Color Harmonization

DIP Group Report

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Which one do you prefer?
Which one do you prefer?
Introduction

- Humans’ Sense of Image
  - Hard To Predict
  - Differing from people

- Similar Characteristics of Chosen Photos?
  - Can We Find Some General Properties?
YEPP!
Models

- **Hue Distributed In Specific Area(s)**
  - In Certain Angle Ranges
    - 18, 90, or 180 (degree)

- **Specific Angle Between Each Areas**
  - One with Multi Area Only
    - 90 or 180 (degree)
Models

- Adjusting Hue Ring of an Image in Models
- 8 Different Models
Why These Eight Models

- **Single-Area Model**
  - Organize The Whole Image Into Same Hue Range

- **Multi-Area Model**
  - Verticality or Complement
  - With More Kinds of Color But Not Becoming A Mess
Color Harmonization

- Rotating Models to Fit the Original Hue Ring
- How to Choose The Angle Rotated
  - Choose One with Least Hue Arc Distance

\[ F(X, (m, \alpha)) = \sum_{p \in X} \left\| H(p) - E_{T_m(\alpha)}(p) \right\| \cdot S(p) \]

\[ M(X, T_m) = (m, \alpha_0) \text{ s.t. } \alpha_0 = \arg\min_{\alpha} F(X, (m, \alpha)) \]
Decision

- Yet Choosing Results Between Models
  - Mathematical Adjustment
  - Not Absolutely and Objectively Harmonious

\[ B(X) = (m_0, \alpha_0) \text{ s.t. } m_0 = \arg\min_{m} F(X, M(X, T_m)) \]
How To Adjust It

- Simply Shift The Hue Out Of The Model
Results
Difficulties We’ve Met
After Basic Steps - Problems

Spatial Color Coherency
(Only in Multi-Area Models)
Solution to Coherency

- Reverse During Process
  - Adjusted Neighbored Pixel
    - Comparing the Difference of Hue
      - Same Area Should Be Adjusted in A Same or Similar Way
  
- Median Mask
  - Filtering on the Denoted Array
    - Corresponding to the Way of Adjustment
    - Comparing Hue Difference Simultaneously
Solution to Coherency

Mask Comparison + Median Mask
After Basic Steps - Problems

Sky Affecting Whole Prediction And Adjustment (Especially In Small-Angle Models)
Solution to Sky Interruption

- Find The Sky Part
  - Still To Be Finished In First Step
  - Done By Photoshop Recently
  - Output “Skymap”

- “Skymap”
  - Excluding Sky Part from All the Processes
Solution to Sky Interruption

Sky is still remained blue
Application
Our Working Ideas

- Simply Put It Online as a Web Application
- Specific Adjustment with Small Samples
- Monochrome Photo with Some Colors Remained
- More Interruption
  - Skin, Sea, Reflection…etc.
Simply Put It Online

- Google App Engine
  - Worked After Semester
    - Similar to “Color Scheme Designer 3.0”
  - Adjusting Photo Uploaded Instantly
    - Users Pick The Desired Result In 8 Models
Specific Adjustment with Samples

- Small Sample Pictures
  - Analyzing Hue Ring
  - Example: Flag
- Adjust The Original Image
Specific Adjustment with Samples

Jamaica Flag

UN Flag
Specific Adjustment with Samples

Pokémon “妙蛙種子”

Movie “さくらん（悪女花魁）”
Monochrome with Color

- Artistic Purpose
- Delete Saturation
  - Pixels With Their Hue Out of the Models
Monochrome with Color

Before

After
**Interruption**

- Skin, Sea, and Reflection
- Similar to Sky Neglect
  - Spatial Method
    - Edge Detection?
    - Recursively Searching Neighbored Area?
Reference

- “Color Harmonization” from SIGGRAPH ‘06
  - Tel Aviv University
  - Microsoft Research Asia

- “HSL & HSV” in Wikipedia.org
Any Questions?