Principles and Applications of Digital Image Processing

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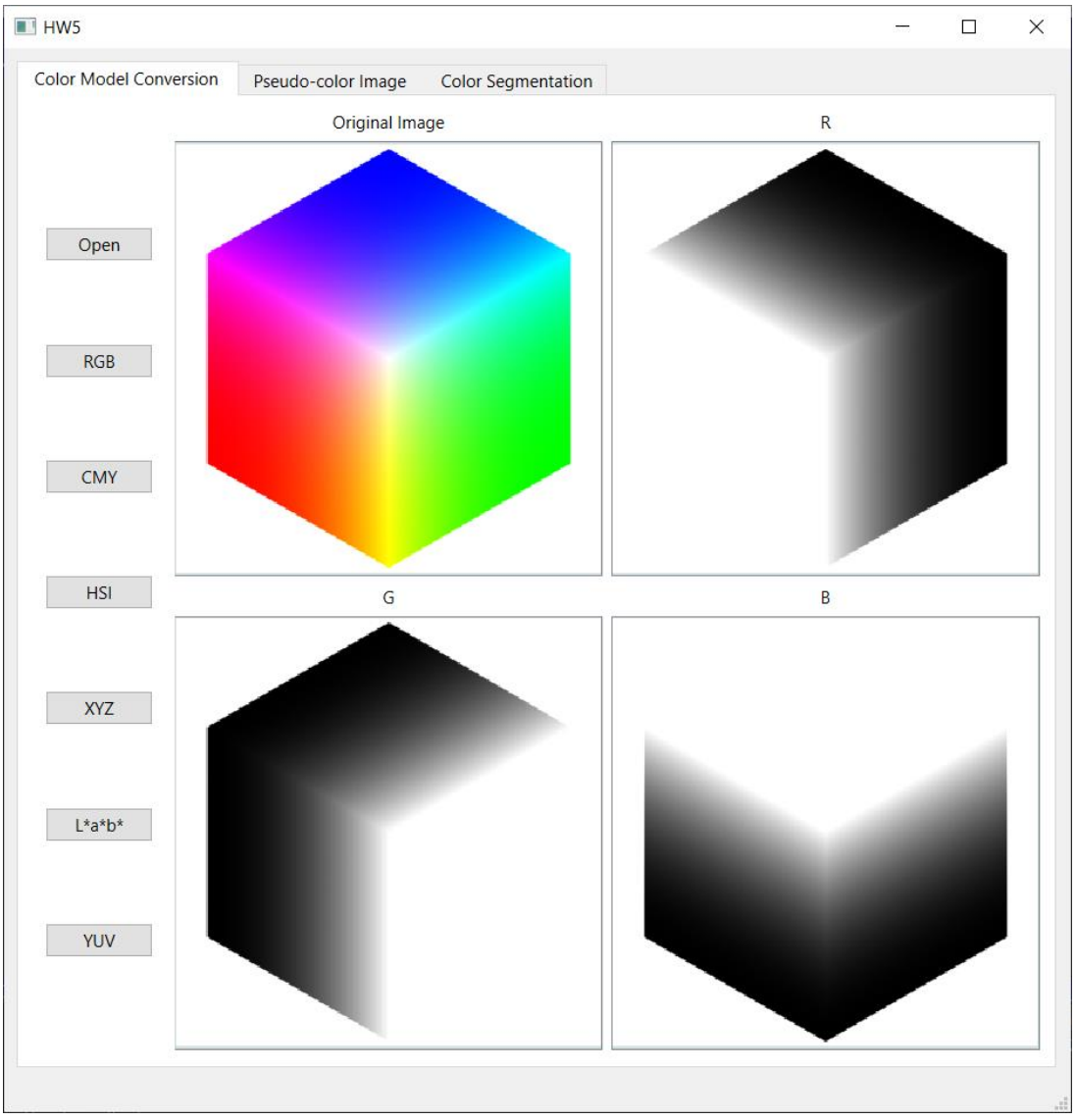
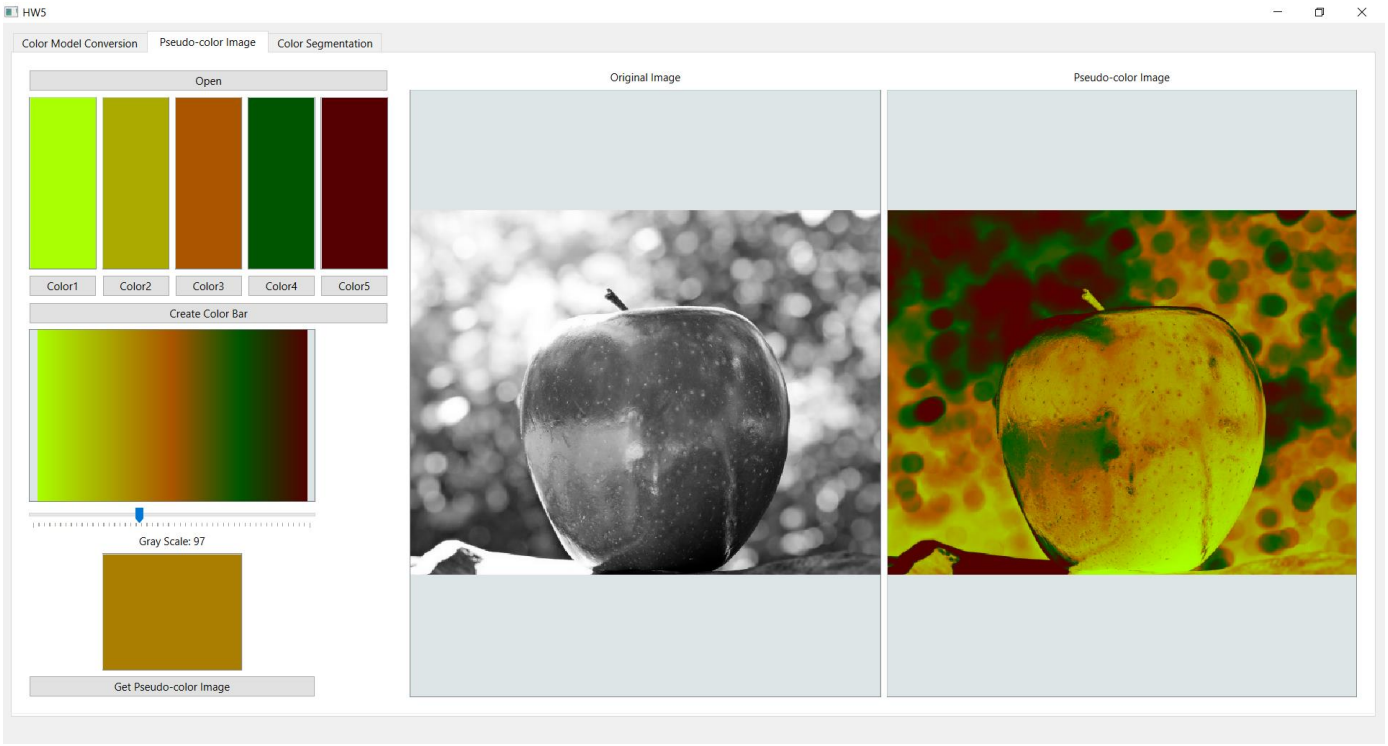
HW5

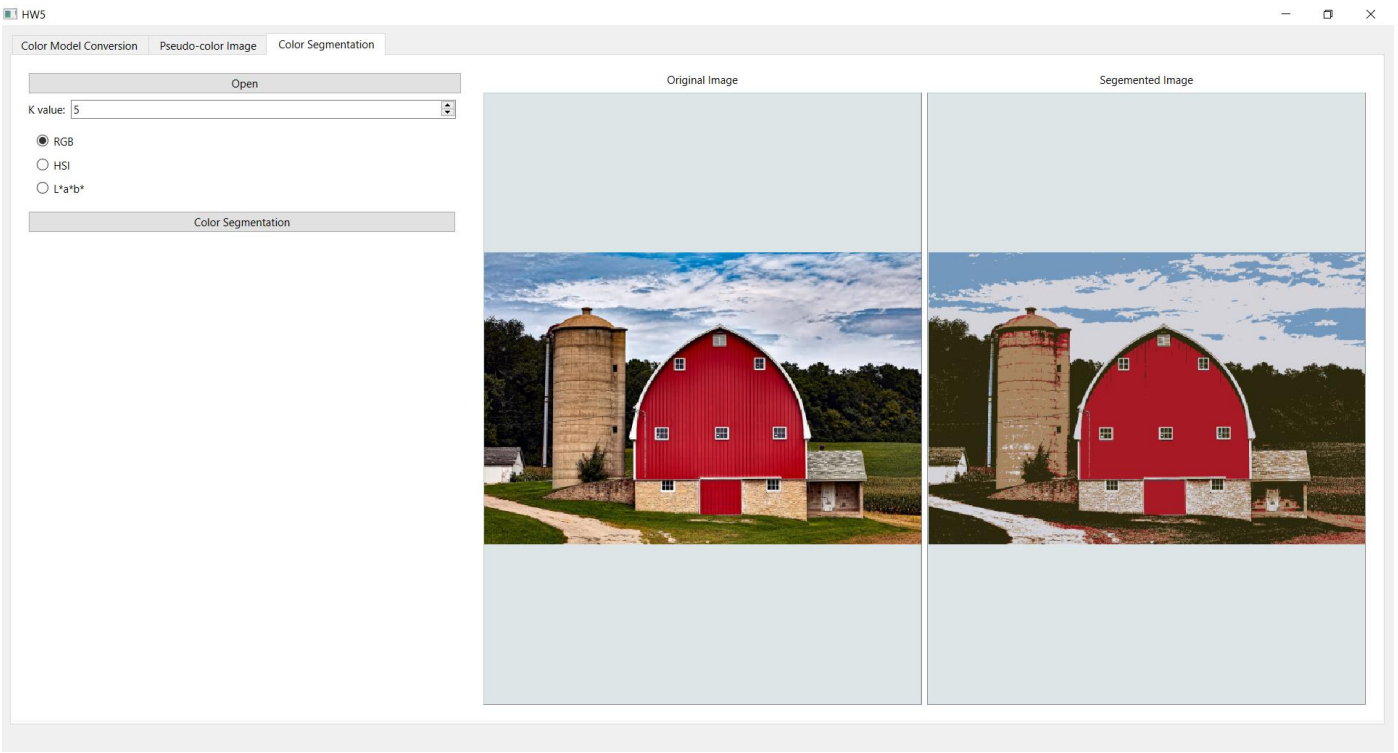
- UI:



Use tab to switch between parts. When doing color model conversion, the cursor would turn into busy; when the operation is done, the application would beep in “La” for 500 ms. All the Pixmap in the application would fit into the QGraphicsView when the window is adjusted.

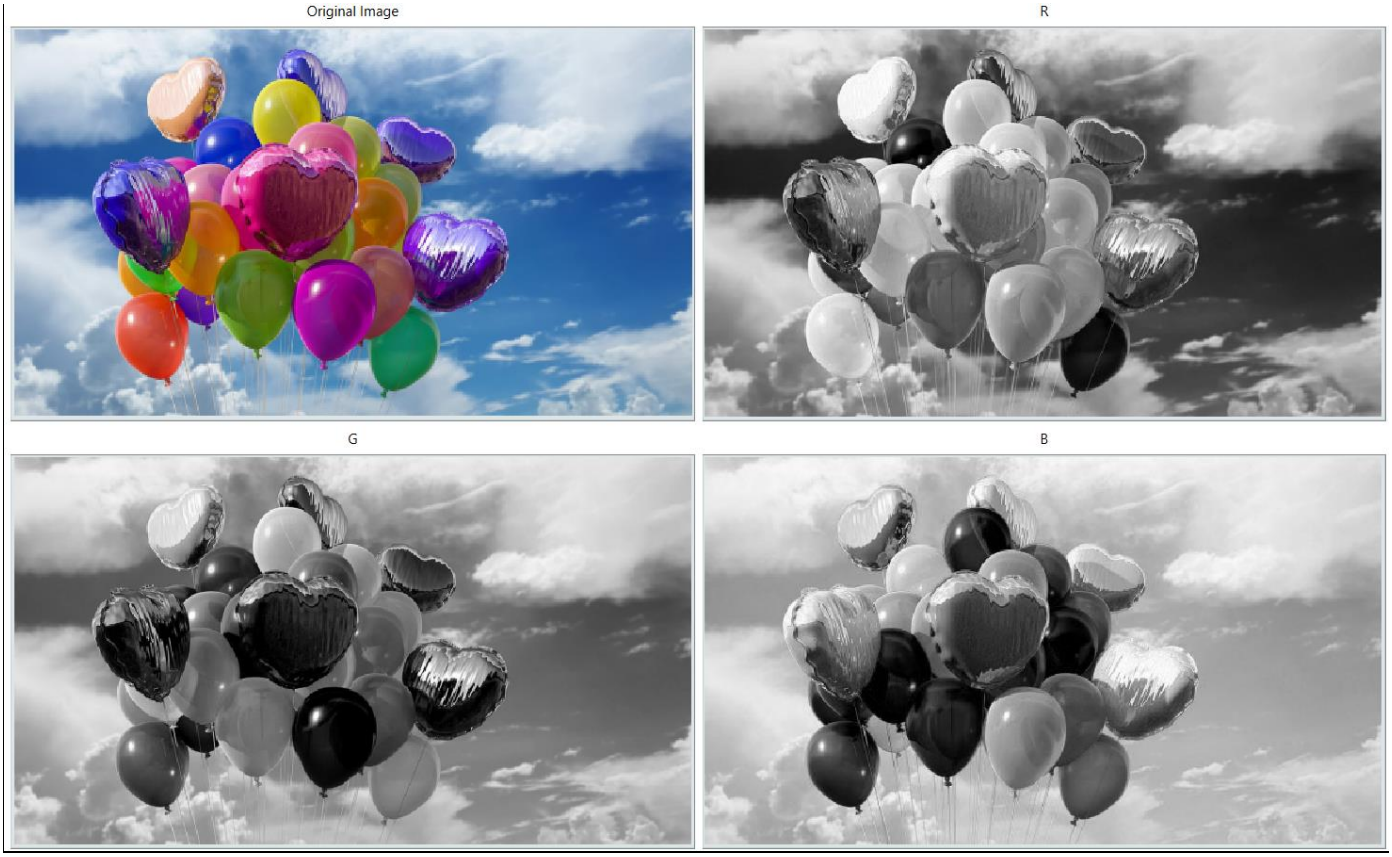


For pseudo-color image, the user can select up to five color to do color interpolation. The Color bar can be created once color5 is selected. The user can use slider bar to check the corresponding color for an intensity level

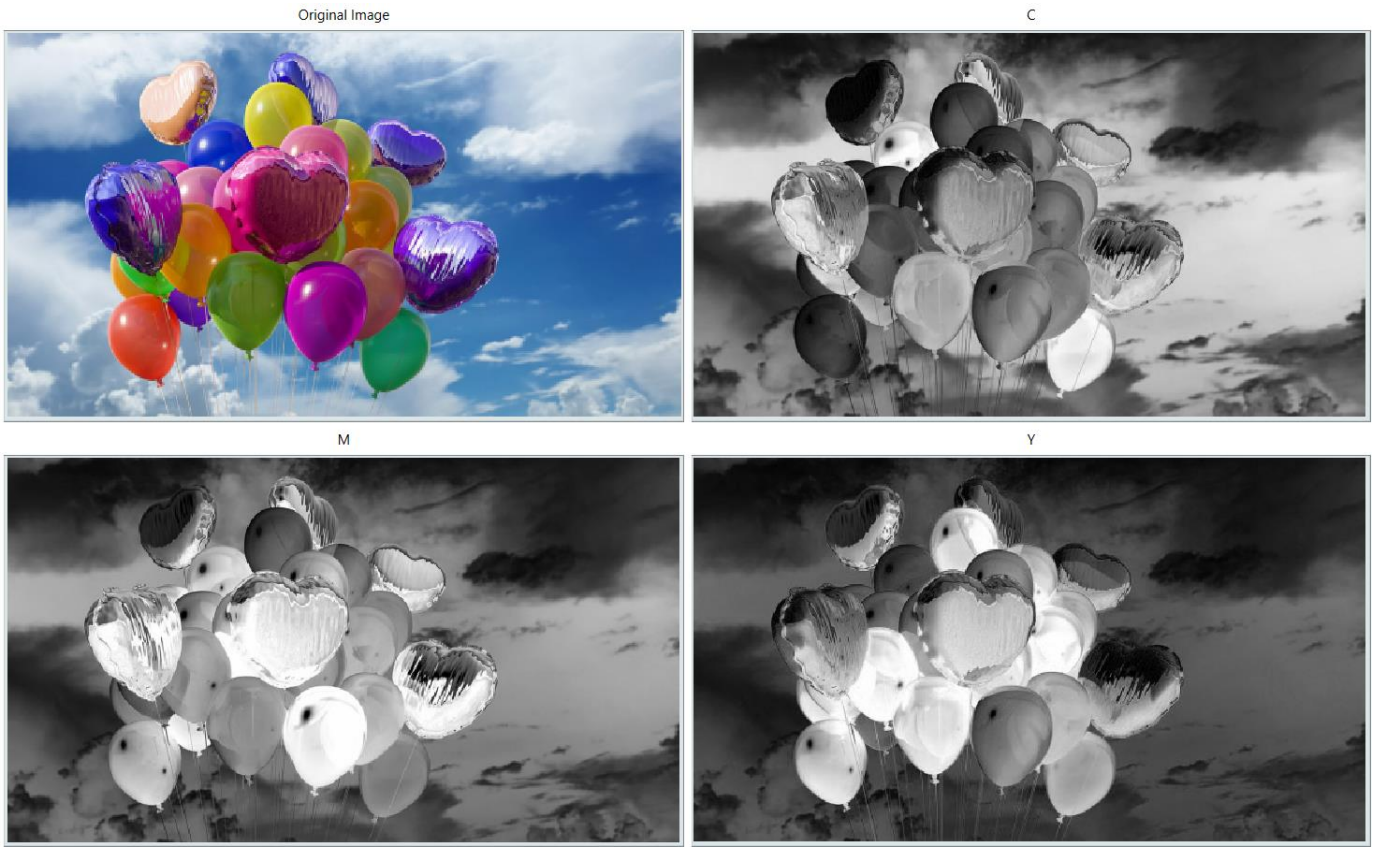


For K-means image segmentation, the user can specify the K value and select K-means color model via radio buttons

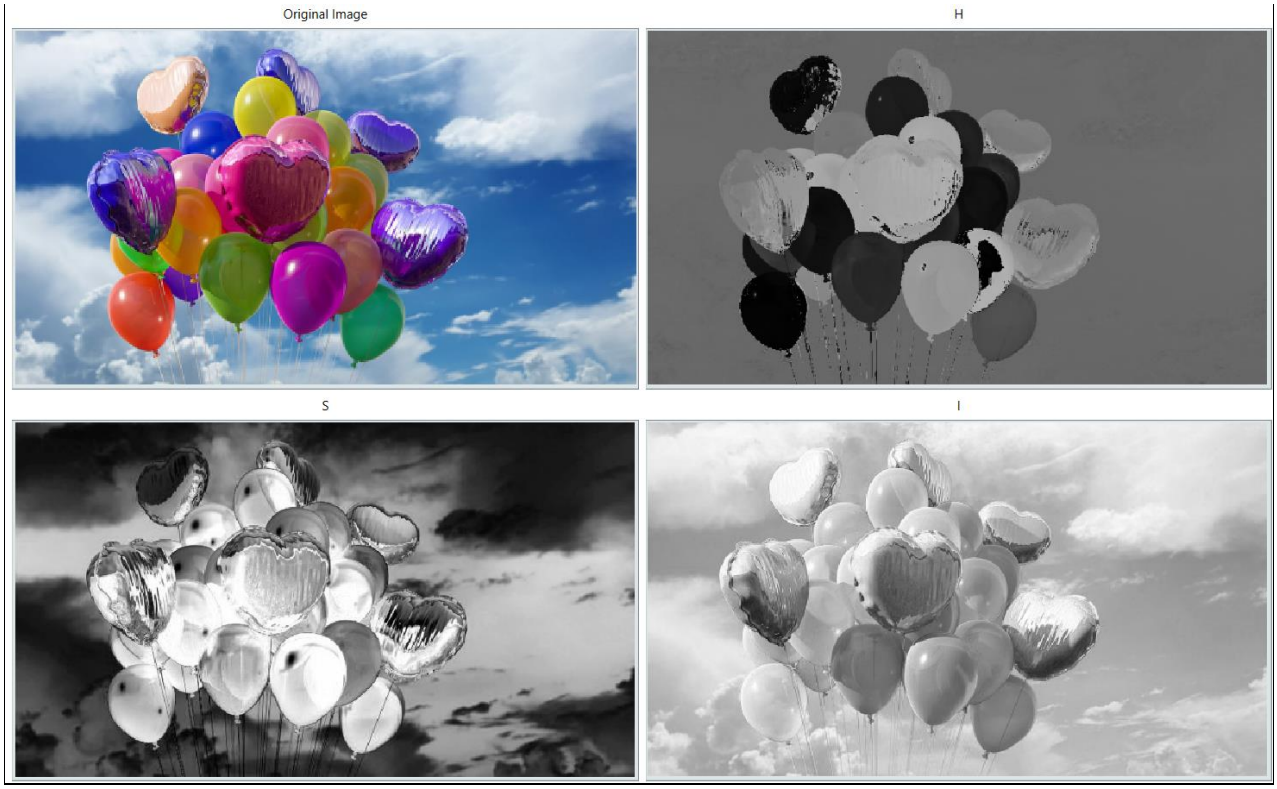
- Discussion
  - In RGB color planes, the result is quite straightforward. The blue sky has high intensity in B plane, while red and green balloons have high intensity in R plane and G plane respectively.



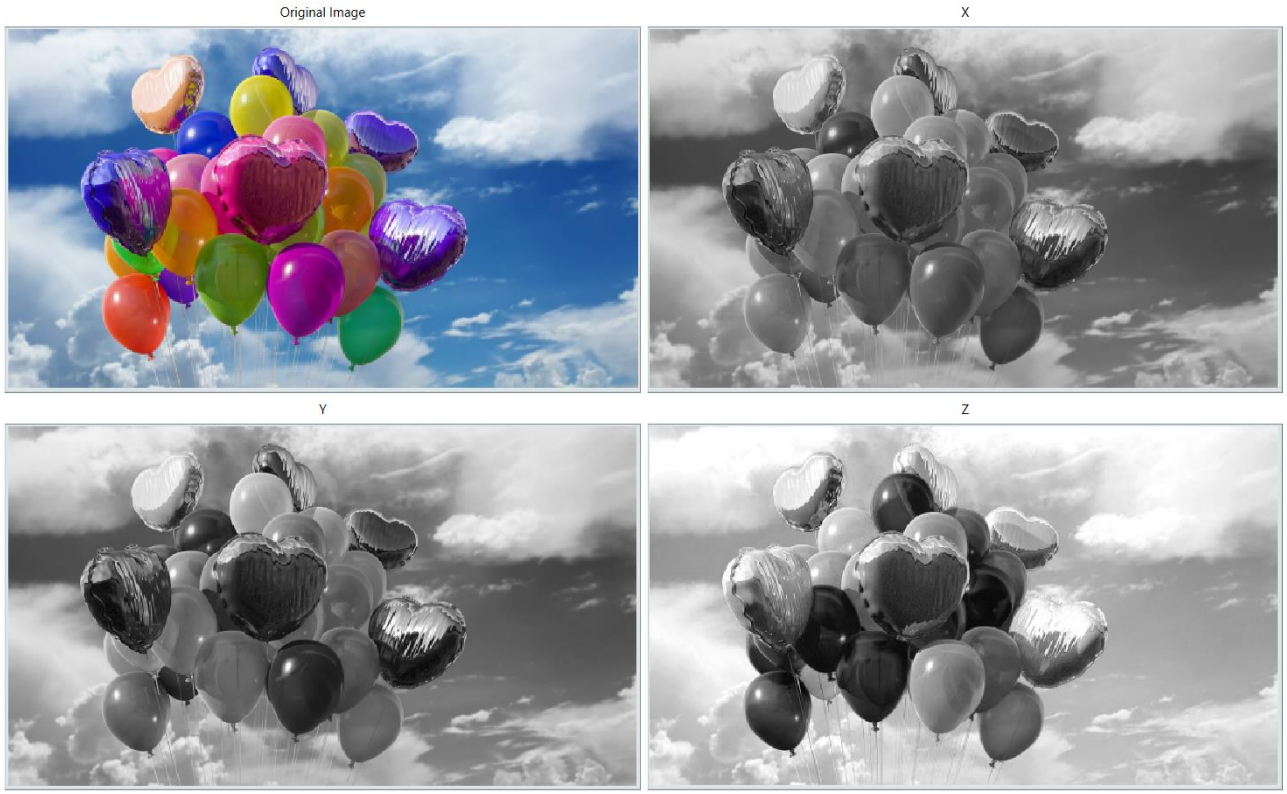
  - In CMY color planes, the result is the inverse of RGB color planes. Because the components are 1.0 – RGB components.



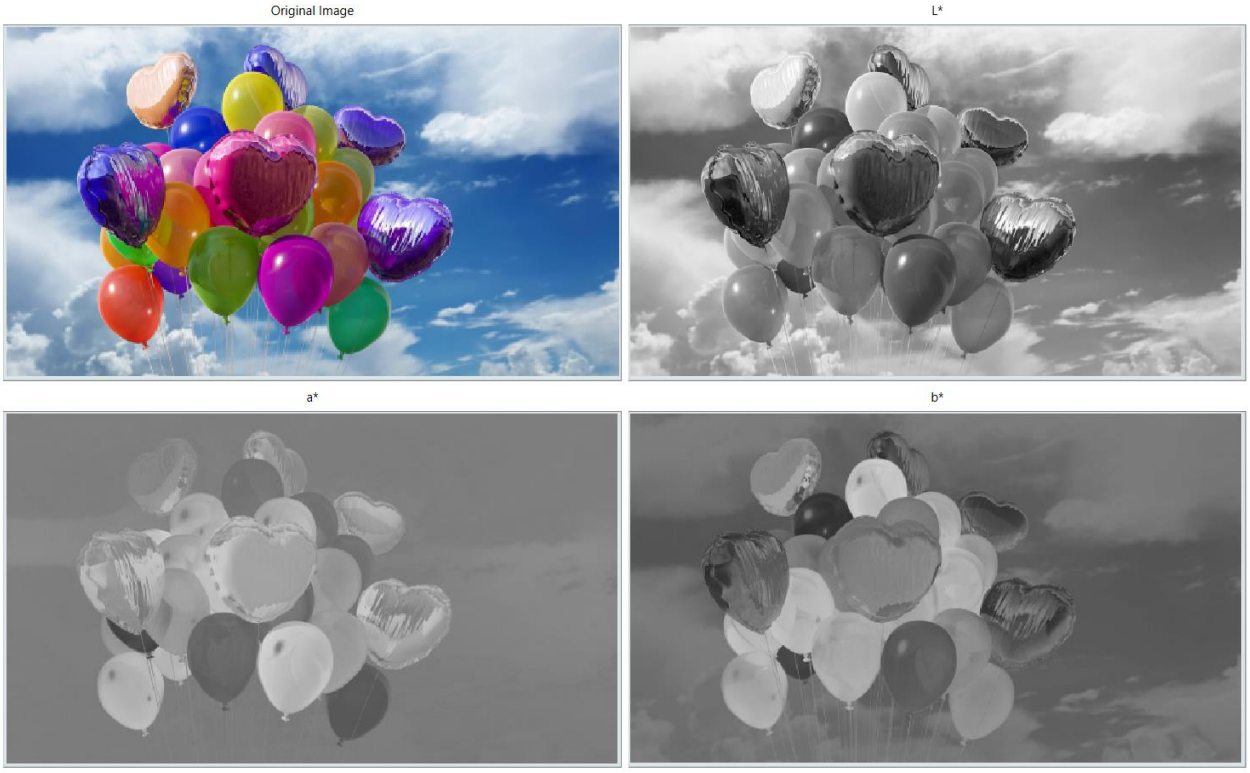
- In HSI color planes, the Hue angle has been normalized to 0-255 for visual representation. Intensity in Hue plane is low at red region but high in magenta region. So the purple balloons in the picture has higher intensity than red balloons, and the blue sky is actually more of cyan so the intensity is slightly lower than 128. Saturation plane has higher intensity in colored balloons whereas lower intensity in white clouds. The intensity plane can be regarded as the gray scale image of the original one.



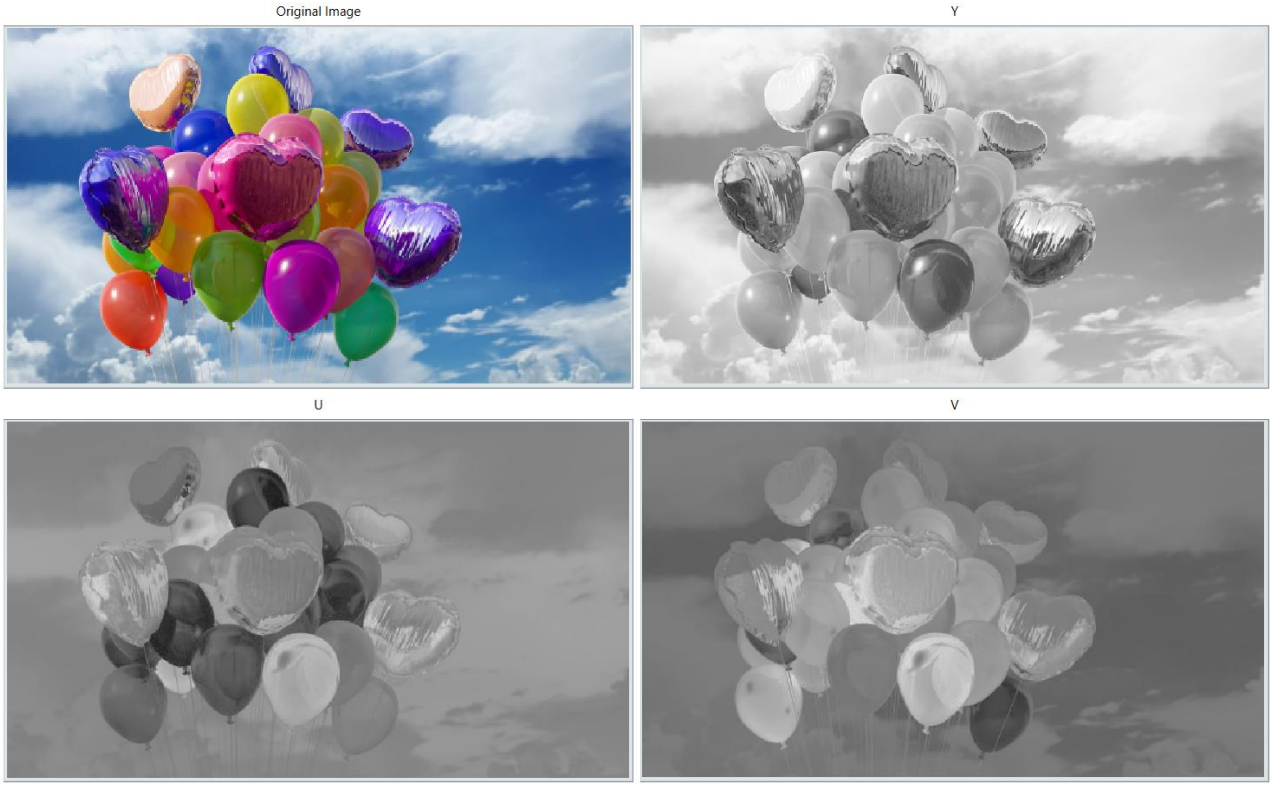
- In XYZ color planes, the negative value has been set to zero to prevent data overflow. The result of XYZ planes is similar to RGB planes.



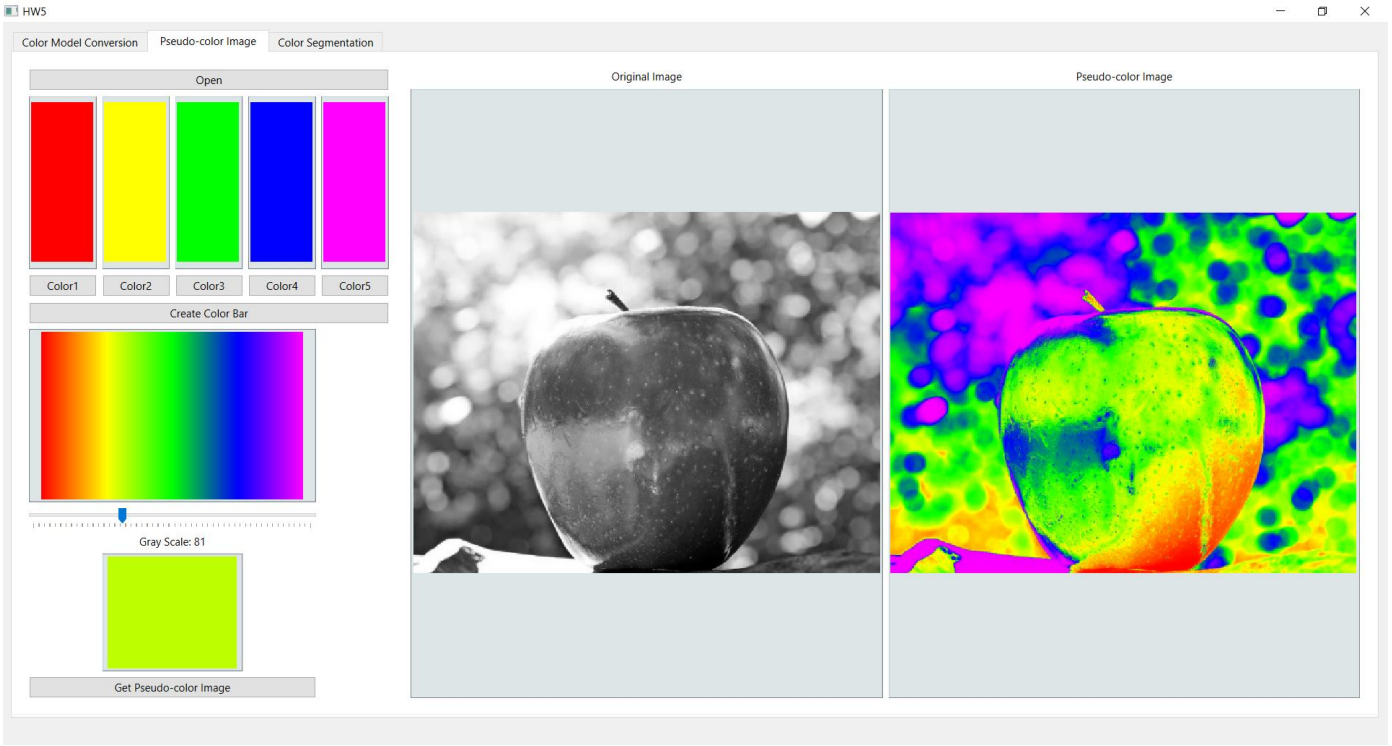
- In CIE L*a*b* planes, the L* lies between 0-100; a* and b* lie between -127-127. The value are then normalized for visual representation. L* means the brightness of the pixel; a* means the proximity of the pixel from green to red; b* means the proximity of the pixel from blue to yellow. The behavior of three planes are as predicted.



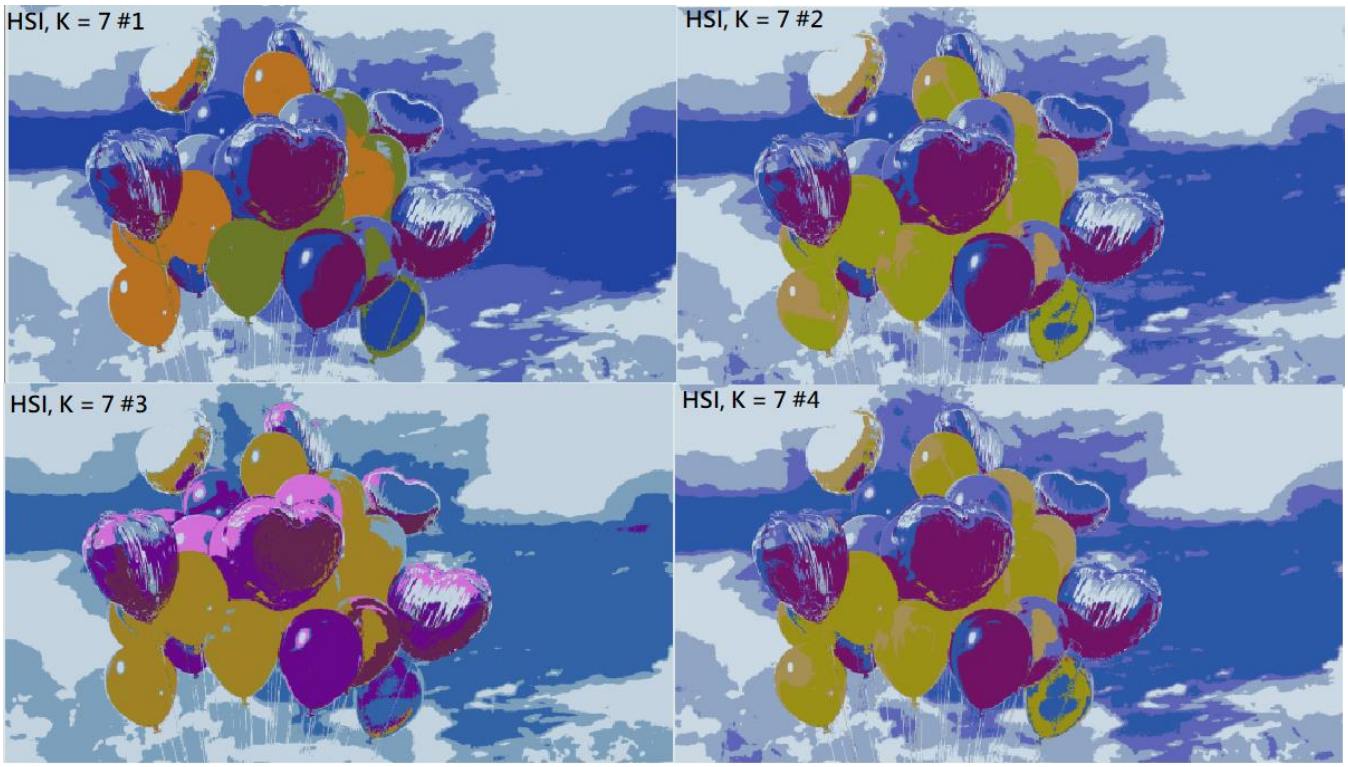
- In YUV planes, the Y mean the illuminance in the image; U means the proximity of the pixel from yellow to blue; V means the proximity of the pixel from green to red. The RGB components need to be gamma corrected before substitute into the transform matrix, the turn to YUV. The gamma coefficient I use is 2.2. YUV space is often used in broadcasting and TV.



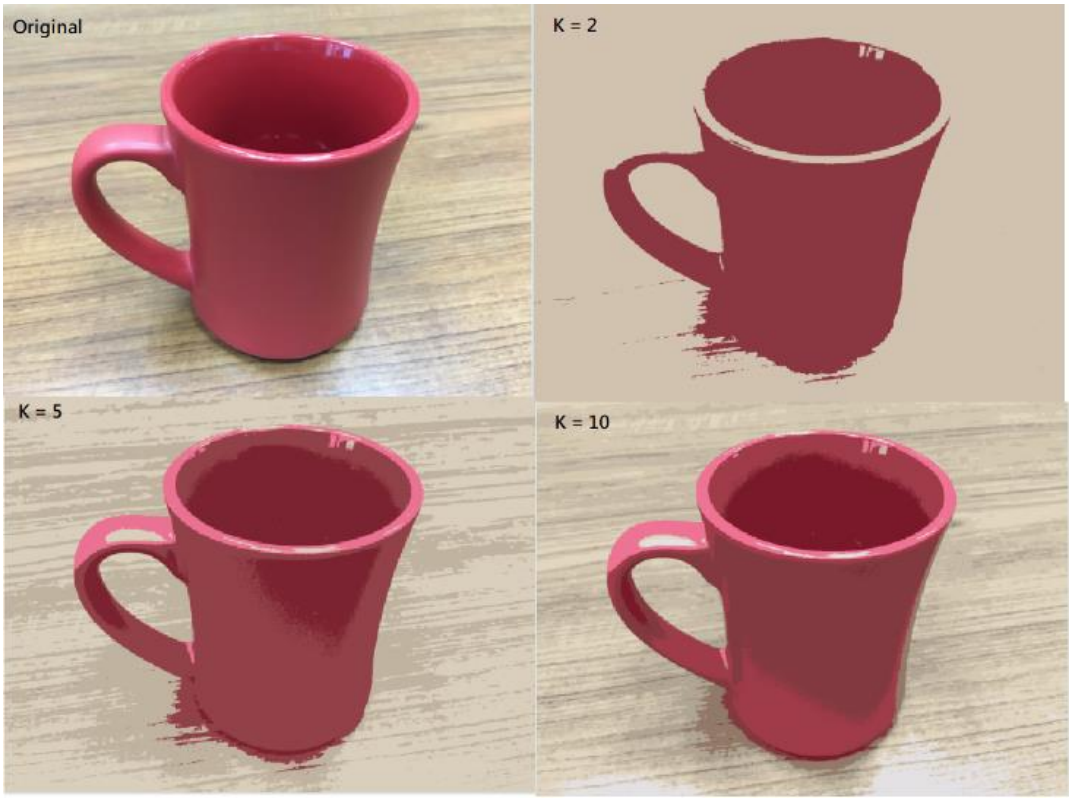
- For pseudo-color part, the user can customize the color used with QColordialog. The individual gradient of RGB components between the five would then be divided by 64, to map 0-255 gray scale evenly to four segments.



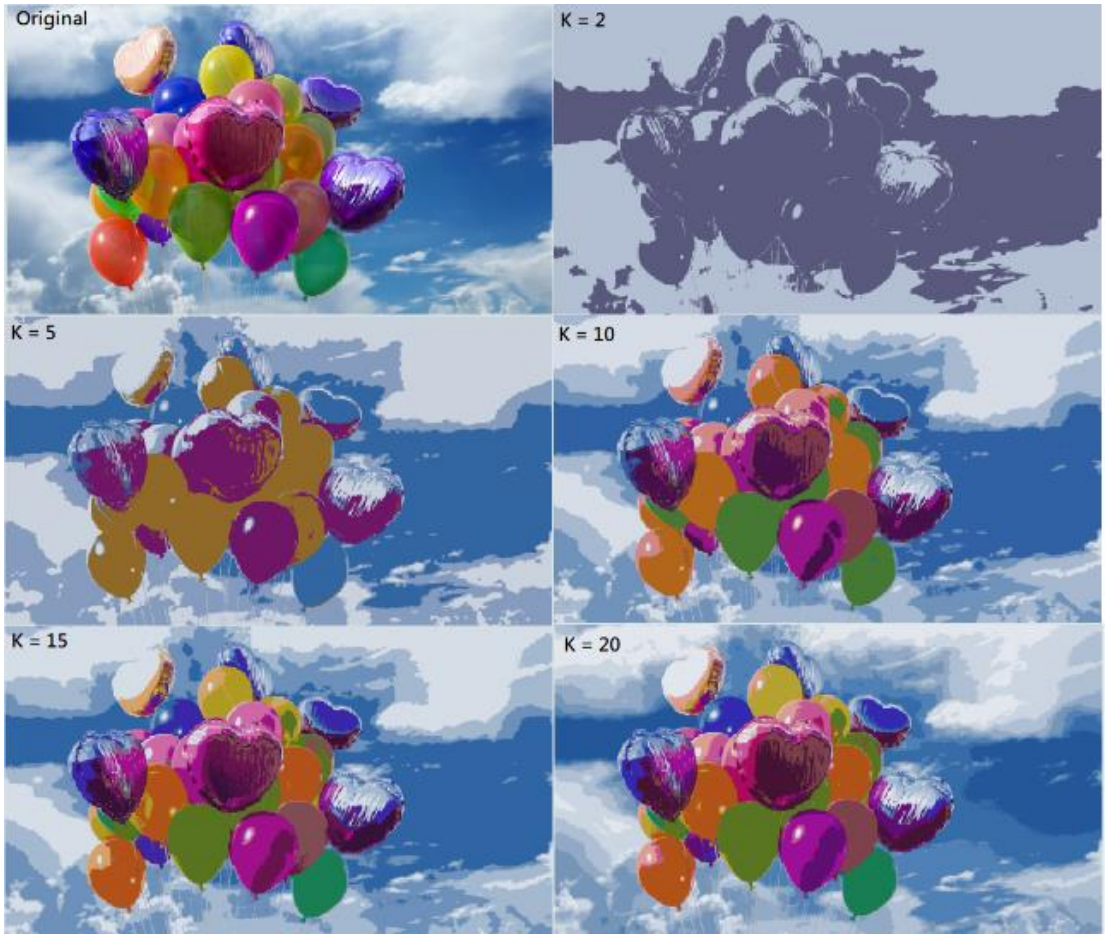
- For K-means, because the center of mean is selected randomly, every time the K-means algorithm would generate different results. Below shows HSI segmentation with K fixed to 7.



- Complexity comparison, in RGB segmentation.
  For simple image with less detail, the image can be approximately shown with smaller K value (10).



- Complexity comparison, in RGB segmentation.
  For complex image with much detail, the image can be approximately shown with bigger K value (the cloud is detailed enough when K = 20).



- Different color space segmentation with K fixed; with K = 2, every color plane in the color model would be either of two value. In RGB, the algorithm would try to use two color to represent the image in terms of color and intensity together; the overall intensity of red is dominant so the entire hue is reddish.
- For HSI, the clustering is based on intensity, hue, and saturation independently. The hue of entire picture is mainly green and blue so the final hue is close to cyan. The saturation plane and intensity plane are likely be assigned to only two values.
- For CIE L*a*b*, again the intensity of red is dominant so the hue is reddish. For L* plane the value is also assigned to only two values.