Digital Image Processing

IMAGE COMPRESSION

JPEG and LZW Compression Techniques

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Introduction

This lab assignment is based on Image compression techniques namely, JPEG Compression and LZW Compression. Both of them are implemented in this project and the outputs are analyzed accordingly.

Objective

1) To encode and decode an image by JPEG Compression Technique and analyze the following parameters:
    a) No. of Coefficient parameters sent
    b) Subimage/Block size
    c) Normalization/Quantization matrix
    d) RMSE, PSNR, and compression ratio

2) To encode and decode an image using LZW Compression the basis of following parameters:

    a) Compression ratio achieved
    b) max compression achievable
    c) No. of Coefficient parameters sent

Overview:

JPEG Compression:

JPEG is a lossy image compression method. It uses the Discrete Cosine Transform method for coding transformation. It allows a tradeoff between storage size and the degree of compression that can be adjusted.

LZW Compression:

Lossless compression reduces bits by identifying and eliminating statistical redundancy. No information is lost in lossless compression.

Algorithm:

JPEG Compression:

1. RGB color space to YCbCr color space Conversion
2. Preprocessing for DCT transformation
3. DCT Transformation
4. Coefficient Quantization
5. Huffman Encoding (Run Length Encoding)

JPEG Decompression:

1. Huffman Decoding
2. Dequantization
3. Inverse DCT Transformation
4. Display the reconstructed image

LZW Compression:

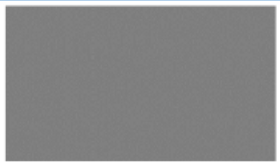
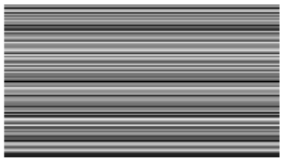
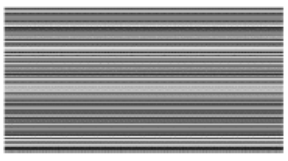
```
w = NIL;
while ( read a character k )
  {
   if wk exists in the dictionary
    w = wk;
   else
    add wk to the dictionary;
    output the code for w;
    w = k;
  }
```

LZW Decompression:

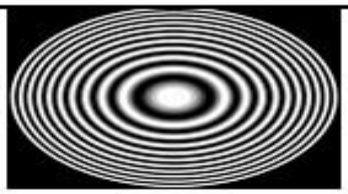
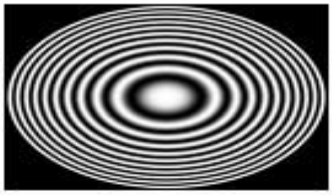
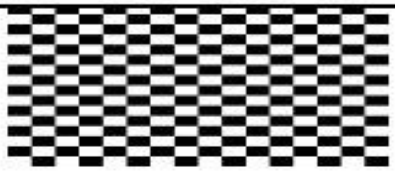
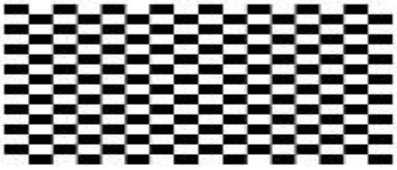
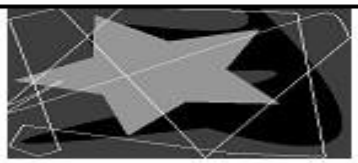
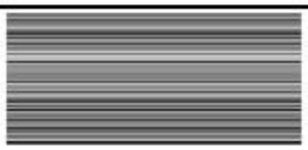
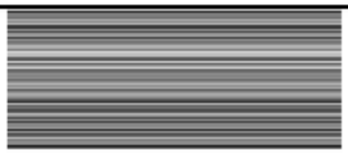
```
read a character k;
  output k;
  w = k;
  while ( read a character k )
 /* k could be a character or a code. */
     {
       entry = dictionary entry for k;
       output entry;
       add w + entry[0] to dictionary;
       w = entry;
     }
```

Observations:

JPEG Compression

Input Image	Output Image	C.R	P.SNR	RMS
		8.407216	26.6652	11.8381
		7.337779	26.7337	11.7450
		12.1330	30.9176	7.2554
		9.039474	27.2948	11.0101
		85.333	52.8856	0.5784
		8.682565	20.7315	23.4404

LZW Compression:

Input Image	Output Image	C.R
		0.47058823529411764
		0.5714285714285714
		0.5
		0.6666666666666666
		0.5714285714285714
		0.6153846153846154

Conclusions:

JPEG compression and LZW compression are two techniques to compress images. JPEG compression is lossy, whereas LZW is lossless compression. In this lab assignment, I learned to work with two programming languages, namely, Matlab and Python, and got hands-on experience on how image data can be compressed.