Computer Vision - Assignment 1

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Question 1)

Luminance: In image processing, grayscale values are commonly used to represent an object's brightness, which is determined by the intensity of light it emits or reflects.

Brightness: The subjective judgment of an object's lightness or darkness, depending on contrast and personal perception, is called brightness. Unlike luminance, which measures the physical intensity of light, brightness varies based on personal interpretation. Brightness permits various reasonable interpretations of an object's perceived brightness, but luminance provides an objective measure.

While brightness captures the subjective human impression of light, luminance quantifies the objective measurement of light reflected by a surface. As an objective metric, luminance is constant under all circumstances, but brightness fluctuates with people and situations. While luminance is used in image processing for technical analysis and operations like Contrast Enhancement algorithms, brightness adjustment is essential for figuring out and adjusting an image's brightness and darkness levels to make them more in line with human perception. This distinction is important because it shows how different observers may perceive two items with the same luminance at various levels because of differences in visual systems, contrast, and settings. This emphasizes the importance of brightness in applications that are focused on people.

Due to definitions, the image in question is accurate because it illustrates how people typically see the edges of images to be brighter. The sudden change in color could be the reason of this.

Question 2)

a)

$$C = 1 - \frac{R}{255}$$

$$M = 1 - \frac{G}{255}$$

$$Y = 1 - \frac{B}{255}$$

Using given RGB values:

$C \approx 0.4078$

$Y \approx 0.8$

$Y \approx 0.8$

$K \approx 0.0196$

$CMYK = (0.0196, 0.4078, 0.8, 0.0196)$

b)

To convert to YIQ:

$Y = 0.299R + 0.587G + 0.114B$

$I = 0.596R - 0.274G - 0.322B$

$Q = 0.211R - 0.523G + 0.312B$

Using given RGB values:

$Y = 0.299 \times 251 + 0.587 \times 151 + 0.114 \times 51 \approx 186.04$

$I = 0.596 \times 251 - 0.274 \times 151 - 0.322 \times 51 \approx 39.73$

$Q = 0.211 \times 251 - 0.523 \times 151 + 0.312 \times 51 \approx 99.63$

So:

$YIQ=(186.04,39.73,99.63)$

c)

$Y=Y$

$Cb=0.564\times(I-Y)+128$

$Cr=0.713\times(Q-Y)+128$

Using the calculated YIQ values:

$Y=186.04$

$Cb=0.564\times(39.73-186.04)+128\approx100.68$

$Cr=0.713\times(99.63-186.04)+128\approx68$

So:

$YCbCr=(186.04,100.68,68.06)$

d)

RGB utilizes light-based color mixing, where combining Red, Green, and Blue light results in white, hence its designation as the additive color wheel. It is primarily employed for images on screens and in working spaces, which are large and predictable RGB gamuts suitable for image manipulation.

YCrCb, like YIQ, employs linear methods to separate lightness from chroma signals in an RGB input. Y represents Luma or Luminosity, indicating the amount of light a color reflects, while Cr and Cb denote Red and Blue Chroma, respectively, measuring color variations along the red-green and blue-yellow axes. This color space finds frequent use in photography.

CMYK, standing for Cyan, Magenta, Yellow, and Key (Black), is the color space utilized in printers for printing purposes.

In conclusion, RGB is generally recommended for most applications. However, each color space has its specific use cases and practical applications, making them all valuable in their respective domains.

Question 3)

In order to convert the left picture into the right picture in this question, speculation is required. We are aware that pr(r) = 2 - 2r and pz(z) = 2z.

First, we will calculate s using the following formula:

$$\int_0^r p_r(w)\,dw$$

So, s = r^2 - 2r

G(z) = z^2 which means G^-1(z) = z^½

Now we will calculate transformation function:

T(r) = z = (r^2 - 2r)^1/2.

Question 4) **a)**

At the first, we should calculate the cumulative distribution.

value	count	cumulative count
1	8	8
2	8	16
3	2	18
5	7	25

This data indicates that there are 4 distinct values and 25 pixels in the image, corresponding to L = 8-1 = 7, M = N = 5, CDF_min = 8.

We must use the following formula to calculate their new values:

$$h(v) = round\left(\frac{CDF(v) - \quad CDF_{min}}{M \times N - CDF_{min}} \times (L-1)\right)$$

putting the values in the formula:

h(x) h(1) = 0 h(2) = 4 h(3) = 4 h(5) = 7 the image will be:

0	4	0	0	0
4	7	4	7	4
4	7	7	7	4
4	7	4	7	4
0	0	0	4	0

b)

Bit 0:

1	0	1	1	1
0	1	1	1	0
0	1	1	1	0
0	1	1	1	0
1	1	1	0	1

Bit 1:

0	1	0	0	0
1	0	1	0	1
1	0	0	0	1
1	0	1	0	1
0	0	0	1	0

Bit 2:

0	0	0	0	0
0	1	0	1	0
0	1	1	1	0
0	1	0	1	0
0	0	0	0	0

The remaining bits will be 0

c)

We will use logarithm transformation to solve this problem. So, we use this formula:

s = C.Log(r +1)

$$C = \frac{L-1}{\log(1+\max(r))}$$

C will be equal to 7.75

L-1 = 7

Max(r) = 7

As s = C * log(r+1),

So:

s(1) = 2.23,

s(2) = 3.7,

s(3) = 4.66,

s(5) = 6.025