Microcontroller

Lecture 2

INTRODUCTION TO MICROPROCESSOR

Almost everyone uses a computer these days, whether it's at home or at work. In fact, it's rare to run into someone that doesn't have access to a computer. We depend greatly on computers, especially in the business world. Yet few people really understand how computers work. How is a computer able to execute the commands that you input? The answer to that question is through the computer's microprocessor. Of course, knowing that doesn't provide much in the way of an explanation. We'll give you an overview of what a microprocessor is, how it functions, and more.

What is a Microprocessor?

The microprocessor is the central unit of a computer system that performs arithmetic and logic operations, which generally include adding, subtracting, transferring numbers from one area to another, and comparing two numbers. It's often known simply as a processor, a central processing unit, or as a logic chip. It's essentially the engine or the brain of the computer that goes into motion when the computer is switched on. It's a programmable, multipurpose device that incorporates the functions of a CPU (central processing unit) on a single IC (integrated circuit)

How Does a Microprocessor Work?

A microprocessor accepts binary data as input, processes that data, and then provides output based on the instructions stored in the memory. The data is processed using the microprocessor's ALU (arithmetical and logical unit), control unit, and a register array. The register array processes the data via a number of registers that act as

temporary fast access memory locations. The flow of instructions and data through the system is managed by the control unit.

Benefits of a Microprocessor

computer systems aren't the only devices that use microprocessors. Everything from smartphones to household appliances to cars use microprocessors these days. Here are a few reasons why microprocessors are so widely used

- **They don't cost a lot** - Due to their use of IC technology, microprocessors don't cost much to produce. This means that the use of microprocessors can greatly reduce the cost of the system it's used in.
- **They are fast** - The technology used to produce modern microprocessors has allowed them to operate at incredibly high speeds--today's microprocessors can execute millions of instructions per second.

- **They consume little power** - Power consumption is much lower than other types of processors since microprocessors are manufactured using metal oxide semiconductor technology. This makes devices equipped with microprocessors much more energy efficient.
- **They are portable** - Due to how small microprocessors are and that they don't consume a lot of power, devices using microprocessors can be designed to be portable (like smartphones).
- **They are reliable** - Because semiconductor technology is used in the production of microprocessors, their failure rate is extremely low.
- **They are versatile** - The same microprocessor chip can be used for numerous applications as long as the programming is changed, making it incredibly versatile.

Components of the Microprocessor

Components of this processor are

- **arithmetic logic unit (ALU)** performs both arithmetic and logical operations. Arithmetic operations such as addition, subtraction, multiplications, divisions, and logical operations such as NOR, AND, NAND, OR, XOR, NOT, XNOR, etc.

- **Control unit** The control unit is used to control the instructions and it generates the signals to operate the other components
- **Input-output devices** Input-output devices are used to transfer data between microcomputers and external devices
- **Register array** The register array consists of registers. Registers that are used by the programmer to store arbitrary data are known as general-purpose registers and the registers which are not used by a programmer to store the data are known as the reserved registers. The length of the register is known as the word length of the computer

Generations of Microprocessor

There are five generations of this processor that mainly include the following.

- **First Generation Microprocessor**: The first generation processors are 4 – bit microprocessor introduced in 1971 – 1972.
- **Second Generation Microprocessor**: The second-generation processors are 8 – bit microprocessor introduced in 1973.
- **Third Generation Microprocessor**: The third-generation processors are 16 – bit microprocessor introduced in 1978.
- **Fourth Generation Microprocessor**: The fourth-generation processors are 32 – bit microprocessors.
- **Fifth Generation Microprocessor**: The fifth-generation processors are 64 – bit microprocessor.

Microcontroller

A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.

microcontrollers are found in vehicles, robots, office machines, medical devices, mobile radio transceivers, vending machines and home appliances, among other devices. They are essentially simple miniature personal computers (PCs) designed to control small features of a larger component, without a complex front-end operating system (OS).

How do microcontrollers work?

A microcontroller is embedded inside of a system to control a singular function in a device. It does this by interpreting data it receives from its I/O peripherals using its central processor. The temporary information that the microcontroller receives is stored in its data memory, where the processor accesses it and uses instructions stored in its program memory to decipher and apply the incoming data. It then uses its I/O peripherals to communicate and enact the appropriate action

What are the elements of a microcontroller?

The core elements of a microcontroller are**:**

The processor (CPU) :A processor can be thought of as the brain of the device. It processes and responds to various instructions that direct the microcontroller's function. This involves performing basic arithmetic, logic and I/O operations. It also performs data transfer operations, which communicate commands to other components in the larger embedded system**.**

Memory :A microcontroller's memory is used to store the data that the processor receives and uses to respond to instructions that it's been programmed to carry out. A microcontroller has two main memory types:

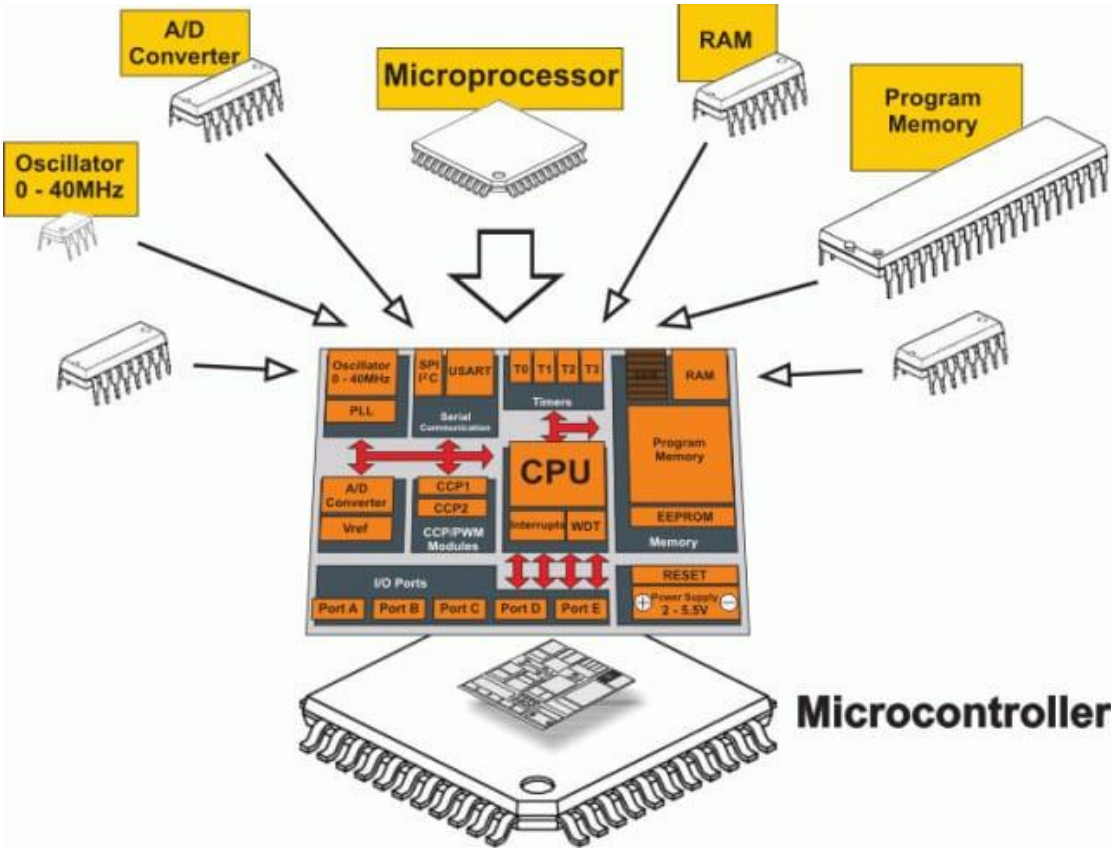
- **Program memory** :which stores long-term information about the instructions that the CPU carries out. Program memory is non-volatile memory, meaning it holds information over time without needing a power source.
- **Data memory:** which is required for temporary data storage while the instructions are being executed. Data memory is volatile, meaning the data it

holds is temporary and is only maintained if the device is connected to a power source.

I/O peripherals : The input and output devices are the interface for the processor to the outside world. The input ports receive information and send it to the processor in the form of binary data. The processor receives that data and sends the necessary instructions to output devices that execute tasks external to the microcontroller.

While the processor, memory and I/O peripherals are the defining elements of the microprocessor, there are other elements that are frequently included. The term I/O peripherals itself simply refers to supporting components that interface with the memory and processor. There are many supporting components that can be classified as peripherals. Having some manifestation of an I/O peripheral is elemental to a microprocessor, because they are the mechanism through which the processor is applied.

- Analog to Digital Converter (ADC) : An ADC is a circuit that converts analog signals to digital signals. It allows the processor at the center of the microcontroller to interface with external analog devices, such as sensors.
- Digital to Analog Converter (DAC) :A DAC performs the inverse function of an ADC and allows the processor at the center of the microcontroller to communicate its outgoing signals to external analog components.
- System bus : The system bus is the connective wire that links all components of the microcontroller together.
- Serial port : The serial port is one example of an I/O port that allows the microcontroller to connect to external components. It has a similar function to a USB or a parallel port but differs in the way it exchanges bits.



Advantages of microcontroller

- A microcontroller is a cheap and minimal size, easy to carry out. Therefore it can be embedded on any device.
- Programming of microcontrollers is simple to learn. It's not much complicated.
- We can use simulators on a computer to see the practical results of our Microcontrollers Programming. Those we can work on an embedded project with even buying the required components and chips.
- We can virtually see the working of our project of a program.

Types of Microcontroller

1) PIC Microcontroller

PIC Stands for Peripheral Interface Controller is a kind of microcontroller components was used in the development of electronics, computer robotics, and similar devices. Even though the PIC was produced by Microchip technology and based on hardware computing architecture, here the code and data are placed in

separate registers to increase the input and output. Pic has a built-in data memory, data bus and dedicated microprocessor for preparing all I/O purposes and methods.

2) ARM Microcontroller

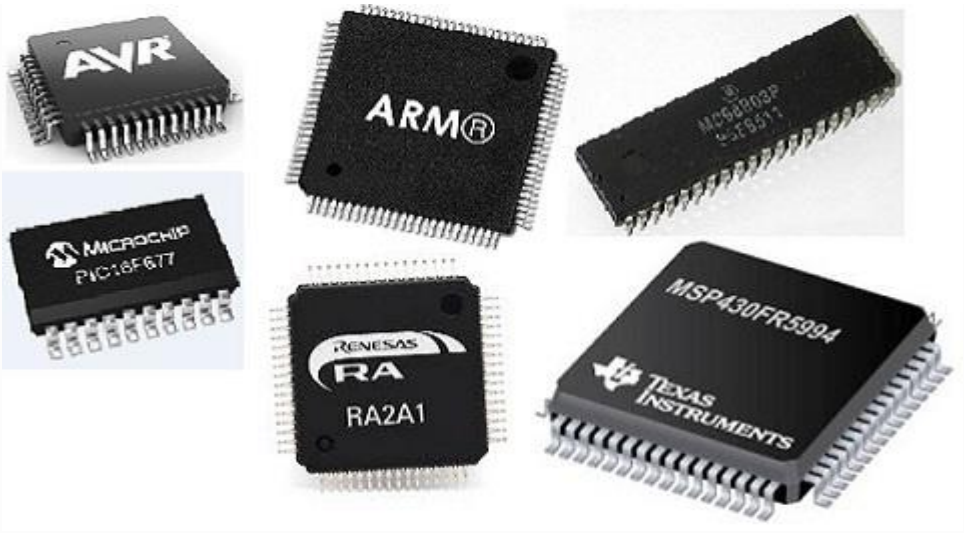
ARM stands for Advanced RISC Machine. It's the most popular Microcontrollers Programming in the digital embedded system world, and most of the industries prefer only ARM microcontrollers since it consists of significant features to implement products with an excellent appearance. It is cost sensitive and high-performance device which has been used in a wide range of application such as Industrial Instrument control systems, wireless networking and sensors, and automotive body systems, etc

3) AVR Microcontroller

AVR stands for Alf and Vegard's RISC Processor. It was the modified Harvard architecture machine, where program and data were stored in the separate physical memory system that appears in different address spaces, but having the ability to browse information things from program memory victimization particular directions. AVR isn't associate degree signifier and doesn't symbolize something specially

4) MSP Microcontroller

MSP stands for Mixed Signal Processor. It's the family from Texas Instruments. Built around a 16 -bit CPU, the MSP is designed for low cost and respectively, low power dissipation embedded statements. It's the controller's appearance is directly related to the 16-bit data bus, and seven addressing modes and the decreased instructions set, which allows a shorter, denser programming code for fast performance.



Microprocessor VS Microcontroller

- Microprocessor consists of only a Central Processing Unit, whereas Micro Controller contains a CPU, Memory, I/O all integrated into one chip.
- Microprocessor is used in Personal Computers whereas Micro Controller is used in an embedded system.
- Microprocessor uses an external bus to interface to RAM, ROM, and other peripherals, on the other hand, Microcontroller uses an internal controlling bus
- Microprocessor is complicated and expensive, with a large number of instructions to process but Microcontroller is inexpensive and straightforward with fewer instructions to process
- Microprocessor-based systems can run at a very high speed because of the technology involved while microcontroller based systems run up to 200MHz or more depending on the architecture.
- Most of the microprocessors do not have power saving features. But the microcontrollers offer power-saving mode
- Microprocessor has a smaller number of registers, so more operations are memory-based, Microcontroller has more register. Hence the programs are easier to write.