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Computer vision final project

Hiding a QR code in an image

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Why hiding a QR code?

The plain old QR code has negative effect on the beauty of the design.

Customers normally do not like to use them.

It leads to an idea to encode the QR code to an image.

Review of the paper embedding QR code into color image.

1.Using halftoning method.

2.Pixel Selection.

3.Luminance Modification.

4.Threshold Calculation for Binarization.

5.Color optimization.

6.Encoding Technique.

7.Decoding Algorithm.

Halftoning method

Halftoning techniques reproduce the same image base on dots but it keeps the high details of the image.

In the paper try to halftone the image and then embed the qr code on the halftoned image .

They believe in this way it is harder

For human eyes to detect The

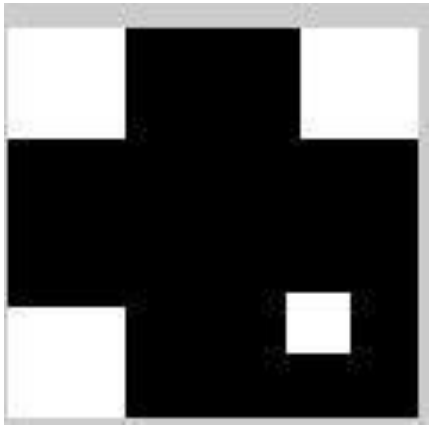
embedded qr code.

Pixel Selection

In the paper they use the fix mask to detect the part of QR code that is not finder pattern or Alignment pattern.

Demerit: Finder pattern or Alignment pattern could be in different location from QR code to another QR code. Fixing this kind of

mask can not be a good And general strategies.



Luminance Modification

$$Y_{i,j}^{out} = \begin{cases} \beta & \text{if } M_{i,j} = 0\ ,\ q_{i,j} = 1,\ I_{p_c,(i,j)} = 1 \\ \alpha & \text{if } M_{i,j} = 0\ ,\ q_{i,j} = 0,\ I_{p_c,(i,j)} = 1 \\ \beta_c & \text{if } M_{i,j} = 1\ ,\ q_{i,j} = 1 \\ \alpha_c & \text{if } M_{i,j} = 1\ ,\ q_{i,j} = 0 \\ Y_{i,j} & \text{otherwise.} \end{cases}$$

Alpha level

Beta level

Alphac level

Betac level

Color optimization

To embed the QR code to color image we need to change the color of modified luminance base on some rules.

HSL color space is selected because it involves simpler computations than other color spaces.

RGB image transforms to HSL, while the H and S keep fixed they change the L values base on this formula on next slides.

Color optimization

W is the predefined weight luminance vector

$$w = [0.298, 0.587, 0.1140]^T$$

$$L = \frac{\min(R,G,B)+\max(R,G,B)}{2}$$

$$L^* = \underset{L}{\operatorname{argmin}} |f(L) - l_t|$$ L is new light of HSL and l is desire luminance.

$$(R^*, G^*, B^*) = T(H, S, L^*)$$

Decode technique

Binarization: The gray scale of image is segmented into black and white pixels

Using the threshold.

$$I_B[i,j] = \begin{cases} 1 & \text{if} \quad Y_{i,j} > t_{i,j} \\ 0 & \text{if} \quad Y_{i,j} \leq t_{i,j} \end{cases}$$

we should play with the luminance value of the qr code, so we need to convert again the image from RGB to HSL color space and then optimising parameter of L until reaching to a good QR code image.

Sample of papers

Binary QR - qij(Q)

Intensity image - Y

Halftoned Binary image - Ipc(H)

Sample of papers

Embede QR code

half decoded optimizing L

fully decode using Zinx libaray


It´s
My
Turn

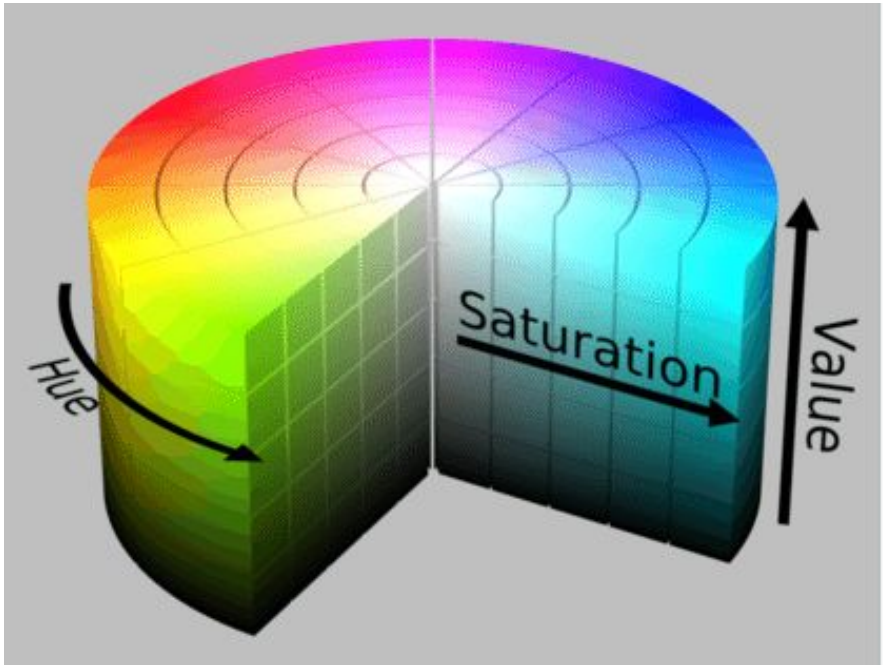
Hidining QR code by tuning the saturation

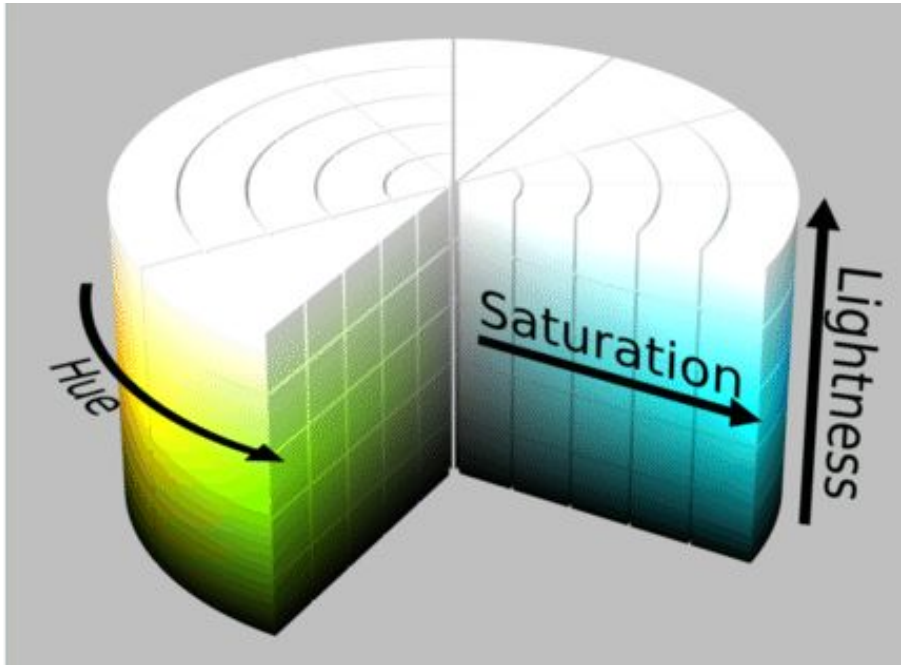
Now I want to choose another method that look more practical. Instead of changing the intensity parameter in HSL color space I want to try saturation parameter.

Why HSL?

Why saturation?

HSL and HSV





The new Idea for hiding QR code

The idea is that removing the saturation layer and putting the tuning gray scale QR code will not change the color image so much. But changing the two other parameters like Hue or intensity can completely destroy the image.

Encoding

- Fetchin image and QR code from hard disk.
- Resizing both image and QR code.
- Converting image from RGB to HSL color model.
- Converting the resized QR code to the gray scale.
- Changing the 0 to 255 from 0 to 1.
- In Gray scale QR code.Change the the numbers smaller than 0.5 to 0.45 and numbers bigger than 0.5 to 0.55 .
- Changin the saturation layer with Grayscale QR code matrix.
- Return HSL matrix image to RGB Image.

Decoding

- converting RGB encoded image to HSL
- extractin L layer and changing numbers of matrix from smaller than0.5 to 0 and larger than 0.5 to 1.
- converting QRcode Grayscale to image.

Encoding algorithm

1. Resizing both QR code image and color image to the size of QR code.
2. Converting the color image from RGB to HSL matrix image.
3. Converting QR code to gray Scale matrix.(values from 0 to 1)
4. change with threshold 0.5 for the gray scale image matrix.so the number bigger than 0.5 will be 0.55 and smaller than 0.5 will be 0.45 .
5. Changing the S layer of HSL matrix with new Gray scale matrix.
6. Converting HSL matrix to RGB image.

Sample image and encoded image(left normal image, right encoded)








Decoding algorithm

1. Converting encoded RGB image to HSL Matrix.
2. Extracting The S layer of HSL matrix.
3. Changing the S layer matrix with threshold of 0.5 (so numbers that are smaller than the 0.5 will be zero and number bigger than 0.5 will be 255).
4. Converting the matrix to an image.

Encoding

- ~~Fetchin image and QR code from hard disk~~.(**DONE**)
- ~~Resizing both image and QR code~~.(**DONE**)
- ~~Converting image from RGB to HSL color model~~.(**DONE**)
- ~~Converting the resized QR code to the gray scale!~~.(**DONE**)
- ~~Changing the 0 to 255 from 0 to 1~~.(**DONE**)
- ~~In Gray scale QR code.Change the numbers smaller than 0.5 to 0.45 and numbers bigger than 0.5 to 0.55~~.(**DONE**)
- ~~Changin the saturation layer with Grayscale QR code matrix~~.(**DONE**)
- ~~Return HSL matrix image to RGB Image~~.(**DONE**)

Decoding

- ~~converting RGB encoded image to HSL~~.(**DONE**)
- ~~extractin L layer and changing numbers of matrix from smaller than0.5 to 0 and larger than 0.5 to 1~~.(**DONE**)
- ~~converting QRcode Grayscale to image~~.(**DONE**)