

Introduction Computer Systems

Lecture 10

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Digital System

- Digital systems are electronic systems that process information using discrete, binary values (0s and 1s), built from components like logic gates and microprocessors to perform tasks like computation, storage, and communication, found in everything from smartphones and computers to telecommunication networks, offering higher accuracy and reliability than analog systems. They work with digital signals, representing data as a finite set of values, making them ideal for data processing and storage, though they can introduce latency and power consumption issues in specific real-time scenarios.

Digital systems are defined as systems that perform information-processing tasks using discrete data, which can include digital computers, telecommunication systems, and calculators

Characteristics of Digital Systems

- Today, digital systems are widely used in almost every aspect of life. This is because of their high reliability and efficiency. The following are some key characteristics of digital systems –
- Digital systems are relative less complex to implement as they use binary number system having only two digits to represent the state of a system.
- In digital systems, the information is represented in the form of a group of 0s and 1s i.e., bits. This is called binary or digital representation of information.
- Digital systems rely on digital signals having two well-defined discrete states. This makes digital systems more reliable and efficient in terms of processing, storage, and communication of information.

- Digital systems use logical mathematics and operations to perform computing tasks.
- Digital systems can be manufactured in the form of integrated circuits (ICs) of very small sizes.
- Digital systems can be easily programmed to perform repeated tasks that reduces human efforts and cost.
- Digital systems are highly immune to noise and distortions.

Benefits of Digital over Analog System:

- There are some reasons why we use Digital representation than Analog System:
- It is economical and easy to design.
- It is very well suited for both numerical and non-numerical information processing.
- It has high noise immunity.
- It is easy to duplicate similar circuits and complex digital ICs are manufactured with the advent of microelectronics Technology.
- Adjustable precision and easily controllable by Computer

Disadvantages of Digital System:

- It has low speed.
- There are need of converters, e.g., Analog to Digital (A/D) converter and Digital to Analog (D/A) converter, because physical world is analog.
- The working of a digital system is entirely based on digital signals or binary signals. Where, a digital signal is a type of signal that is represented as a discrete-elements. It can have two possible states namely high or low. The high state is denoted by the logic 1 and the low state is denoted by the logic 0.
- In a digital system, if the state of the signal is logic 1, the system will be on, and if the state of the signal is 0, the system will be off.

Types of Digital Systems

- Digital systems can be classified based on various parameters. Here are some important types of digital systems that we commonly use in practice —
- **Combinational Digital Systems**
- A combinational logic circuit or system is a type of digital circuit that performs logical operations and produces output depending on the present inputs. Hence, the output of a combinational digital circuit does not depend on the past inputs and outputs of the system.
- **Example** — The common examples of combinational digital systems are binary adders, subtractors, logic gates, multiplexers, demultiplexers, etc.

- **Sequential Digital Systems**

- A type of digital system that has a memory element to store past history of the system operation is called a sequential digital system. Therefore, the output of a digital system depends on both present inputs and past outputs of the system.
 - **Example** of sequential digital systems are flip-flops, registers, memory devices, counters, etc.
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- **Programmable Logic Devices (PLDs)**
 - A programmable logic device is one that can be programmed to perform a specific task automatically.
 - **Example** of programmable logic devices are microcontrollers, PLCs, etc.

- **Digital Communication Systems**

- A digital communication system is a type of digital system used for transmission and reception of information in the form of digital signals.
- **Example** of digital communication systems are internet, intranet, mobile communication system, Wi-Fi, etc.

- **Digital Control Systems**

- A digital control system is a computerized control system used to monitor and regulate the behavior of a dynamic system.
- **Example** – Digital control systems are extensively used in robotics, industrial automation, etc.

- **Conclusion**

- In conclusion, digital systems are modern systems known for their high speed and reliability. A digital system utilizes digital signals to store, process, and communicate the information.