How Color Analysis Help People Reduce Appearance Anxiety

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Why this topic matters?

- Personal color analysis has become **a major trend** in Korea, Japan, and the global beauty and fashion industry.
- Traditional color diagnosis relies on human judgment and can be **subjective and inconsistent**.
- Many people feel anxious because they struggle to identify what colors suit them best. As the result, people may lose their confidence.
- It is also relatively **expensive**, making it difficult for many people and STUDENTS like us to access professional color consultation.

Evidence

1. Interpersonal influence on decision-making. Abdelaziz, M. N., Moustafa, A. R. A., Azzam, H., Bshar, A. M., Ismail, I. S., & Elhadidy, O. Y. (2024).

2. Association between beauty standards shaped by social media and body dysmorphia among Egyptian medical students.Termizi, A. N. M., & Herwan, N. N. M. (2023).

3. The relationship between beauty standards on social media and body dissatisfaction. Journal Evolusi, Sahin, E., Barut, Y., Ersanli, E., & Kumcagiz, H. (2014).

4. Self-esteem and social appearance anxiety: An investigation of secondary school students. Davis, C., Brewer, H., & Weinstein, M. (1993).

5. A study of appearance anxiety in young men. Social Behavior and Personality: An International Journal, 21(1), 63–74.

Project Goal

We aim to build a more objective and free system which everyone can access with. By using **image processing** and **data science method**, it can analyze skin tones, and make more confident, informed appearance decisions, helping people reduce the anxiety.

Dataset and Preprocessing

- 4905 online facial images labeled with four seasonal color types
- **Face Detection and Alignment:**
  - **MediaPipe Face Mesh** for automatically located and cropped the regions of skin, lips, and eyes
- **Color Space Conversion:**
  - **RGB**: Highly sensitive to lighting variations and therefore not suitable as main features
  - **HSV**: Separates hue and brightness, more effectively for captures warm and cool tones
  - **LAB**: A perceptually uniform color space (L: lightness, A: red–green, B: yellow–blue)
- **Feature Extraction:**
  - Computed the mean HSV and LAB values from cheeks, forehead, lips, and eyes
  - And contrast features, such as hue differences between skin and lips and lightness contrast between skin and eyes

Model Evolution and Experiments

Stage 1: Perceptron

- Method: Used a basic linear classifier
- Accuracy was only **35%**

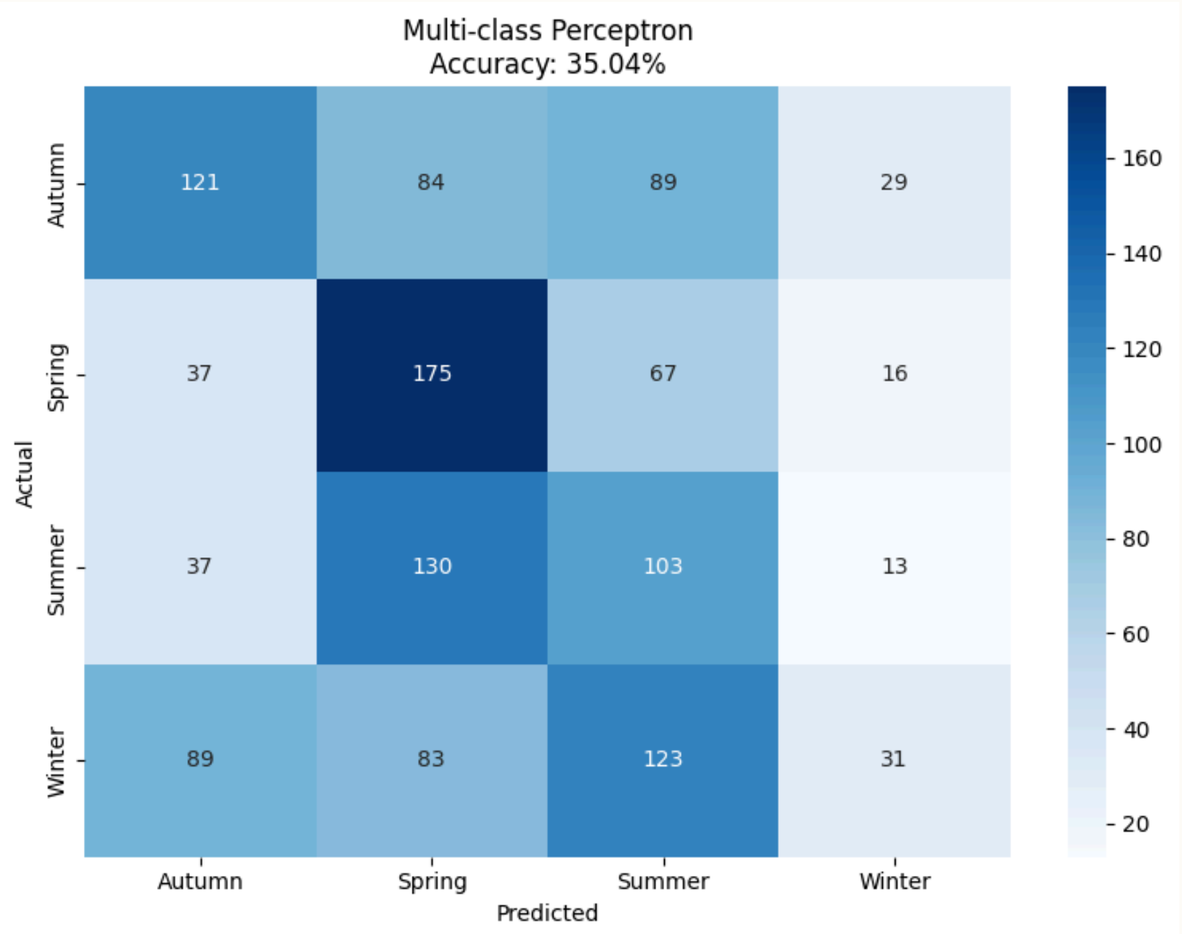
Core Issue: Linearly Inseparable

In the confusion matrix, common errors include:

- Winter → Summer
- Summer → Spring

The Perceptron fails to capture subtle non-linear differences, demonstrating that **simple linear models are insufficient for personal color analysis**.

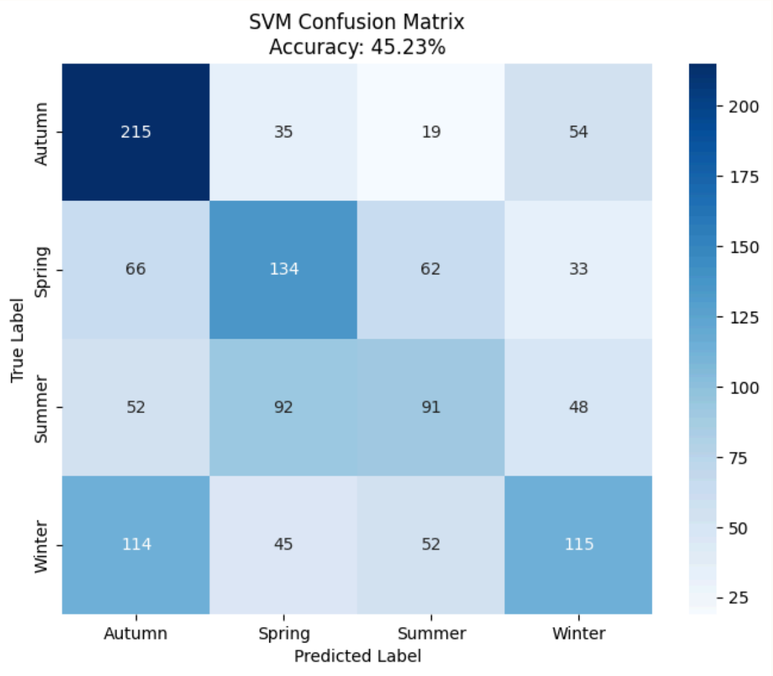
We also tried unsupervised K-Means clustering
but the ARI score was extremely low.
Reason: K-Means groups samples based only on color similarity.
Seasonal color types follow complex rules that involve undertone, value, and chroma, so simple color clustering does not align well with the true seasonal labels.

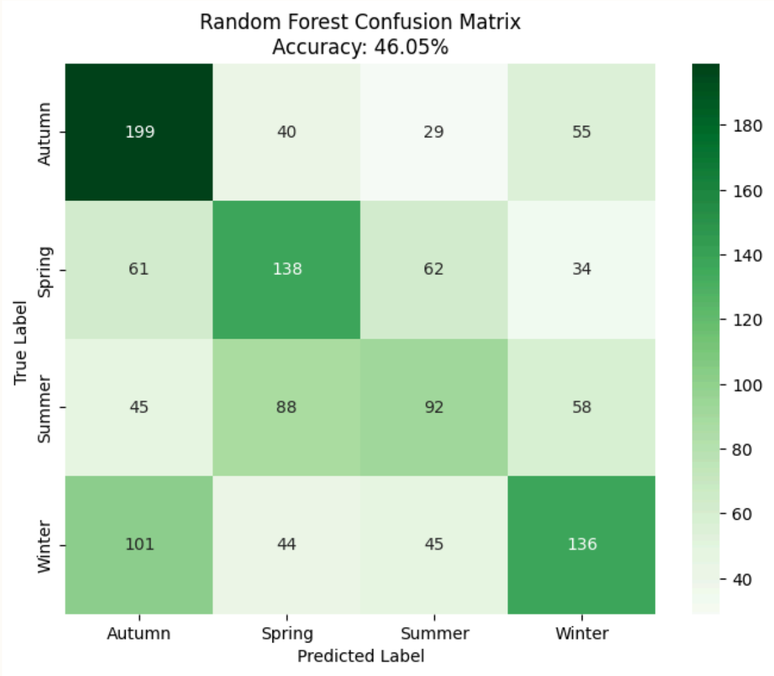


Model Evolution and Experiments

Stage 2: Support Vector Machine (SVM) and Random Forest

- Method: Switched to models capable of learning non-linear decision boundaries
  - **SVM:** Applied an RBF kernel to map data into a higher-dimensional space to find an optimal boundary
  - **Random Forest:** Used an ensemble of decision trees with a voting mechanism
- Accuracy improved to **over 45%**

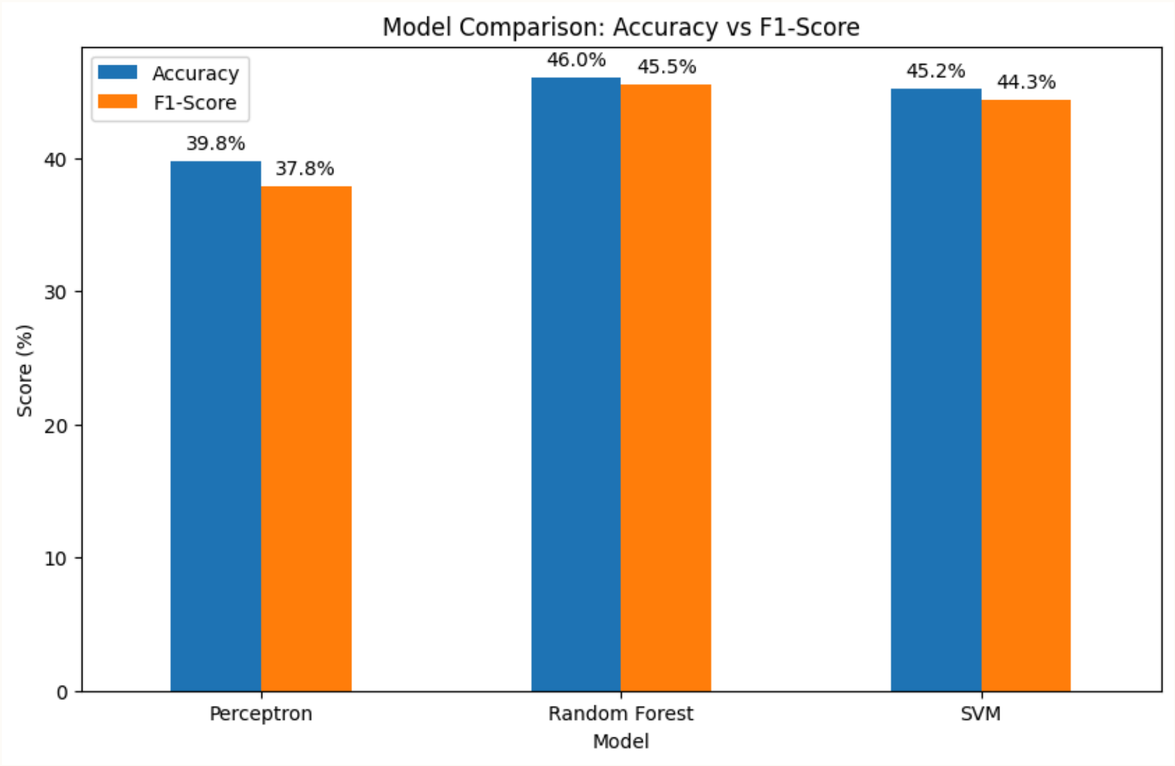




Model Evolution and Experiments

The significant improvement over the Perceptron, indicating that non-linear models better capture the complexity of seasonal color features.

Model	Accuracy	F1-Score	Precision	Recall
Perceptron	39.77%	37.83%	40.57%	39.77%
Random Forest	46.05%	45.51%	45.68%	46.05%
SVM	45.23%	44.31%	44.78%	45.23%



Result

📸 請點擊下方按鈕上傳照片 (jpg, png)...
選擇檔案 未選取檔案
Saving 張元英.jpeg to 張元英.jpeg

🔄 正在分析：張元英.jpeg ...

Upload your photo...

🌊 夏季型 Summer – 柔和冷調、優雅夢幻

✨ 特點：冷色調、柔和色彩最能帶出自然透明感。

💄 妝容細節

- 底妝： 粉冷色底/自然粉底，讓膚色看起來柔和不暗沉。
- 腮紅： 柔霧粉色、柔粉玫瑰，像夏日微風般飄逸。
- 眼妝： 霧藍、灰粉、薰衣草紫，增加眼部層次感。眼線選灰黑色或深棕。
- 唇色： 玫瑰粉、淡梅子色、冷調粉紅，不會搶走你的氣質光芒。

✨ 鼓勵語：
「用一點涼意的色調，就像夏夜的微風，柔和且令人著迷。」

💇‍♀️ 髮色建議
- 霧灰棕、淺灰色、冷巧克力棕 讓整體色感更協調自然。

✨ 隨手一撥，都像夏日微光浪漫。

🧪 穿搭建議

- 顏色方向： 淺粉藍、冰川藍、芭比粉、薰衣草紫、灰粉。
- 單品搭配法： 上衣選冷色系 → 下身搭配白或灰色褲裙更顯清爽。

✨ 你不需要大花俏，柔和優雅就是你的特色。

💍 飾品推薦
- 銀色、珍珠、淡色寶石（藍×白）。

✨ 每一次轉頭，都像夏日湖面上的光閃動。

Then receive your personal seasonal color analysis, along with recommendations for makeup, hair, outfits, and accessories!

Future Work

- **Improving Model Accuracy**
  - **Advanced Models:**
    - Explore more powerful models to improve the accuracy.
  - **Better Data Quality:**
    - Improve **lighting normalization** and **color calibration** during preprocessing to reduce noise caused by illumination differences.
  - **Multi-Stage Classification:**
    - Consider a **hierarchical approach**, for example, first classify warm vs. cool tones, then distinguish between bright vs. deep or soft vs. clear subtypes.
- **Internationalization of Recommendations**
  - Currently, the recommendations are provided in Chinese.
  - In future work, these recommendations can be **translated into English or multiple languages**, allowing users from different countries to benefit from the system.

Team Contribution & Self-Assessment

We adopted a collaborative approach for this project.
Instead of working in silos, we worked together on every section, from coding to slide design.

Topic Definition & Literature Review	**Emily, Lia**
Data Collection & Preprocessing	**Ryder**
Model Design (Perceptron, SVM, RF)	**Ryder, Emily**
Visualization & Analysis	**Ryder, Lia**
Presentation Slides Design	**Lia**
Presentation	**Emily**

Benefits:

This allowed us to **debug errors instantly**, ensure everyone fully understands the code logic, and **brainstorm solutions for the problem effectively**.

Challenge:

While **coordinating schedules was difficult**, working together significantly improved the consistency and quality of our analysis.

Thank you.

What is “Personal Color Analysis”?

a method that helps people understand which colors look the most flattering on their skin tone.

Spring
bright, warm, fresh
Colors are clear and light,
like peach, coral, warm green

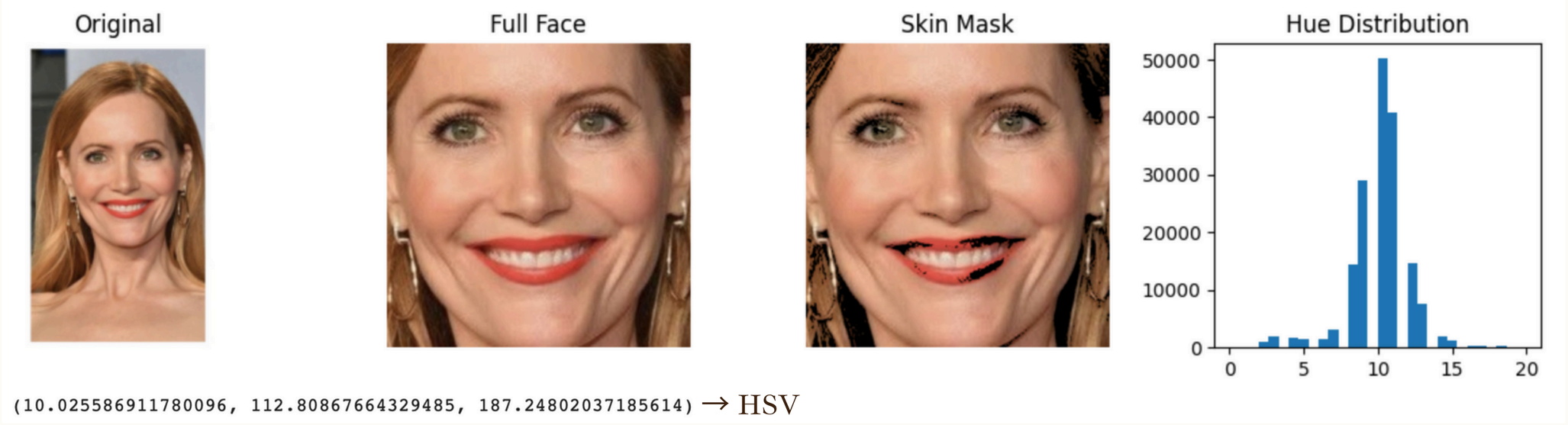
Summer
soft, cool, hazy
Colors are gentle and airy,
like dusty rose, lavender, mauve

Autumn
warm, deep, earthy
Colors are rich and muted,
like olive, mustard, terracotta

Winter
cool, bold, and high-contrast
Colors are icy and vivid,
like black, fuchsia, emerald

We will develop a model that predicts a person's seasonal color type from a face image

1. Extract skin-tone pixels from the image.
2. Convert them into HSV color space.
3. Use clustering and classification algorithms to analyze color characteristics.
4. Predict the most suitable seasonal palette.



(10.025586911780096, 112.80867664329485, 187.24802037185614) → HSV

Expected Results

We expect our system to:

Correctly classify skin tones into their closest seasonal type.

Produce clear visualizations showing:

- HSV distribution
- K-means clustering
- Comparison between predicted skin tone and each seasonal palette
- Identify which categories are hardest to classify

Provide personalized recommendations:

- Suggest suitable clothing colors and styles
- Recommend makeup colors (lipstick, eyeshadow, blush)
- Automatically search and provide relevant fashion/makeup resources via API