like reading a state of sensor or controlling a motor

Overview about different Microcontrollers families:

8051 microcontrollers: is 8-bit family of microcontrollers developed by intel in 1981 This microcontroller is referred to as "system on a chip" it has 128 bytes of RAM ,4Kbytes of ROM ,2 Timers, 1 Serial Port , and 4 ports on a single chip The CPU can work on 8-bit data at a time if the data is bigger than 8-bit it is broken into parts so CPU can process it easily

Main Areas of Focus:

Energy Management: Efficient metering systems facilitate in controlling energy usage in homes

Touch screens: For touch-sensing capabilities for portable devices such as smartphones

Automobiles: used in Hybrid vehicles to handle engine variants and functions such as cruise control and anti-brake system

Medical Devices: for devices such as blood pressure and glucose monitoring

PIC Microcontroller:

This microcontroller consists of RAM, ROM, CPU, timer, counter, ADC (analog to digital converters), DAC (digital to analog converter).

PIC Microcontroller also supports the protocols like CAN, SPI, UART for an interfacing with additional peripherals

PIC mostly used to modify Harvard architecture and also supports RISC (Reduced Instruction Set Computer) by the above requirement RISC and Harvard that means PIC is faster than the 8051 based controllers which is prepared up of Von-Newman architecture

AVR Microcontrollers:

AVR microcontroller was developed in the year of 1996 by Atmel Corporation. the AT90S8515 was the initial microcontroller which was based on the AVR architecture

There are three Categories :

TinyAVR: Less memory, small size, used in simpler applications

MegaAVR: more popular ones with good quality of memory (up to 256 KB) ,has more number of peripherals and used in more complex applications

XmegaAVR: for more complex applications that needs large memory

ARM Proccessor:

An ARM processor is also one of a family of CPUs based on the RISC (reduced instruction set computer) architecture developed by Advanced RISC Machines (ARM).

An ARM makes at 32-bit and 64-bit RISC multi-core processors.

RISC processors are designed to perform a smaller number of types of computer instructions so that they can operate at a higher speed, By removing out unnecessary instructions and optimizing pathways,

RISC gives more performance at a part of power demand of CISC (complex instruction set computing)

ARM processors are used in smartphones ,tablets

Main Categories of ARM :

Cortex A : For high performance

Cortex R : Real time and low latency processors for automotive and medical applications

Cortex M : used in low power microcontrollers for embedded applications

Main differences between AVR,ARM,PIC Microcontrollers:

	8051	PIC	AVR	ARM
Bus width	8-bit for standard core	8/16/32-bit	8/32-bit	32-bit mostly also available in 64-bit
Communication Protocols	UART, USART,SPI,I2C	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	12 Clock/instruction cycle	4 Clock/instruction cycle	1 clock/ instruction cycle	1 clock/ instruction cycle
Memory	ROM, SRAM, FLASH	SRAM, FLASH	Flash, SRAM, EEPROM	Flash, SDRAM, EEPROM
ISA	CLSC	Some feature of RISC	RISC	RISC
Memory Architecture	Harvard architecture	Von Neumann architecture	Modified	Modified Harvard architecture
Power Consumption	Average	Low	Low	Low
Families	8051 variants	PIC16,PIC17, PIC18, PIC24, PIC32	Tiny, Atmega, Xmega, special purpose AVR	ARMv4,5,6,7 and series
Community	Vast	Very Good	Very Good	Vast
Manufacturer	NXP, Atmel, Silicon Labs, Dallas, Cyprus, Infineon, etc.	Microchip Average	Atmel	Apple, Nvidia, Qualcomm, Samsung Electronics, and TI etc.
Cost (as compared to features provide)	Very Low	Average	Average	Low
Other Feature	Known for its Standard	Cheap	Cheap, effective	High speed operation Vast

Difference between PIC16F877A and TM4C123GH6PM

PIC16F877A:

20 MHz Crystal Oscillator , high performance RISC CPU , 8 K Words Programmable Flash Memory , 368 bytes Data Memory (RAM) , 256 bytes EEPROM , 33 I/O pins , 8-Channel 10-bit Analog to Digital Converter (ADC)

Two PWM Channels , 1 SPI

Advantages :

Cost effective , Ease of use , Low Power Consumption , Wide range of models : with different memory sizes and I/O options

Disadvantages:

Limited performance Compared to ARM microcontrollers , More complex in interrupt handling compared to ARM

TM4C123GH6PM:

32-bit ARM® Cortex™-M4 80-MHz processor core , 32 KB single-cycle SRAM , internal ROM loaded with TivaWare™ for C Series software , 2KB EEPROM , Number of GPIO: 43 , two 12-bit Analog-to-Digital Converters (ADC) with 12 analog input channels , PWM: 16 , SPI : 4 , integrated Nested Vectored Interrupt Controller (NVIC), On-chip memory, featuring 256 KB single-cycle Flash up to 40 MHz ,

Advantages:

Higher performance , Energy efficient : with Cortex-M class delivering high performance while consuming least amount of power

Disadvantages:

Cost : more expensive than PIC microcontrollers especially when advanced peripherals are involved , **Complex Architecture , Higher Power Consumption Compared to PIC microcontrollers**