A Smart Palette for Helping Novice Painters to Mix Physical Watercolor Pigments

Chen, M.-Y.[1], Yang, C.-S.[2] and Ouhyoung, M.[1,2]

1 Graduate Institute of Networking & Mutimedia, National Taiwan University, Taiwan
2 Department of Computer Science & Information Engineering, Taiwan

Abstract

For novice painters, color mixing is a necessary skill which takes many years to learn. To get the skill easily, we design a system, a smart palette, to help them learn quickly. Our system is based on physical watercolor pigments, and we use a spectrometer to measure the transmittance and reflectance of watercolor pigments and collect a color mixing dataset. Moreover, we use deep neural network (DNN) to train a color mixing model. After that, using the model to predict a large amount of color mixing data creates a lookup table for color matching. In the smart palette, users can select a target color from an input image; then, the smart palette will find the nearest color, which is a matched color, and show a recipe where two pigments and their respective quantities can be mixed to get that color.

1. Color Mixing by DNN

Weuse 207 features as input which is the transmittance, reflectance, quantity of two pigments and paper reflectance. The color mixing model has 7 hidden layers, which are 100, 80, 80, 70, 70, 60 and 60 neurons respectively, and 100,000 epochs are used. In the hidden layers of first, third, fifth and seventh, we use softsign as activation function; the others use tanh. The output is a mixed pigment with 41 sample wavelength. Adam is our optimizer and its learning rate is used 0.001. The loss function use mean square error and L2-norm is a he loss function use mean square error and L2-normis a regularization term. In term. In our experiment, 782 training data and 261 testing data are used.

2. Building a Lookup Table for Color Matching

We use an interpolation method to generate more primary pigments at 0.002 intervals; then, using color mixing model to predict their mixture, which will take about an hour in prediction from two pro-cesses (Intel(R) Xeon(R) E5-2650 v3 with 2.30GHz CPU). Finally, webuild a lookup table, which has 75,088 data of the same primary pigment to mix, namely increased pigment quantity, and 1000 X 1000 data of two different primary pigments to mix.

3. User Interface of a Smart Palette

In the system, users can select any image type of that they want to draw, whether a portrayed scenery or still life. In Fig. 1, a target color is selected from a red circle of an input image in part E and the resulting recipe is shown in part B and C. Thus, we can derive that an RGB value (63, 92, 44) can be matched by RGB value (62, 95, 44) in the color space of 13 watercolor pigments and its ingredient is 0.014 ml of cadmium yellow hue and 0.012ml of cerulean blue hue and it takes one second to find the matched color on a desk-top computer (Intel(R) Xeon(R) E3-1231 v3 with 3.40GHz CPU). More cases are shown in Fig. 2.

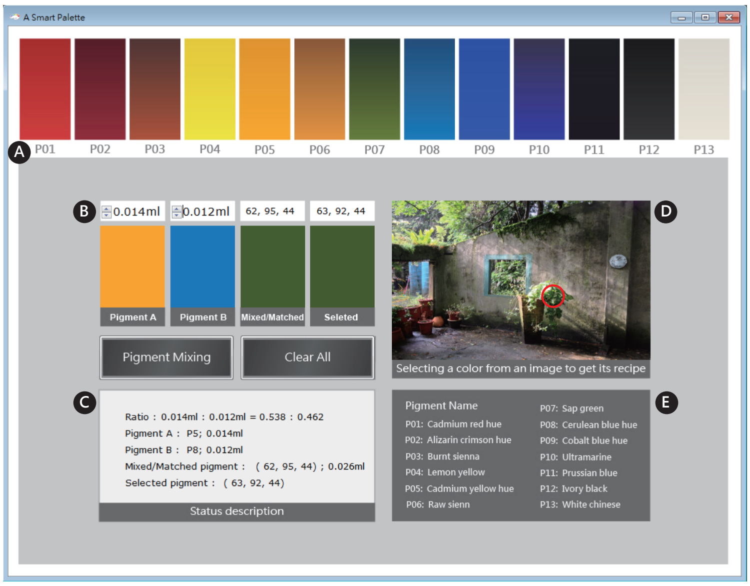

Figure 1: A smart palette. In part A, users can select 13 pigments with different quantities. Part B shows a result of color mixing or color matching and its ingredient pigment. The user can find more information about color mixing or color matching in part C and select a target color from an image in part D. Finally, users can get pigment name in part E and then use them to mix color in the real world.

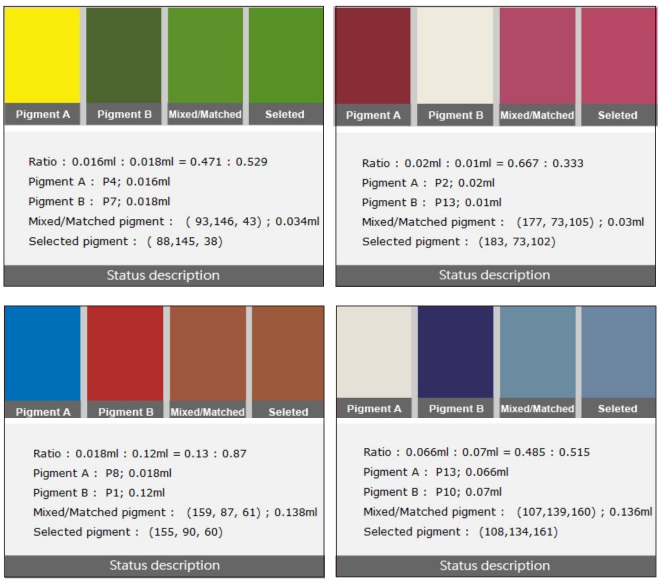

Figure 2: The Four cases of color matching.