THE UNIVERSITY OF TEXAS AT ARLINGTON, TEXAS
DEPARTMENT OF ELECTRICAL ENGINEERING

EE 5356

DIGITAL IMAGE PROCESSING

PROJECT # 2

by

SOUTRIK MAITI

1001569883

Presented to

Dr. K.R.RAO

Feb 15, 2019

1. UNIFORM QUANTIZER

The code has been written according to the pseudocode provided. Comments are added in the MATLAB script to explain the algorithm

MATLAB CODE:

```
%%MATLAB implementation of Uniform Quantizer
%%Read the image

img = imread('goldhill256.bmp');

%%Convert the datatype of the image to double for calculation in
matlab

id = double(img);

%%Assign the number of levels of Quantization

L = [32,64,128];

%%Looping through the different levels of quantization

for i = 1:3
    %%setting the quantization size
    q_size = 256/L(i);

    tk(1) = 0;

    %%quantization process for Uniform quantization

    for k = 2:(L(i)+1)
        tk(k) = tk(k-1) + q_size;
        rk(k-1) = tk(k-1) + q_size/2;
    end

    %%creating quantization levels for uniform quantization

    for m = 1:256
        for n = 1:256
            for p = 1:L(i)
                if (id(m,n) < tk(p + 1) && id(m,n) >= tk(p))
                    res_img(m,n) = rk(p);
                end
            end
        end
    end

%%converting res_image to double datatype for calculating MSE & PSNR
out_img = double(res_img);
```

```
t = 0;

for q = 1:256
    for r = 1:256
        t = t + (id(q,r) - out_img(q,r))^2;
    end
end
%%calulating MSE using formula

MSE = (1/(256^2))*t;

%%calculating PSNR using formula

PSNR = 10*log10((255^2)/MSE);

%%results

figure(1)
subplot(2,2,i+1)
imshow(uint8(out_img))
title(['Quantized Image for L = ',num2str(L(i))])
xlabel(['MSE = ', num2str(MSE),' & PSNR =', num2str(PSNR)])
hold on
end
hold off
figure(1)
subplot(2,2,1)
imshow(img)
title('Orignal Image')

%%saving figure file

saveas(gca,'Uniform Quantizer','jpg')
```

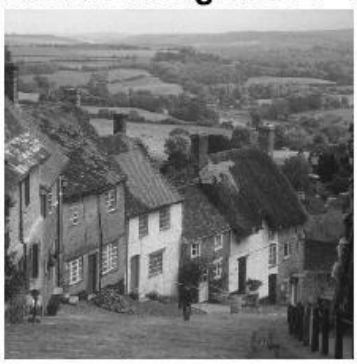
RESULTS:

Orignal Image

Quantized Image for L = 32

MSE = 5.5036 & PSNR =40.7244

Quantized Image for L = 64



MSE = 1.5006 & PSNR =46.3683

Quantized Image for L = 128

MSE = 0.50151 & PSNR =51.128

2. CONTRAST QUANTIZER

The code has been written according to the pseudocode provided. Comments are added in the MATLAB script to explain the algorithm

MATLAB CODE:

```
%%MATLAB implementation of Contrast Quantizer
%%Read the image

img = imread('goldhill256.bmp');

%%Convert the datatype of the image to double for calculation in
matlab

id = double(img);

%%Assign the number of levels of Quantization

L = [40,60,80];

%%Looping through the different levels of quantization

for i = 1:3

    %%quantization process for Contrast quantization
    %%Assign the values of alpha and beta
    alpha = 1;
    beta = 1/3;

    %%converting Luminance to contrast domain

    c = alpha * id(:,:).^beta;

    %%new max and min according to c
    tk(1) = min(min(c));
    tk(L(i)+1) = max(max(c));

    %%setting the quantization size

    q_size = (tk(L(i)+1)-tk(1))/L(i);

    rk(1) = tk(1) + q_size;

    for k = 2:(L(i)+1)
        tk(k) = tk(k-1) + q_size;
        rk(k-1) = tk(k-1) + q_size/2;
    end

    %%creating quantization levels for contrast quantization
```

```
    for m = 1:256
        for n = 1:256
            for p = 1:L(i)
                if (c(m,n) < tk(p + 1) && c(m,n) >= tk(p))
                    res_img(m,n) = rk(p);
                end
            end
        end
    end


%%Converting contrast back to Luminance
out_img = ((res_img).^(1/beta))/alpha;
%%converting image to double for calculating MSE and PSNR
out_img = double(out_img);

t = 0;

for q = 1:256
    for r = 1:256
        t = t + (id(q,r) - out_img(q,r))^2;
    end
end
%%calculating MSE according to formula

MSE = (1/(256^2))*t;

%%calculating PSNR according to formula

PSNR = 10*log10((255^2)/MSE);

%%results
figure(1)
subplot(2,2,i+1)
imshow(uint8(out_img))
title(['Quantized Image for L = ',num2str(L(i))])
xlabel(['MSE = ', num2str(MSE),' & PSNR =', num2str(PSNR)])
hold on
end
hold off
figure(1)
subplot(2,2,1)
imshow(img)
title('Orignal Image')
%%saving figure
saveas(gca,'Contrast Quantizer','jpg')
```

RESULTS:

Orignal Image

Quantized Image for L = 40

MSE = 101.1779 & PSNR =28.0799

Quantized Image for L = 60

MSE = 99.2695 & PSNR =28.1626

Quantized Image for L = 80

MSE = 98.6178 & PSNR =28.1912

3. PSEUDORANDOM QUANTIZER

The code has been written according to the pseudocode provided. Comments are added in the MATLAB script to explain the algorithm

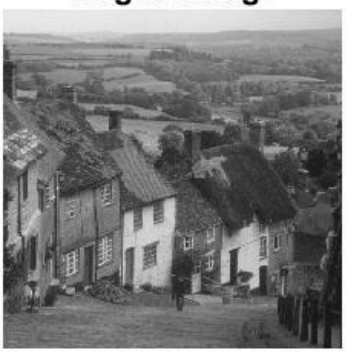
MATLAB CODE:

```
%%MATLAB implementation of Pseudorandom Quantizer
%%Read the image

img = imread('goldhill256.bmp');

%%Convert the datatype of the image to double for calculation in
matlab

id = double(img);

%%Assign the different noise values for A

A = [22,89,113];

%%Number of bits

L = 2^3;

%%Looping through the different levels of noise

for i = 1:3
    %%quantization process for Pseudorandom quantization

    %%generating pseudorandom noise

    ps_ran = randi([-A(i),A(i)],256,256);

    %%adding image and noise

    c = id(:,:,1) + ps_ran;

    %%new min and max values according to c

    tk(1) = min(min(c));
    tk(L+1) = max(max(c));

    %%setting the quantization size

    q_size = (tk(L+1)-tk(1))/L;

    rk(1) = tk(1) + q_size;

    for k = 2:(L+1)
        tk(k) = tk(k-1) + q_size;
```

```
        rk(k-1) = tk(k-1) + q_size/2;
    end

    %%creating quantization levels for pseudorandom quantization

    for m = 1:256
        for n = 1:256
            for p = 1:L
                if (c(m,n) < tk(p + 1) && c(m,n) >= tk(p))
                    res_img(m,n) = rk(p);
                end
            end
        end
    end


%%subtracting noise from image
res_img = res_img - ps_ran;

%%converting image to double datatype for calculating MSE and PSNR

out_img = double(res_img);

t = 0;

for q = 1:256
    for r = 1:256
        t = t + (id(q,r) - out_img(q,r))^2;
    end
end

%%calculating MSE and PSNR using formula
MSE = (1/(256^2))*t;
PSNR = 10*log10((255^2)/MSE);

%%results
figure(1)
subplot(2,2,i+1)
imshow(uint8(out_img))
title(['Quantized Image for L = 8 and A = ',num2str(A(i))])
xlabel(['MSE = ', num2str(MSE),' & PSNR =', num2str(PSNR)])
hold on
end
hold off
figure(1)
subplot(2,2,1)
imshow(img)
title('Orignal Image')

%%saving figure
saveas(gca,'Pseudorandom Quantizer','jpg')
```

RESULTS:

Orignal Image



Quantized Image for L = 8 and A = 22

MSE = 87.7071 & PSNR =28.7005

Quantized Image for L = 8 and A = 89

MSE = 197.9916 & PSNR =25.1643

Quantized Image for L = 8 and A = 113

MSE = 252.0583 & PSNR =24.1158

CONCLUSION:

- According to the results it can be shown that the MSE and PSNR values in Uniform quantization is the least and the image obtained is very similar to the original image.
- Another observation that can be seen from the contrast quantizer is that the PSNR values remain almost similar in the different levels of quantization.
- The Pseudorandom quantization shows that the output is grainy because of the added noise. As the noise increases, the image becomes grainier.