Crowd Sourcing Memory Colors For Image Enhancement

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1 Introduction

Memory colors refer to those colors recalled in association with familiar objects [Hering 1961]. The deficiency with existing research in this area is that a) screen memory colors have not been rigorously established and b) existing studies do not include extensive human judgements when evaluating image edits based on memory colors. We first perform a context-free perceptual experiment to establish the overall distributions of screen memory colors for three pervasive objects (skin, sky and grass). Then, we use a context-based experiment to locate the most representative memory colors. Finally, we show a simple, yet effective, application using representative memory colors to enhance digital images.

2 Establishing and Applying Memory Colors

We repeated the memory color experiment of [Bartleson 1960] using digitized color chips based on the Lu^*v^* color gamut over a uniform neutral gray background, participants were crowd sourced. Lu^*v^* values were converted to sRGB for display. No attempt to detect or adjust for the type, size or settings of the monitors of the participants was made. This was deliberate to enable discovery of the *most general* representative memory colors. Figure 1 left, shows the results. We then use three 2D Gaussian functions to approximate these elliptically shaped distributions, Figure 1 (right). Due to the nature of crowd sourcing, a wide range of participants, cultures, monitors, viewing conditions, and etc, are sampled. Despite all the potential variations in the stimuli, we find that the results are very close to those from existing psychophysical experiments, which were executed under controlled settings. *This is a nice result as it validates the usage of crowd sourcing techniques for color evaluation.* We then take natural images that include regions of skin, sky and grass, and generate a set of stimuli by shifting the colors of individual regions toward a few candidate colors (based on the memory colors established in our first experiment). Then, we ask viewers to rate these manipulated images, which contain different combinations of candidate colors. The ratings reveal humans' preferences for the joint distribution of three memory colors in the context of natural images. In this manner we thereby locate the *representative memory colors* based on these preferences. As before, we use crowd sourcing to elicit the judgements on stimuli, while keeping results as general as possible. Participants rate images based only on the quality of the *color reproduction*, ignoring all other image elements such as content, composition etc. The generally high positive correlations demonstrate that, despite different image contexts, the preferences to memory colors are rather consistent.

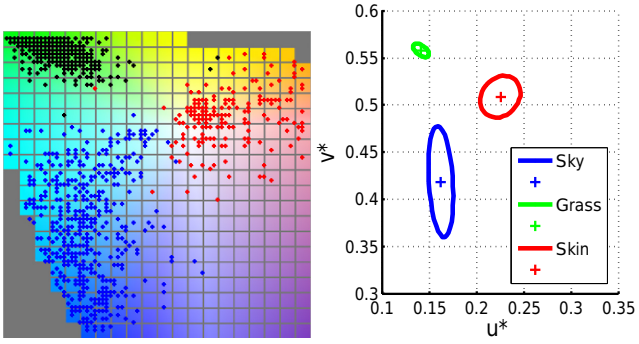

Figure 1: *Left: Responses from crowd sourced workers: red crosses for skin, blue for sky, & black for grass. Right: Fitted Gaussian distributions for three memory colors on u^*v^* color space.*

Application: Given a raw photo as input, people often seek a simple solution to making the component colors more pleasing. Color can be manipulated in many ways, the domain of possibilities is overwhelming making this a challenging task for non-expert users. Notably, the representative memory colors, which we located using human preference via context-free and context-based experiments, serve promisingly as candidate "standards" for color reproduction. For images containing regions of memory objects, arbitrary color correction is converted to $1D$ color shifting: moving colors of memory objects toward (or away from) a target, that is, the representative memory color. In conclusion, we have introduced a simple but effective, technique based on this observation. We found, through a third experiment, that several scenarios exist (for example Figure 2), in which color shifts can greatly enhance the perceived color reproduction of images. (please see supplemental information for more examples).

Figure 2: *Left: Original. Right: Our Technique. In this case, participants preferred the corrected image which shifted skin regions toward the representative memory color values*

References

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