

Color Image Processing

By,

Navya Sushma Tummala,

Wahab Nadir Kadiwar,

Jaivardhan Singh Shekhawat,

Fabian Mendez,

Sikender Shahid,

Tyler Driver,

Israel Perez.

Objective

- To develop a Tkinter based application to perform color image processing operations on an given input image.
- The color image processing operations involve:
 - Color Image Transformations
 - Rgb to HIS (Hue Saturation Intensity)
 - Rgb to CMYK (Cyan, Magenta, Yellow and Black)
 - Intensity Slicing
 - Image smoothening
 - Image Sharpening

Roles and Responsibilities

Section	Implemented by
Color Image Processing	Navya Sushma Tummala
Smoothing	Wahab Nadir Kadiwar
Sharpening	Jaivardhan Singh Shekhawat
Intensity/Color slicing	Sikender Shahid & Israel Perez
GUI	Fabian Mendez
Backend	Tyler Driver

Color Image Transformations

- Operations

- Rgb to HSI:

$$H = \begin{cases} \cos^{-1}\left(1/2 \cdot \frac{(R-G)+(R-B)}{\sqrt{(R-G)(R-G)+(R-B)(G-B)}}\right), & \text{if } G \geq B; \\ 360^\circ - \cos^{-1}\left(1/2 \cdot \frac{(R-G)+(R-B)}{\sqrt{(R-G)(R-G)+(R-B)(G-B)}}\right), & \text{Otherwise} \end{cases}$$

$$H \in [0, 360[$$

$$S = 1 - 3 \cdot \frac{\min\{R, G, B\}}{R + G + B} \quad S \in [0, 1]$$

$$I = \frac{R + G + B}{3} \quad I \in [0, 255]$$

- Rgb to CMYK:

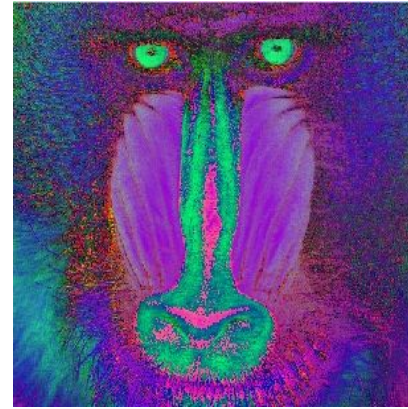
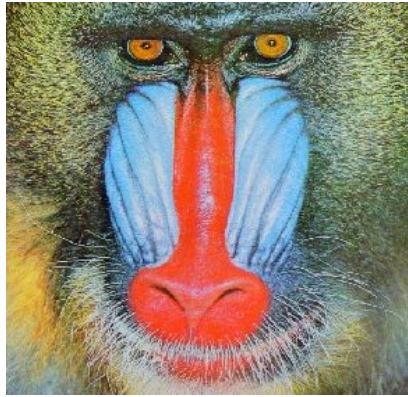
$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

Calculate
minimum of
cmy

Black (K) = minimum of C,M,Y
Cyan_{CMYK} = (C - K)/(1 - K)
Magenta_{CMYK} = (M - K)/(1 - K)
Yellow_{CMYK} = (Y - K)/(1 - K)

Cont...

- Rgb to HSI:



- Rgb to CMYK:



Intensity & Color Intensity Slicing

Amplify regions as function of intensity values

Functionality

Select a channel from set : {R,G,B}, {C,M,Y} , {H,S,I}

Select boundary values : $[I_a, I_b]$ [intensity]

Confirm range or inverted range

Perform transformation: non-inverted selection

$\text{Image}(x,y) = \text{Gain} * \text{Image}(x,y) \text{ if } I_a < \text{Image}(x,y) < I_b \text{ else } \text{Image}(x,y)$

Or

$0 < \text{Gain} < 1$: decreasing

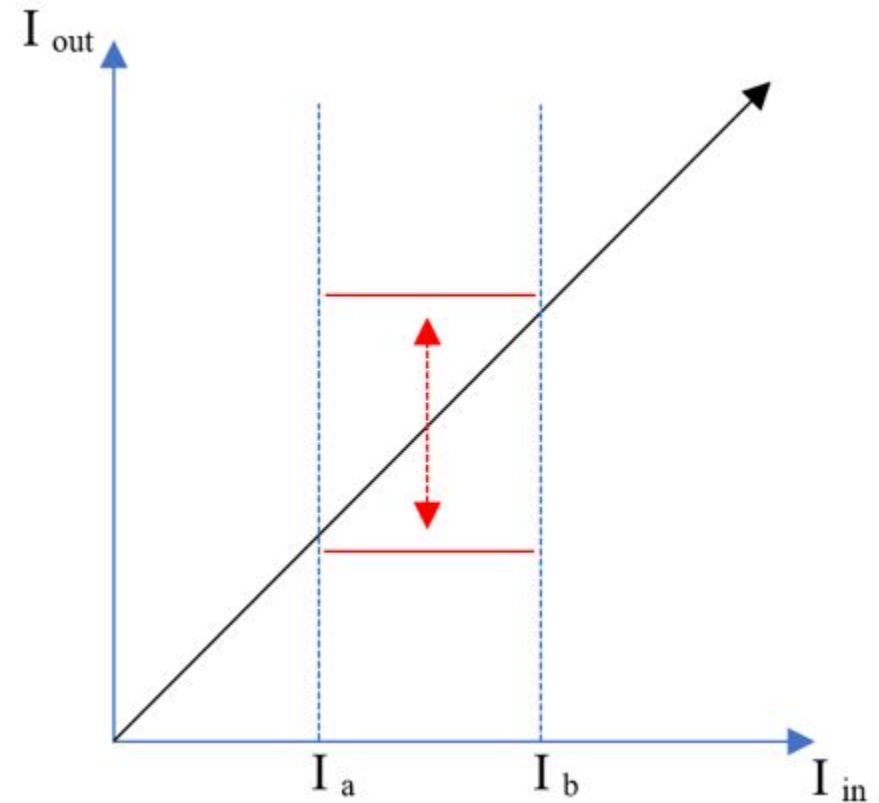
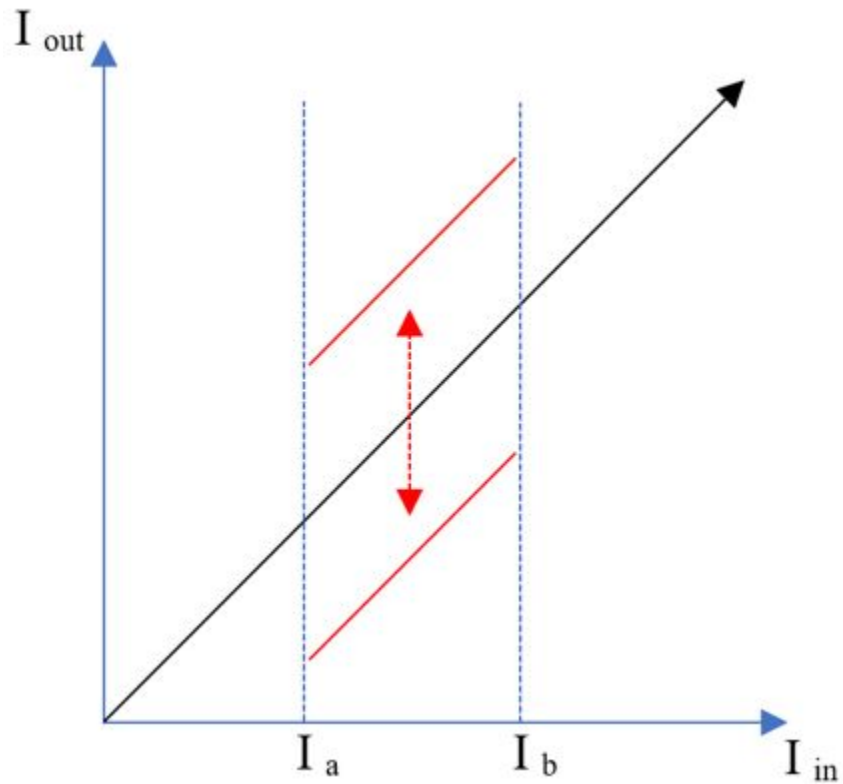
$1 < \text{Gain}$: increasing

$\text{Image}(x,y) = \text{Gain} * \text{Median}(I_a, I_b) \text{ if } I_a < \text{Image}(x,y) < I_b \text{ else } \text{Image}(x,y)$

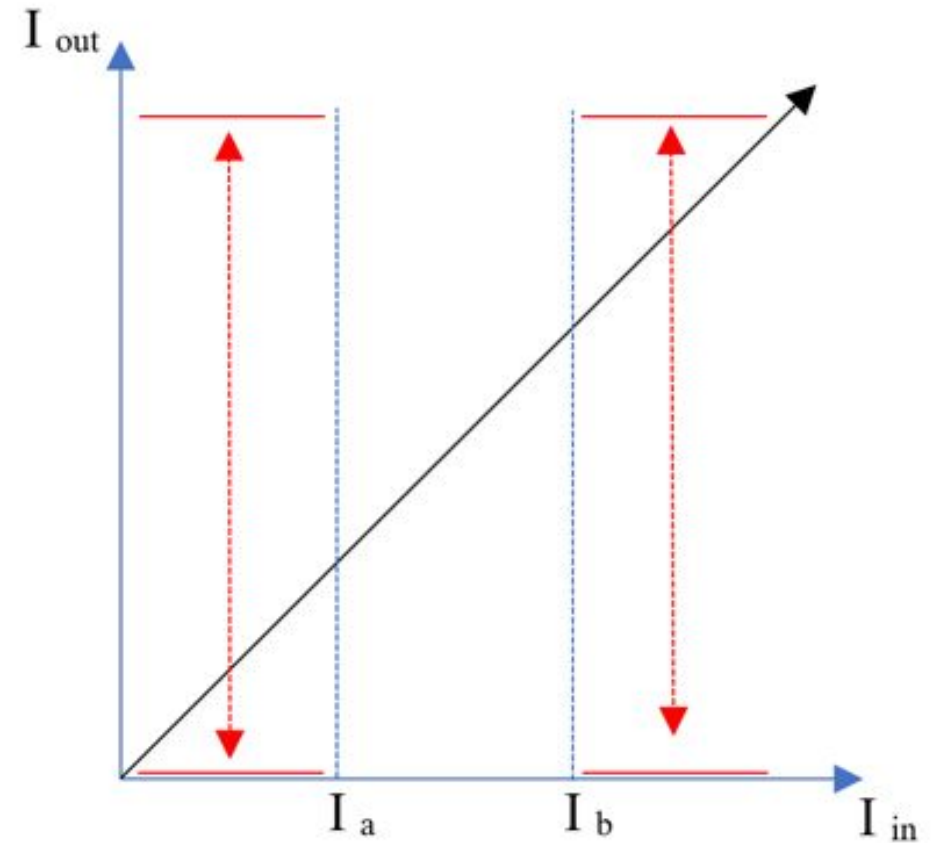
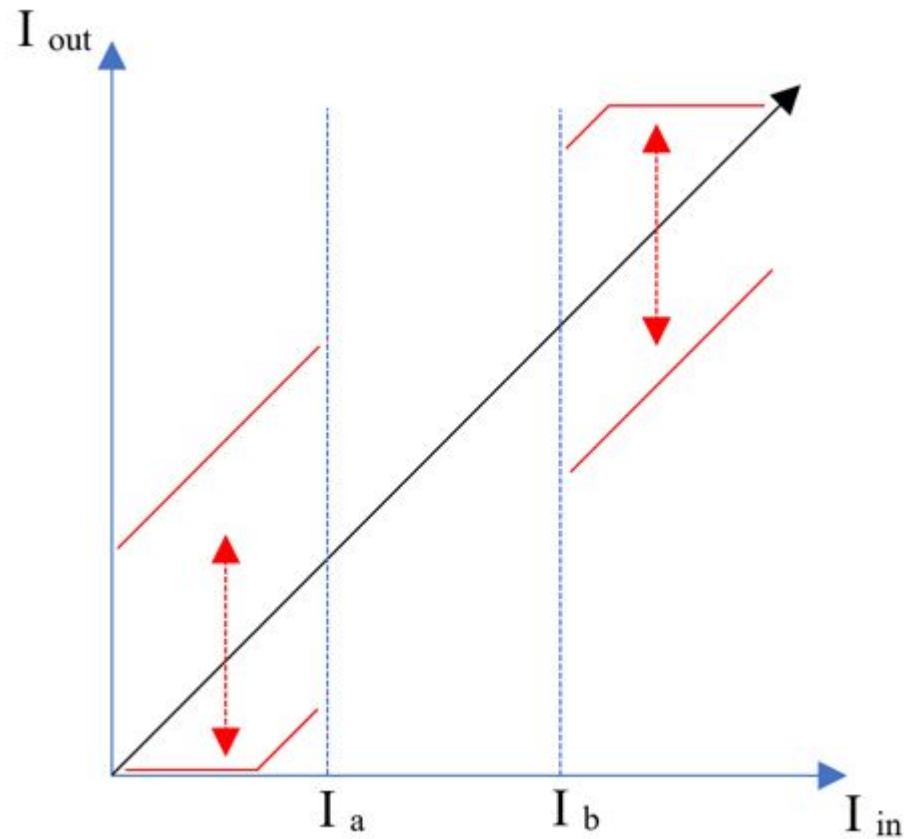
*Ignoring saturation in pseudo code

*Ignoring inverted selection step

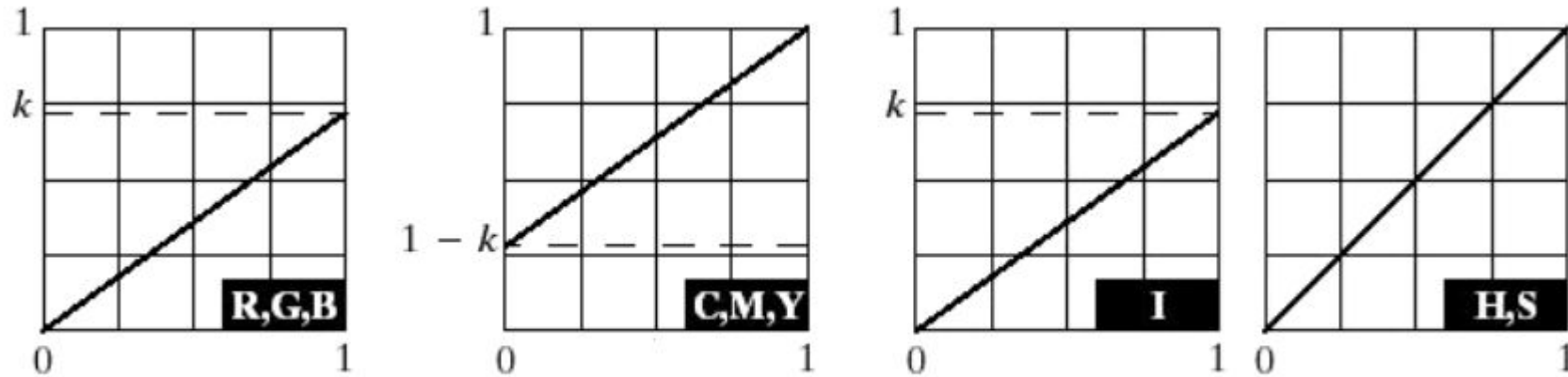
Intensity & Color Intensity Slicing



Intensity & Color Intensity Slicing

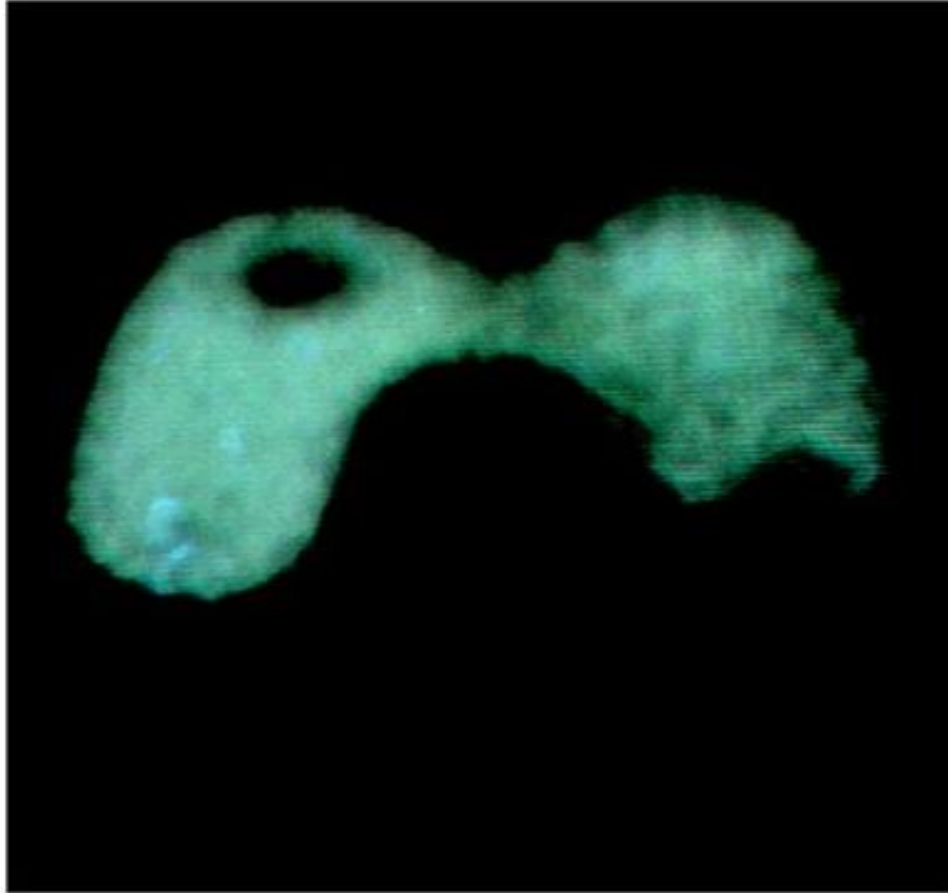


Intensity & Color Intensity Slicing

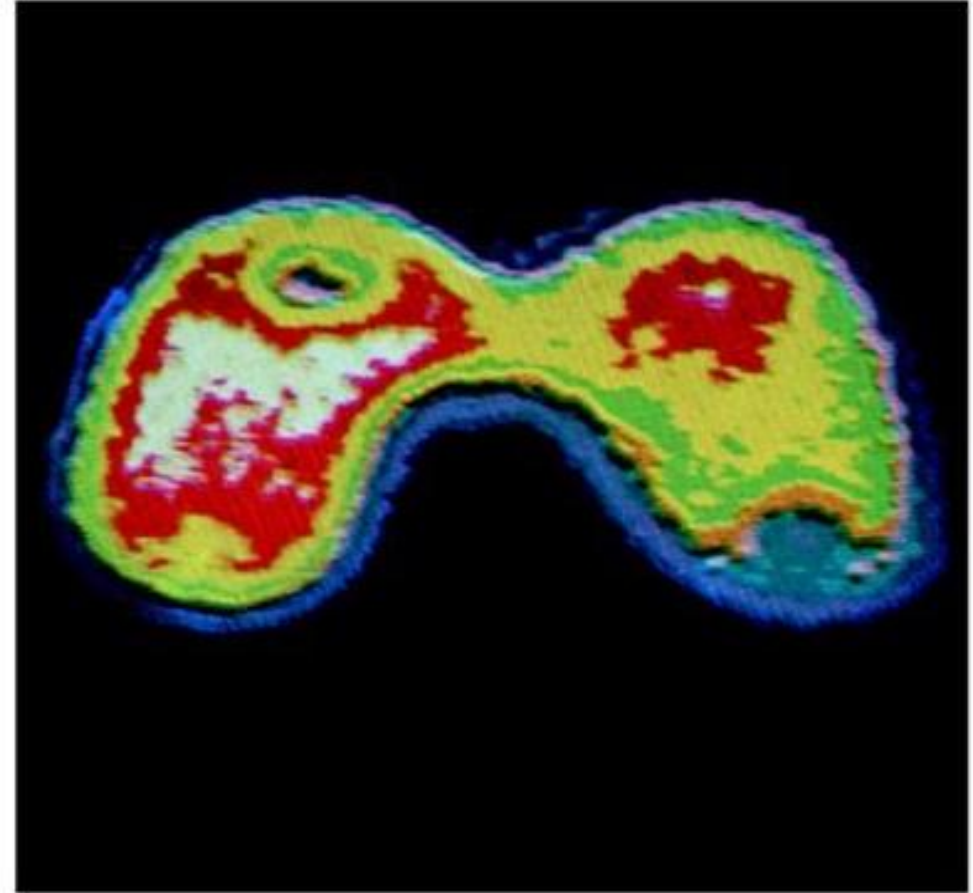


Reusing slicing algorithm for different color channels

Intensity Sliced transformation (Input & Output)



An X-ray image of the Picker Thyroid Phantom.



After density slicing into 8 colors

Image Smoothing

Averaging:

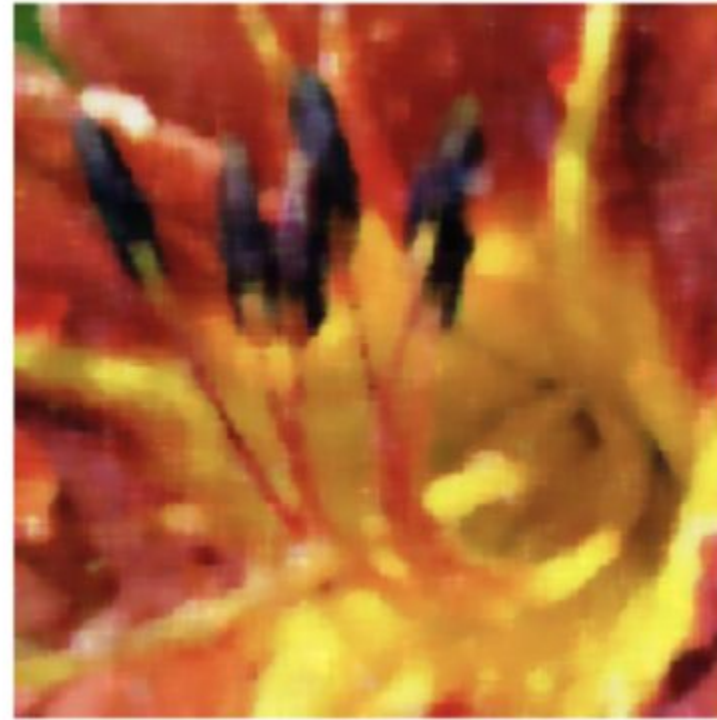
$$\bar{c}(x, y) = \frac{1}{K} \sum_{(x, y) \in S_{xy}} c(x, y)$$

$$\bar{c}(x, y) = \begin{bmatrix} \frac{1}{K} \sum_{(x, y) \in S_{xy}} R(x, y) \\ \frac{1}{K} \sum_{(x, y) \in S_{xy}} G(x, y) \\ \frac{1}{K} \sum_{(x, y) \in S_{xy}} B(x, y) \end{bmatrix}$$

Image Smoothing (Input & Output Images)



Original Image



Smoothened Image

Image Sharpening

The Laplacian of Vector \mathbf{c} :

$$\nabla^2 [\mathbf{c}(x, y)] = \begin{bmatrix} \nabla^2 R(x, y) \\ \nabla^2 G(x, y) \\ \nabla^2 B(x, y) \end{bmatrix}$$

Image Sharpening (Input & Output Images)

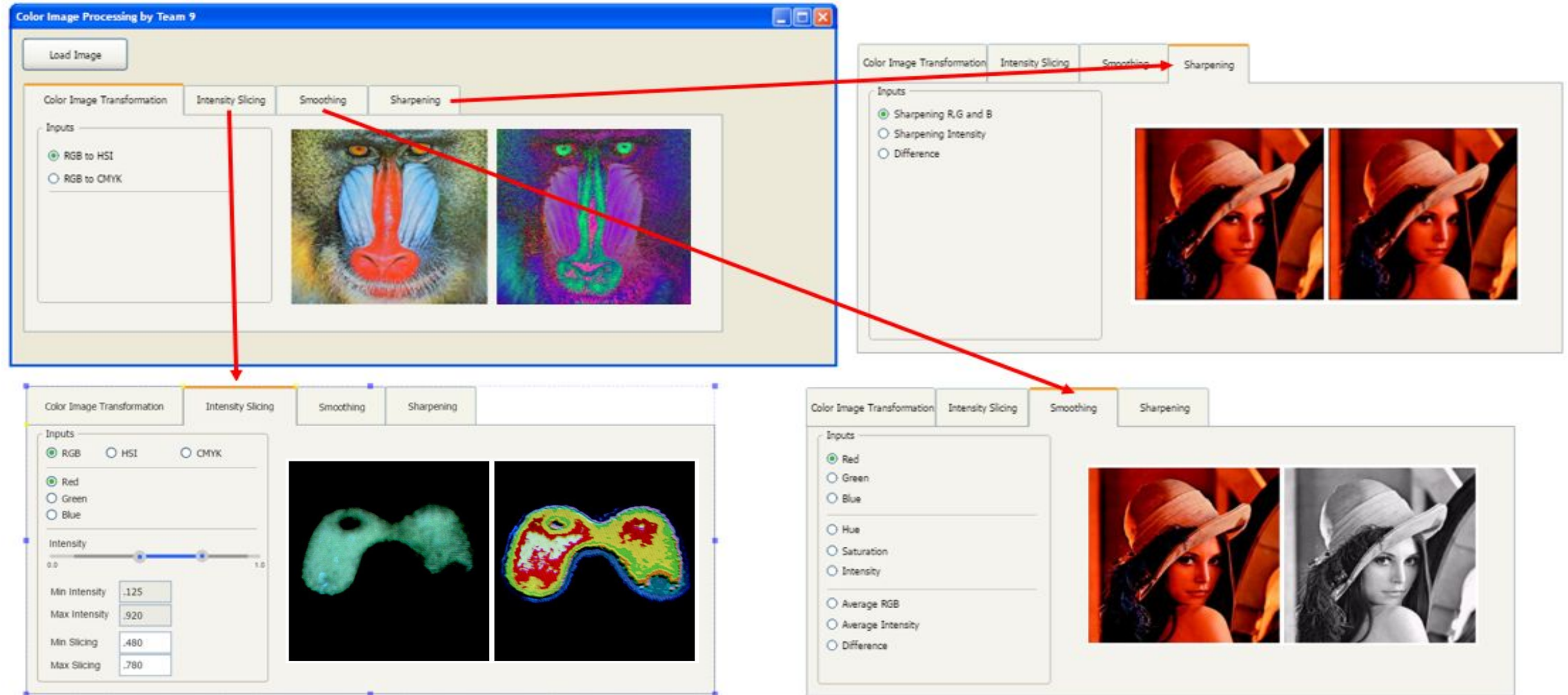


Original Image



Sharpened Image

GUI (Framework used: Tkinter)



Libraries Used

Section	Libraries planning to Use	Libraries planning not to use
Color Image Processing	Opencv,numpy	No other libraries other than these.
Image Sharpening	Numpy, Cv2	No other libraries other than these.
GUI	Tkinter	No other libraries other than these.
Intensity Color Slicing	Numpy	No other libraries other than these.



THANK YOU

FOR A FEW MINUTES OF YOUR TIME