

Hidden image



A single image can show two different pictures by changing the background color(black/white). The left one with white background shows nothing and the right one with a black background has a character. This kind of image is occasionally seen at mobile applications which display the image with white background and when the user click on and open the image it will be shown at fullscreen with black background.

After reading some articles about this kind of image, it seems that alpha blending is the key to realize this technic. For alpha blending, to calculate the color:

$$\text{Color} = \text{Color}_{front} * \text{Alpha} + \text{Color}_{back} * (1 - \text{Alpha})$$

For image 1, we have: $\text{Color}_1 = (r_1, b_1, g_1, 1)$

For image 2, we have: $\text{Color}_2 = (r_2, b_2, g_2, 1)$

For two images mixed: $\text{Color}_{mix} = (r_{mix}, b_{mix}, g_{mix}, 1)$

Then we get the equation:

$$\left\{ \begin{array}{l} r_1 = r_{mix} * a_{mix} + (1 - a_{mix}) \\ g_1 = g_{mix} * a_{mix} + (1 - a_{mix}) \\ b_1 = b_{mix} * a_{mix} + (1 - a_{mix}) \\ \\ r_2 = r_{mix} * a_{mix} \\ g_2 = g_{mix} * a_{mix} \\ b_2 = b_{mix} * a_{mix} \end{array} \right.$$

The solution should be:

$$\left\{ \begin{array}{l} a_{mix} = 1 - r_1 + r_2 \\ a_{mix} = 1 - g_1 + g_2 \\ a_{mix} = 1 - b_1 + b_2 \\ \\ r_{mix} = r_2 / (1 - r_1 + r_2) \\ g_{mix} = g_2 / (1 - g_1 + g_2) \\ b_{mix} = b_2 / (1 - b_1 + b_2) \end{array} \right.$$

Obviously, the solution would be simple if it's a grayscale image because $r = g = b$

Thus, the solution for the mix image is:

$$\left\{ \begin{array}{l} a_{mix} = 1 - r_1 + r_2 \\ r_{mix} = r_2 / a_{mix} \end{array} \right.$$

Moreover, in consider of the range of alpha ($[0,1]$) we must fix the value of r_1 and r_2 . The appropriate way is to scale down the value of r_2 .