1 Advanced Image Processing Final Project: Face Detection

In this project, I research in region of interest proposal method just like R-CNN, implementation methods can be divided into the following steps:

1. Build Color Model
2. Skin-like pixel detection using evolutionary agents
3. Skin-like region segmentation and adjacent region graph
4. SVM Training

2 Build Custom Color Model

I use skin-like pixel detection using evolutionary agents and custom color model to find skin areas and it referenced from [1], where the custom color model is

$$\begin{aligned} I &= R + G + B \\ r &= R/I \\ g &= G/I \end{aligned} \tag{1}$$

$$\begin{aligned} 0.36 <= r <= 0.465 \\ 0.28 <= g <= 0.363 \end{aligned} \tag{2}$$

$$\begin{aligned} 0 <= H <= 50 \\ 0.2 <= S <= 0.68 \\ 0.35 <= V <= 1.0 \end{aligned} \tag{3}$$

3 Skin-like pixel detection using evolutionary agents

Skin-like pixel detection using evolutionary agents is mark skin-like pixel with agents uniformly distributed around the image, and use color model equation to check pixel whether is skin-like pixel or not. It referenced from [1].The following steps are used for implementation:

1. Uniformly distribute an initial set of agents A, divide the image into 12*12 cells, put a agent on cell's left-top corner.
2. Use Color Model to find skin-like pixel, if pixel where the agent locates is skin-like and has not been visited by any other agents, then reproduce son agents on 4 neighbors and remove father agent, otherwise, diffuse to one of 8 neighbors randomly, and life span add 1, if life span of agent exceeds 1, remove it.

Figure 1: Skin-like pixel detection using evolutionary agents

(a) Skin-like pixel (b) Skin-like pixel Region

Figure 2: Skin-like pixel detection

4 Skin-like region segmentation and adjacent region graph

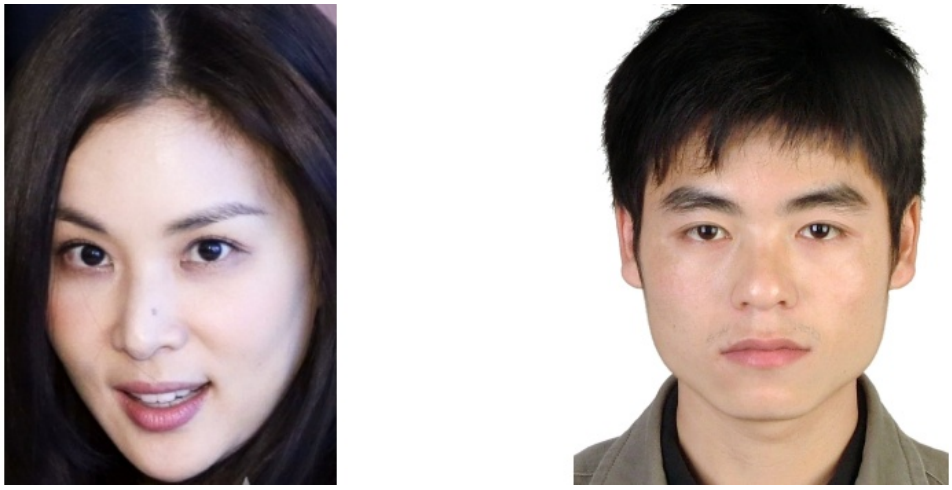
Use k-means to create segmentation on skin-like region and build adjacent region graph on segmentation, and use mean color of region to merge region, and find each bounding box of each final part. It referenced from [2].

(a) Region after segmentation (b) Region after segmentation merging

Figure 3: Skin-like region segmentation and adjacent region graph

5 SVM Training

1. Positive Sample: SCUT-FBP5500 Database, has 5500 image, shape of each image is 350×350×3, image has no background.
2. Negative Sample: Fashion MNIST, has 60000 samples in its training set, 5500 samples, random pick, 28×28×1.



(a) SCUT-FBP5500 Database sample

(b) SCUT-FBP5500 Database sample

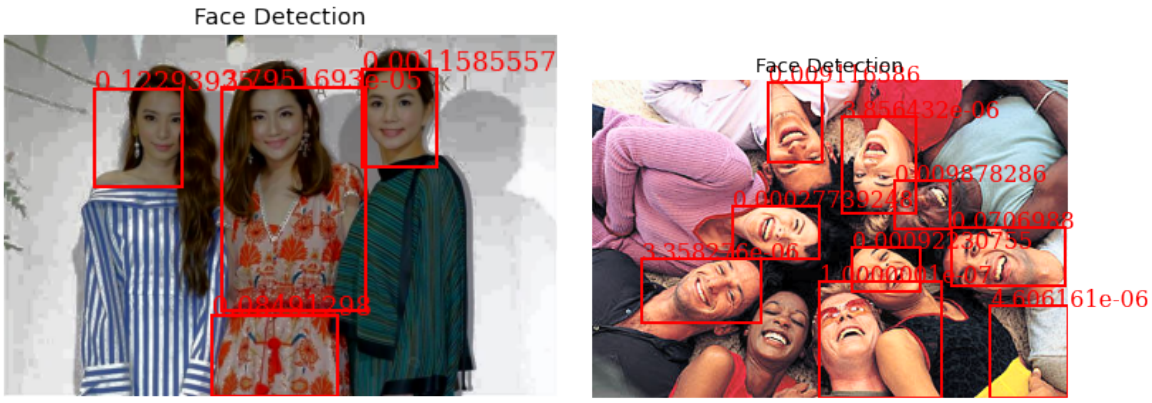
Figure 4: SCUT-FBP5500 Database

Data Processing:

1. Image Resize to 100×100×1.
2. Use Image Histogram Equalization.
3. Calculate Correlation Matrix of Image, value range is [-1, 1].

Test and training set ratio is 1: 9, and test set accuracy is 96.45%, but it is poor in reality, so there may be too little data and a variety of collections, this method referenced from [3].

6 Some Result



(a) Result1 (b) Result2

Figure 5: Result

7 References

1. A Novel Approach for Human Face Detection from Color Images under Complex Background, 2001
2. Face Detection Using Quantized Skin Color Regions Merging and Wavelet Packet Analysis, IEEE, 1999
3. Wavelet Transform based Feature Extraction for Face Recognition, International Journal of Bioinformatics Research and Applications, 2010