

Problem Statement

With the immergence of large social media platforms, a growing rift is forming between members' lifestyles and their digital presence. Digital Identity addresses this disparity head on by providing its users with a tool to explore their own digital reflection.

Design Goals

- **Accuracy** – The Digital Identity must resemble the original image.
- **Performance** – The Digital Identity must be created quickly.
- **User Centered Design** – The application must be simple and intuitive enough for a large range off audiences to use.
- **Dynamic Scalability** – The application must be designed to handle any number of users in case it becomes popular on Facebook.
- **Cost Effective** – The cost of hosting the application should be minimized.

Engineering of Photomosaics

Color Analysis

Pixels are converted from *RGB* to *XYZ* to *L*a*b** color space.

RGB → *XYZ*

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \frac{1}{0.17697} \begin{bmatrix} 0.49 & 0.31 & 0.20 \\ 0.17697 & 0.81240 & 0.01063 \\ 0.00 & 0.01 & 0.99 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

XYZ → *L*a*b**

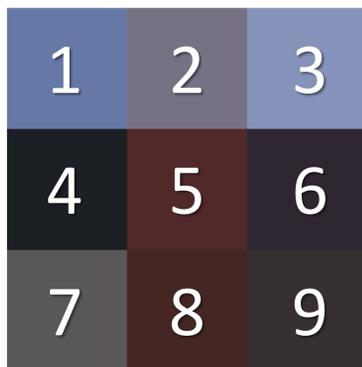
$$L = 166 \left[f\left(\frac{Y}{Y_n}\right) - 16 \right]$$

$$a = 500 \left[f\left(\frac{X}{X_n}\right) - f\left(\frac{Y}{Y_n}\right) \right]$$

$$b = 200 \left[f\left(\frac{Y}{Y_n}\right) - f\left(\frac{Z}{Z_n}\right) \right]$$

$$f(t) = \begin{cases} \frac{1}{t^3}, & t > \left(\frac{6}{29}\right)^3 \\ \frac{1}{3}\left(\frac{29}{6}\right)^2 t + \frac{4}{29}, & t \leq \left(\frac{6}{29}\right)^3 \end{cases}$$

Image Analysis



$$\vec{V}_{avg Lab} = \begin{pmatrix} (51.07, 4.64, -26.23) \\ (49.05, 5.52, -9.53) \\ (60.87, 4.50, -21.77) \\ (12.15, -0.47, -3.54) \\ (22.10, 18.30, 7.83) \\ (16.88, 5.45, -5.24) \\ (37.74, 0.69, 1.08) \\ (19.55, 13.46, 7.04) \\ (20.72, 2.64, 1.49) \end{pmatrix}$$

Image Matching

Perceptual Distance Metric: ΔE_{94}^*

$$\Delta E_{94}^* = \sqrt{\left(\frac{\Delta L^*}{k_L S_L}\right)^2 + \left(\frac{\Delta C_{ab}^*}{k_C S_C}\right)^2 + \left(\frac{\Delta H_{ab}^*}{k_H S_H}\right)^2}$$

$$\vec{E} = \Delta E_{94}^* (\vec{V}_{target}, \vec{V}_{lib})$$

$$\begin{pmatrix} E_1 \\ E_2 \\ E_3 \\ E_4 \\ E_5 \\ E_6 \\ E_7 \\ E_8 \\ E_9 \end{pmatrix}$$

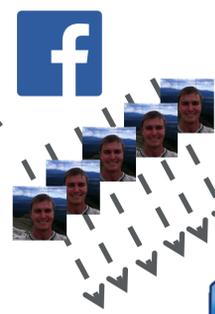
$$d = \sqrt{(E_{target 1} - E_{lib 1})^2 + (E_{target 2} - E_{lib 2})^2 + \dots + (E_{target 9} - E_{lib 9})^2}$$

Software Solution

Browser and Facebook communicate to authenticate user and request permissions



Browser delegates processing tasks to Google App Engine



Google App Engine makes requests to Facebook on the user's behalf and performs all of the processing involved in creating the Digital Identity

Webapp2

app_analyze_image.py
app_calculate_digital_identity.py
app_create_digital_identity.py

ImageLoader Photomosaic
ImageDatastore ImageAnalyzer
ImageFinder ColorConverter

Leveraged Technologies

Client Side

- HTML 5
- CSS
- JavaScript
- jQuery
- jQueryUI
- Facebook JDK
- AJAX
- JSON

Server Side

- Google App Engine
- Webapp2 Framework
- Python
- Python Imaging Library
- RESTful API

Iterative Design and Collaboration

GitHub was used to address the issues of iterative design, collaboration, and versioning.

