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% Created by vatsav
% Performing DWT (Discrete Wavelet Transform) without built-in commands
clear all; close all; clc;

% Read the image
url = 'C:\Users\vatsa\OneDrive\Pictures\Saved Pictures\cropped-512x512-1.png';
img_color = imread(url);

% Convert to grayscale for DWT processing
img_gray = rgb2gray(img_color);
img_gray = double(img_gray); % Convert to double precision

% Define Haar wavelet filters
LPF = [1/sqrt(2), 1/sqrt(2)]; % Low-pass filter
HPF = [-1/sqrt(2), 1/sqrt(2)]; % High-pass filter

% Row-wise Convolution and Downsampling
low_rows = conv2(img_gray, LPF, 'same'); % Low-pass
high_rows = conv2(img_gray, HPF, 'same'); % High-pass

low_rows_ds = low_rows(:, 1:2:end); % Downsample columns
high_rows_ds = high_rows(:, 1:2:end); % Downsample columns

% Column-wise Convolution and Downsampling
LL = conv2(low_rows_ds, LPF, 'same'); % Approximation
LH = conv2(low_rows_ds, HPF, 'same'); % Horizontal details
HL = conv2(high_rows_ds, LPF, 'same'); % Vertical details
HH = conv2(high_rows_ds, HPF, 'same'); % Diagonal details

LL = LL(1:2:end, :); % Downsample rows
LH = LH(1:2:end, :); % Downsample rows
HL = HL(1:2:end, :); % Downsample rows
HH = HH(1:2:end, :); % Downsample rows

% Display results
figure;
subplot(2,3,1); imshow(img_color); title('Original Image (Color)');
subplot(2,3,2); imshow(img_gray, []); title('Grayscale Image');
subplot(2,3,3); imshow(LL, []); title('LL (Approximation)');
subplot(2,3,4); imshow(LH, []); title('LH (Horizontal)');
subplot(2,3,5); imshow(HL, []); title('HL (Vertical)');
subplot(2,3,6); imshow(HH, []); title('HH (Diagonal)');

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### 3. Output Images

Below are the images generated from the DWT process:

- Original Image (Color)
- Grayscale Image
- LL (Approximation Sub-band)
- LH (Horizontal Details Sub-band)
- HL (Vertical Details Sub-band)
- HH (Diagonal Details Sub-band)

