# Course: Multimedia Processing

**Sem: VII**

**By**

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# UNIT - III
# BASIC DIGITAL SIGNAL PROCESSING

Signal, System, Sampling, Quantization, Digital Filters

# Signal

- A signal is a physical quantity carrying information
- Varies with time or space
- Example: audio, image, video signals

# Types of Signals

- 1D Signal: depends on time
- 2D Signal: image with coordinates (x,y)
- 3D Signal: video with (x,y,t)

# System

- A device that processes signals
- Example: vocal cord system producing speech

# Digital Signal Processing

- Processing signals using digital computers
- Used for analysis or modification of signals

# Advantages of DSP

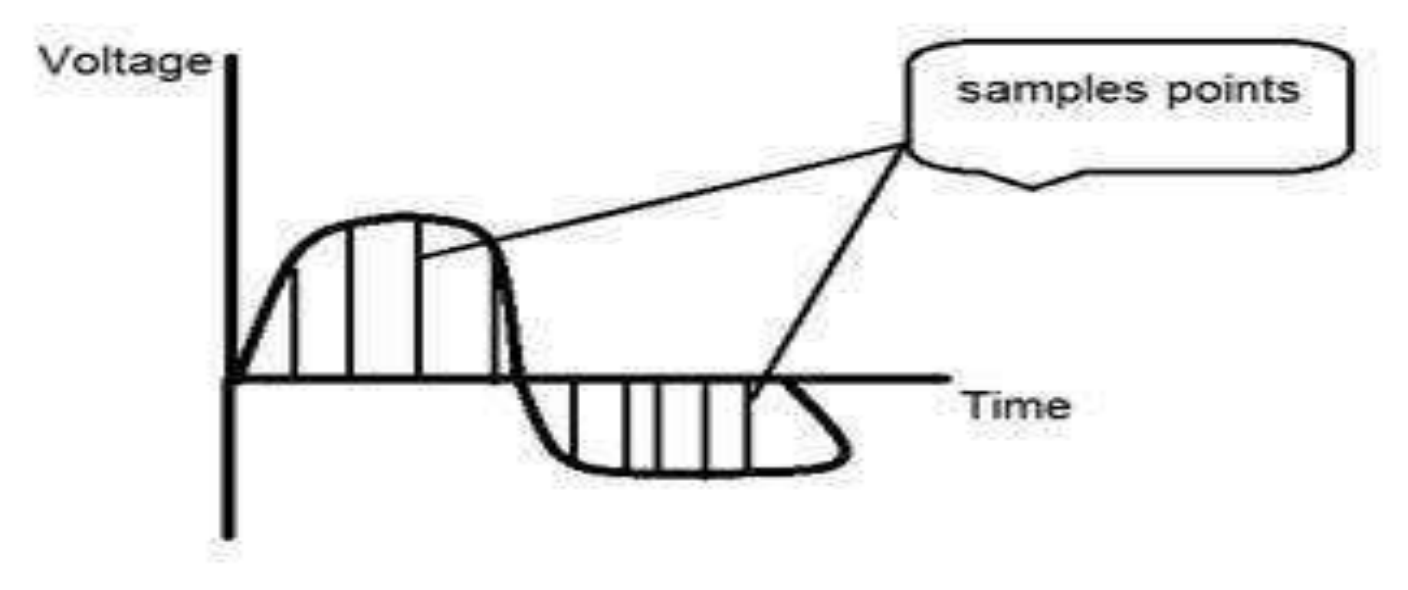
- High accuracy
- Signals easily stored
- Flexible programming
- Low cost and high reliability

# Disadvantages of DSP

- Increased system complexity
- Requires fast ADC for high bandwidth
- Higher power consumption

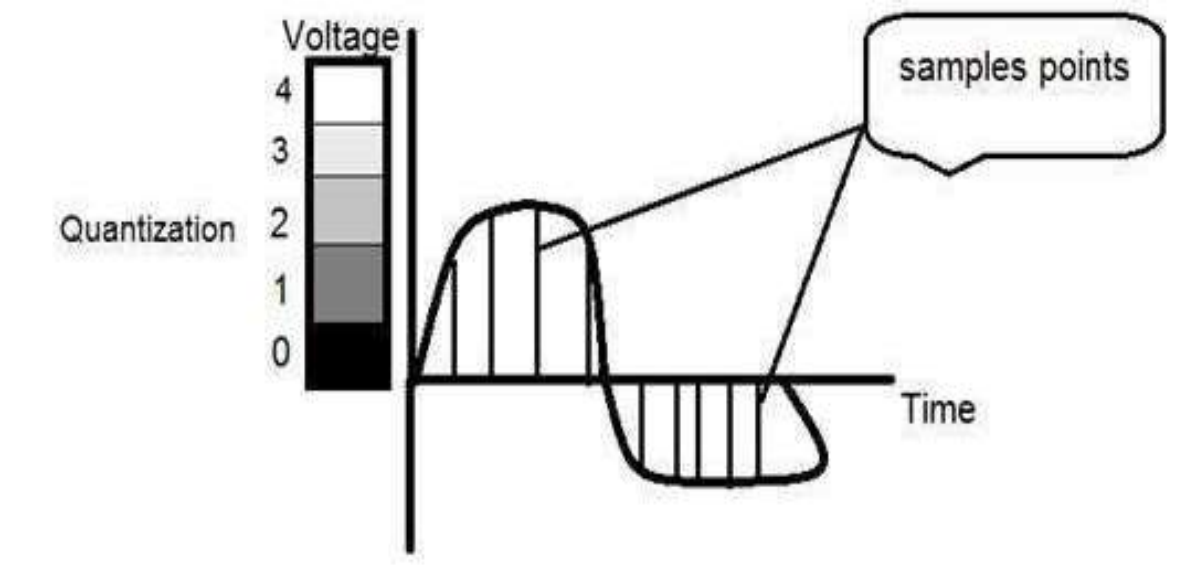
# Sampling

- Process of digitizing coordinate values
- Samples taken along x-axis
- More samples → better image quality



# Quantization

- Process of digitizing amplitude values
- Levels assigned to sampled signal
- More levels → better gray resolution



# Digital Filters

- Algorithm used to remove noise from signals
- Extract useful information

# Types of Digital Filters

- IIR – Infinite Impulse Response
- FIR – Finite Impulse Response

# IIR Filter

- Impulse response infinite
- Uses feedback
- Recursive system
- High computational efficiency

# FIR Filter

- Impulse response finite
- No feedback
- Always stable
- Used in audio and control systems

# IIR Vs FIR Filter

| IIR Filter | FIR Filter |
|---|---|
| **IIR filter stands for infinite impulse response filter.** | FIR filter stands for finite impulse response filter. |
| **An IIR filter gives impulse responses for an infinite duration of time.** | A FIR filter provides impulse responses for a finite duration of time. |
| **Feedback system is available in IIR filters.** | Feedback system is not present in FIR filters. |
| **The IIR filter is recursive.** | The FIR filter is non-recursive in nature. |
| **IIR filters are less stable than that of FIR filters due to the presence of poles.** | FIR filters do not contain any poles. Hence the FIR filter is always stable and the stability is more than that of IIR filter. |
| **The transfer function of IIR filter contains both poles and zeros.** | The transfer function of FIR filter contains only zeros. |
| **The memory requirements of an IIR filter is less than that of FIR filter as it contains feedback path.** | Due to the absence of feedback path in the FIR filters, it needs more memory to keep the more number of coefficients even for a single function. |
| **The computational efficiency of an IIR filter is more than that of a FIR filter.** | The computational efficiency of a FIR filter is less. |
| **Butterworth filter, Chebyshev type I filter, Chebyshev type II filter, etc.** | Differentiator, Hilbert transformer, etc. |
| **In biomedical sensor, telecommunication, audio equalization, the IIR filters are used.** | The uses of FIR Filters are found in audio system, control system, medical devices, etc. |