SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE NAME : 19EC513 – IMAGE PROCESSING AND COMPUTER VISION

III YEAR / V SEMESTER

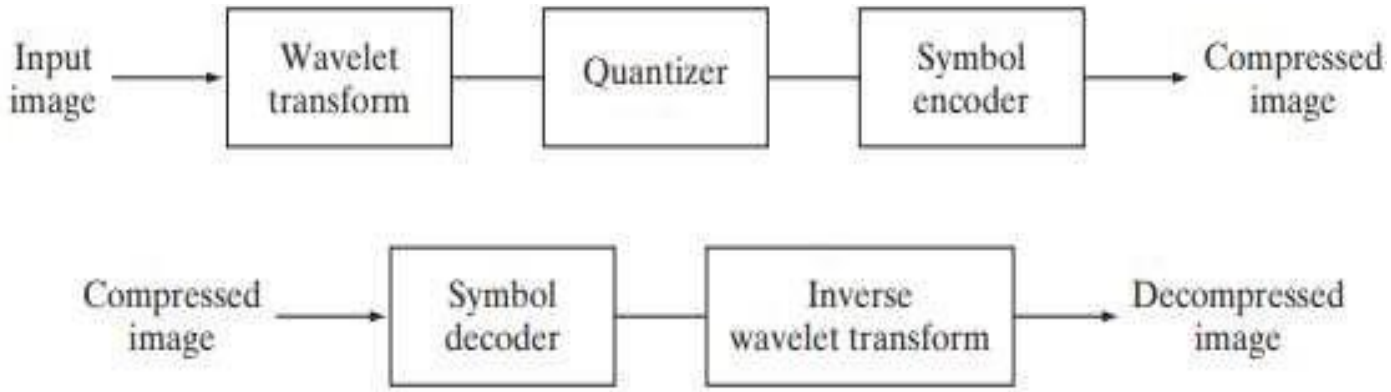
Unit III- **IMAGE COMPRESSION AND IMAGE SEGMENTATION**

Topic : Wavelet coding

WAVELET CODING

Wavelet coding is a technique used in image processing for efficient image compression and encoding. It involves transforming the image into a wavelet domain, where it can be represented in a more compact form, allowing for better compression while preserving important image details.

FIGURE: A wavelet coding system: (a) encoder; (b) decoder.



WAVELET CODING ENCODER & DECODER

This is the original image that needs to be compressed. It is usually represented as a matrix of pixel intensity values.

Wavelet Transform:

Purpose: The wavelet transform decomposes the image into different frequency components. It does this by applying a series of filters (wavelets) to the image.

How It Works: The image is passed through high-pass and low-pass filters to separate it into various sub-bands. These sub-bands correspond to different levels of detail in the image (e.g., edges, textures).

Output: The output of this stage is a set of wavelet coefficients that represent the image in the wavelet domain. These coefficients are typically organized into sub-bands, such as:

LL (Low-Low): Represents the approximation or coarse details of the image.

LH (Low-High): Captures the vertical details (horizontal edges).

HL (High-Low): Captures the horizontal details (vertical edges).

HH (High-High): Captures the diagonal details.

WAVELET CODING ENCODER & DECODER

Quantization:

Purpose: Quantization reduces the precision of the wavelet coefficients, which decreases the amount of data needed to represent the image.

How It Works: The wavelet coefficients are mapped to a smaller set of values. This can be done by dividing the coefficients by a step size and rounding to the nearest integer. The larger the step size, the more data is lost, but the higher the compression rate.

Output: The output of this stage is a set of quantized coefficients that are more compact but less precise than the original wavelet coefficients.

Encoding:

Purpose: The encoding stage further compresses the quantized coefficients using various coding techniques to achieve efficient data storage or transmission.

How It Works: Common encoding techniques include:

Run-length Encoding (RLE): Compresses sequences of repeated values.

Huffman Coding: Assigns shorter codes to more frequent values and longer codes to less frequent values.

Arithmetic Coding: Represents entire sequences of symbols with a single code based on their probabilities.

Output: The final output is a compressed image file that is significantly smaller in size than the original image.

ADVANTAGES & APPLICATIONS

•**High Compression Ratios:** Wavelet coding can achieve high compression ratios with minimal loss of image quality, making it suitable for applications like JPEG2000.

•**Scalability:** Images compressed with wavelet coding can be decoded at different resolutions, which is useful for applications where images need to be viewed at varying levels of detail.

•**Error Resilience:** Wavelet coding is more robust to errors compared to traditional methods like JPEG, making it ideal for transmission over noisy channels.

Applications:

•**JPEG2000:** A popular image compression standard that uses wavelet coding, offering better quality at lower bit rates compared to the traditional JPEG standard.

•**Medical Imaging:** Wavelet coding is used in compressing medical images (e.g., CT scans, MRI) where preserving image quality is crucial.

•**Remote Sensing:** Satellite images are often compressed using wavelet coding to efficiently store and transmit large amounts of data.

Wavelet Transform:

•A mathematical tool that decomposes an image into different frequency components.

•Unlike Fourier transform, which only provides frequency information, wavelet transform provides both frequency and spatial information, making it particularly useful for analyzing localized features in an image.

Multi-Resolution Analysis:

Wavelet transform allows for multi-resolution analysis, meaning the image can be analyzed at various levels of detail.

High-frequency components correspond to fine details (e.g., edges), while low-frequency components correspond to the general structure of the image.

THANK YOU !!!