Jpeg Standard

A lossy baseline coding system, adequate for most compression applications

1. An extended coding system for greater compression, higher precision or progressive reconstruction applications
2. A lossless independent coding system for reversible compression

Details of JPEG compression Algorithm

1) Level shift the original image
2) Divide the input image in to 8x8blocks
3) Compute DCT for each block (matrix)(8x8)
4) Sort elements of the 8x8matrix

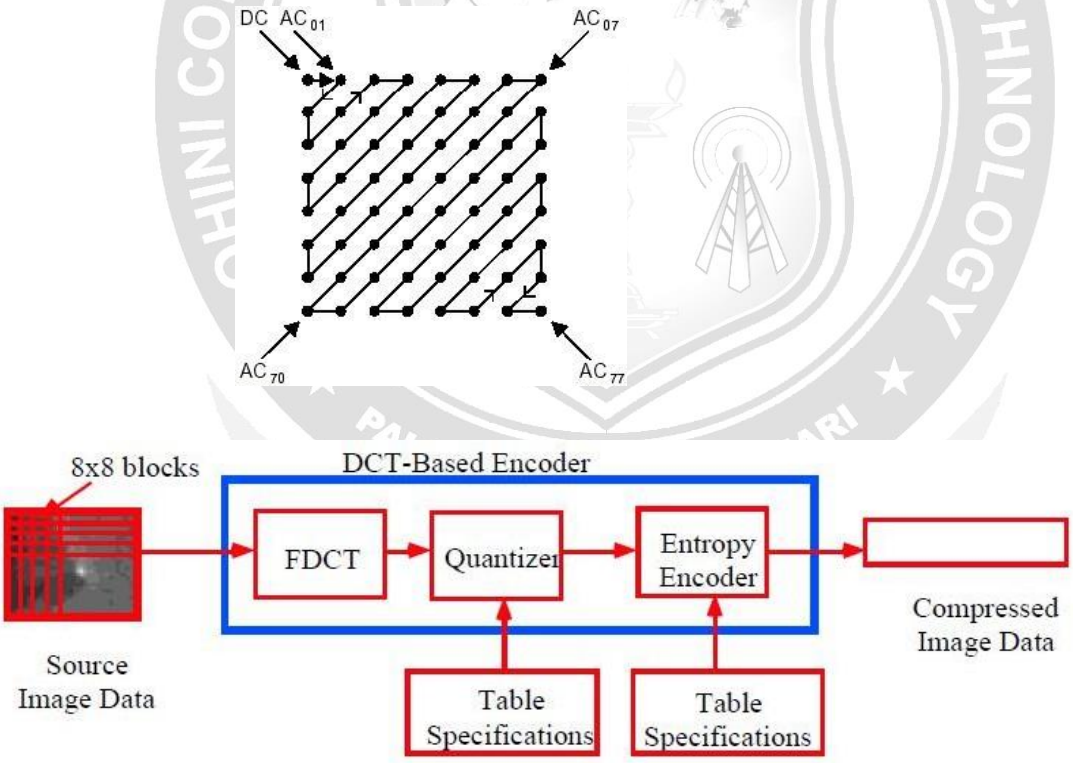

Fig 5.3.1 JPEG Encoder Block Diagram

Source: Tutorial Point

Details of JPEG Decompression Algorithm

1) Compute the reverse order for the output vector
2) Perform Huffman decoding next.
3) Restore the order of the matrix
4) De-normalize the DCT and perform block processing to reconstruct the Original image.
5) Level shift back the reconstructed image

JPEG Decoder Block Diagram

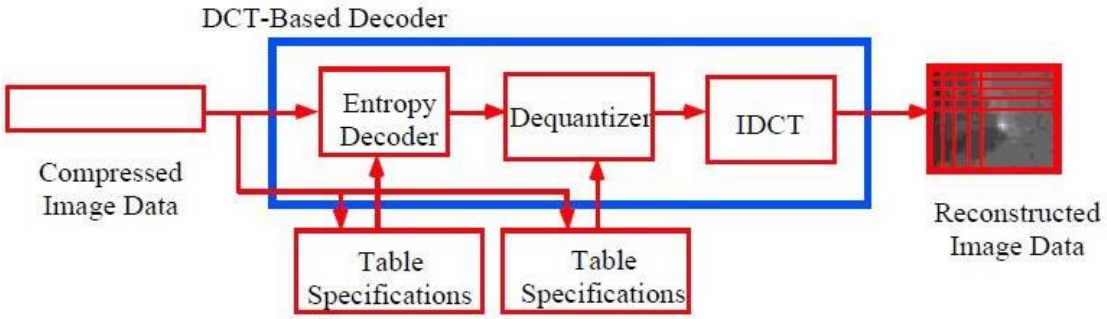

Fig 5.3.2 JPEG decoder Block Diagram

Source: Tutorials point.

2. JPEG2000

JPEG 2000 Encoder Algorithm:

a. The first step of the encoding process is to DC level shift the pixels of the image by subtracting 2^{m-1}, where 2^m is the number of gray levels of the image
b. If the input image is a color image, then RGB value is converted into YUV and these components are level shifted individually.
c. .After the image has been level shifted, its components are divided into tiles.
d. .Tiles are rectangular arrays of pixels that contain the same relative portion of all the components. Tile component is the basic unit of the original or reconstructed image.
e. A wavelet transform is applied on each tile. The tile is decomposed into different resolution levels.

e. The decomposition levels are made up of sub bands of coefficients that describe the frequency characteristics of local areas of the tile components, rather than across the entire image component.

f. Thus 1D-DWT of the rows and columns of each tile component is then computed.

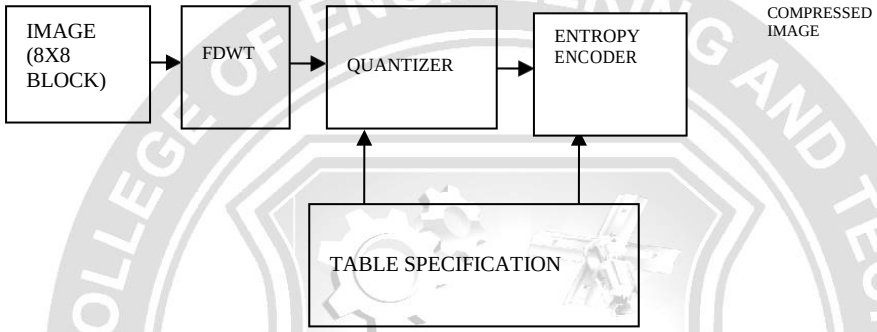

Fig: 5.3.3 Main structure of JPEG2000encoder.

Source: Tutorials point.

g. This involves six sequential lifting and scaling operations.

$$Y(2n+1)=X(2n+1)+\alpha[X(2n)+X(2n+2)],i_o-3\le 2n+1\le i_1+3$$

$$Y(2n)=X(2n)+\beta[Y(2n-1)+Y(2n+1)],\ i_o-2\le 2n\le i_1+2$$

$$Y(2n+1)=Y(2n+1)+\gamma[Y(2n)+Y(2n+2)],\ i_o-1\le 2n+1\le i_1+1$$

$$Y(2n)=Y(2n)+\delta[Y(2n-1)+Y(2n+1)],i_o\le 2n\le i_1\ Y(2n+1)=(-k).Y(2n-1),i_o\le 2n+1\le i_1$$

$$Y(2n)=Y(2n)/K,i_o\le 2n\le i_1$$

X = input tile component

Y = resulting transform coefficients

io and i1 = represent the position of the tiles component within a component.

JPEG 2000 Decoder Algorithm:

a. Decode the bit modeled or arithmetically bit streams

b. Dequantize the coefficients using,

$$R_{qb}(u,v) = \begin{cases} (\overline{q_b}(u,v) + 2^{M_b - N_b(u,v)}).\Delta_b, & \overline{q_b}(u,v) > 0 \\ (\overline{q_b}(u,v) - 2^{M_b - N_b(u,v)}).\Delta_b, & \overline{q_b}(u,v) < 0 \\ 0, & \overline{q_b}(u,v) = 0 \end{cases}$$

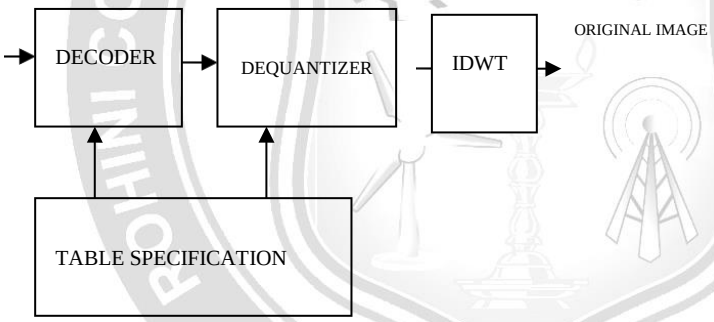

Fig: 5.3.4 Main structure of JPEG 2000 decoder.

Source: Tutorials point.

a. The dequantized coefficients are then inverse transformed by column and by row using inverse forward wavelet transform filter bank or using the following lifting based operations

b. $X(2n)=k.Y(2n), i_o-3 \le 2n \le i_1+3$

c. $X(2n+1)=(-1/k).Y(2n+1), i_o-2 \le 2n+1 \le i_1+2$

$X(2n)=X(2n)-\delta[X(2n-1)+X(2n+1)], i_o-3 \le 2n \le i_1+3$

$X(2n+1)=X(2n+1)-\gamma[X(2n)+X(2n+2)], i_o-2 \le 2n+1 \le i_1+2$

$X(2n)=X(2n)-\beta[X(2n-1)+X(2n+1)], i_o-1 \le 2n \le i_1+1$

$X(2n+1)=X(2n+1)-\alpha[X(2n)+X(2n+2)], i_o \le 2n+1 \le i_1$

d. Perform DC level shifting by adding 2^{m-1}