**Final Image Processing Project**

KURUPPU K.D.R.J

29/11/2023

Here are the steps followed in the final image processing project.

Step 1: Load and Convert Image to Grayscale

As the initial step the sample image is loaded and converted to gray scale of 8bpp format. The image is converted to the grayscale using the following formular

Y = 0.299 \* R + 0.587 \* G + 0.114 \* B

Here the R- red pixel value, G- green pixel value, B- blue pixel value

Step 2: Image Enhancement

Several image enhancement techniques were used in this step to produce the highest quality images.

To reduce noise in the image, mean and median filters are applied. These filters introduce a slight blur to the image.

Contrast stretching is another image enhancement techniques. The contrast stretching function accepts a 2D list representing an image and performs contrast stretching to enhance image visibility. It first converts the image to a list of lists, flattens it to find the minimum and maximum pixel values, and then applies contrast stretching to adjust each pixel value in the entire image. The adjusted values are scaled to the range [0, 255], resulting in a contrast-stretched 2D list representing the enhanced image.

The sharpen image function enhances an input image by applying a 3x3 sharpening kernel through convolution. First need to define the kernel and normalize it. Then the function takes each pixel in the input image, extracts a local region from it, and uses the kernel to compute the weighted sum to perform convolution. An output array is initialized and a threshold is applied to guarantee non-negative values.

For each of the above filters SNR is calculated,

SNR of the Mean filtered image: 28.148125409570607

SNR of the Median filtered image: 28.288748921199

SNR of the contrast stretched image: 28.125818688416988

SNR of the sharpened image: 28.124728220079803

After applying a noise filter, signal-to-noise ratio (SNR) may increase because the filter works to lower noise.

Contrast stretching typically does not introduce or remove noise directly. Its primary purpose is to enhance the contrast between different intensity levels. SNR might remain similar.

High-frequency elements in the image may be amplified by sharpening operations, which may improve details but also increase noise. This could possibly lead to a lower SNR.

Step 3: Plot Histogram of the Final Image

Here the OpenCV library is used to read the final image. After that, it makes use of Matplotlib to produce a histogram of the image's pixel intensities.

Step 4: Compute Entropy and Compression Ratio

The code defines a function, CalculateEntropy, that computes the entropy of a given image by flattening it and generating a normalized histogram of pixel values. The entropy is calculated using the negative sum of non-zero probabilities and their logarithms. This metric quantifies the information content and uncertainty in the image's pixel distribution.

To determine the compression ratio between the original and final images, the original image size is divided by the final image size.

Here the compression ratio is

Compression Ratio: 6.917204510059796

In conclusion, the image processing pipeline involved loading, enhancing, and analyzing the given image, considering various image enhancement operations. After the final images were saved, important metrics like SNR, histogram, entropy, and compression ratio were calculated to assess the final image's qualities and features.

END.