# "Wow! You Are So Beautiful Today!"

Luoqi Liu[1], Hui Xu[2], Si Liu[1], Junliang Xing[1], Xi Zhou[2],Shuicheng Yan[1]
[1]Department of Electrical and Computer Engineering, National University of Singapore
[2]Chongqing Institute of Green and Intelligent Tecnology, Chinese Academy of Science
{liuluoqi, dcslius, elexing, eleyans}@nus.edu.sg, {xuhui, zhouxi}@cigit.ac.cn

## ABSTRACT

In this demo, we present Beauty e-Experts, a fully automatic system for hairstyle and facial makeup recommendation and synthesis. Given a user-provided frontal facial image with short/bound hair and no/light makeup, the Beauty e-Experts system can not only recommend the most suitable hairstyle and makeup, but also show the synthesis effects. Two problems are considered for the Beauty e-Experts system: what to recommend and how to wear, which describe a similar process of selecting and applying hairstyle and cosmetics in our daily life. For the what-to-recommend problem, we propose a multiple tree-structured super-graphs model to explore the complex relationships among the beauty attributes, beauty-related attributes and image features, and then based on this model, the most suitable beauty attributes for a given facial image can be efficiently inferred. For the how-to-wear problem, a facial image synthesis module is designed to seamlessly blend the recommended hairstyle and makeup into the user facial image. Extensive experimental evaluations and analysis on testing images well demonstrate the effectiveness of the proposed system.

## Categories and Subject Descriptors

H.3.3 [**Information Search and Retrieval**]: Retrieval models; I.2.6 [**Learning**]: Knowledge acquisition

## Keywords

Beauty Recommendation, Beauty Synthesis, Multiple Tree-structured Super-graphs Model

## 1. INTRODUCTION

Hairstyle and makeup are two main factors that influence people's judgment about one's look, especially for female. By choosing proper hairstyle and makeup, one may look more attractive. This demo presents a novel Beauty e-Experts system, which helps users to select beauty items automatically and produces the synthesized visual effects. The beauty items, including hairstyle and makeup products, are indexed and represented by *beauty attributes* in this system. As shown in Fig. 1, a user first inputs an instantly captured or uploaded facial image. If one chooses the recommendation mode, several suitable hairstyles and makeup items are recommended automatically. Alternatively, the user enters the optional mode to select beauty items. After that, the synthesis results are shown with selected beauty items. We are the first to explore a comprehensive system considering both hairstyle and makeup recommendation in the multimedia area.

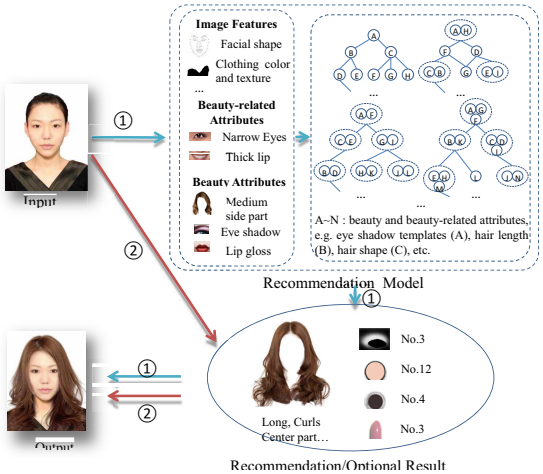


**Figure 1: System flowchart. ① recommendation mode: given a user facial image, some suitable hairstyles and makeups are recommended. ② optional mode: the user can select the items that he/she prefers optionally. Then, a set of corresponding synthesis results are shown on the screen.**

The recommendation objective of the Beauty e-Experts system is to suggest the most suitable *beauty attributes*, which index real hairstyle and makeup items. The beauty attributes contain 9 types, such as hair length, lip color. The beauty attributes are highly person-dependent. The effects of the same beauty products applied onto different faces may vary dramatically. Thus we define 21 types of *beauty-related attributes*, such as eye shape and mouth width, to describe the personal characteristics. The main challenge of the Beauty e-Experts system is how to model the complex relationships among different beauty and beauty-related attributes for reliable recommendation. To explore the complex relationships among these attributes, we propose to learn a multiple tree-structured super-graphs model. We use its multiple tree-structured approximation to reserve the most important relationships and make the inference procedure tractable. Different from the recommendation mode, the beauty attributes can also be selected manually in the optional mode. After the beauty attributes are obtained in


*MM'13,* October 21–October 25, 2013, Barcelona, Spain.
ACM 978-1-4503-2404-5/13/10.
http://dx.doi.org/10.1145/2502081.2502258.

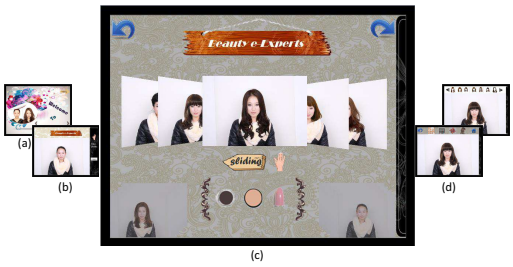


**Figure 2: The interface of Beauty e-Experts system. (a) welcome screen, (b) photo taking screen, (c) recommendation screen, (d) optional screen.**

either recommendation or optional mode, an effective and efficient facial image synthesis module is conducted based on the selected beauty attributes, and the results are sent back to the user.

## 2. SYSTEM INTERFACE

The Beauty e-Experts system has multiple screens. After entering the welcome screen in Fig.2(a), the user chooses to take or upload a short/bound hair and non-makeup photo, shown in Fig.2(b). If choosing to take photo, the user makes the photo-taking gesture and waits 3 seconds countdown. After that, the user can choose to enter the recommendation screen or optional screen. (1) If the user enters the recommendation screen, as shown in Fig.2(c), top 5 recommended results are listed in the center of the screen. The user can swipe to check each synthesis result with the corresponding recommended beauty items. Moreover, hairstyles only and makeup only results are shown on the left and right bottom corner, respectively. (2) If the user enters the optional screen, as shown in Fig.2(d), he/she can touch the icon bar on the top of the screen to select the hairstyles and makeup items. Note that in the Beauty e-Experts system, Kinect is used for the interactive operation, due to its touch-free control, and high recognition rate of users' gestures.

## 3. SYSTEM WORKFLOW

Given a testing image, we extract 4 types of image features from the face and clothing region based on face detection. All features are concatenated to form a feature vector of 173 dimension after Principal Component Analysis.

The values of 9 beauty attributes are obtained by different methods. Some are set manually (such as hair length), some are clustered by $k$-means algorithm (such as hair color), and the others are extracted by image matting [3] (such as eye shadow shape attribute). The original hairstyle templates (sets of hair beauty attributes) are also extracted by image matting. What's more, we manually label 21 beauty-related attributes, which mainly focus on the facial shapes and clothing properties, to narrow the gap between the beauty attributes and the image features.

Based on all these attributes, we propose a multiple tree-structured super-graphs model to explore the complex relationships among these attributes for recommendation. The model describes the mapping rules among the visual features, beauty-related attributes and beauty attributes. These tree-structured super-graphs can be considered as different recommendation experts, each of which is good at modeling some kinds of relationships. The recommendation results generated by these experts are voted to form the final result. In the demo, we offer the top 5 recommended beauty items associated with beauty attributes, as shown in Fig. 2(c). With the recommended or optionally selected beauty items, hair template and eye shadow shape attribute are aligned to facial image [1]. Guided filter [2] is applied on image lightness channel $L^*$ to imitate the smoothing effect of foundation, and other recommended color beauty attributes are fused to the image by alpha blending. In all, Beauty e-Experts can offer reliable recommendation results, and also produce natural and appealing synthesis effects. For details, please refer to [4].

## 4. DEMONSTRATION

In Fig. 3, we compare the recommendation results of our model with three baselines (latent SVM [5], multi-class SVM and neural network). The performance is measured by Normalized Discounted Cumulative Gain (NDCG). From the results, we can observe that our model has best performance, because our model can express complex relationships among different attributes. Additionally, by employing multiple tree-structured super-graphs, our model tends to obtain more robust recommendation results.

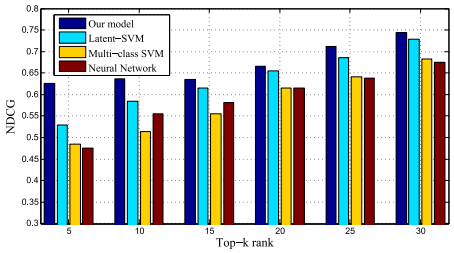


**Figure 3: Comparision between our model and baselines. The horizontal axis is top-$k$, and the vertical axis is NDCG.**

We evaluate the recommendation and synthesis results of Beauty e-Experts. As shown in Fig. 4, these results still look natural with a variety of style changes, which demonstrates that Beauty e-Experts is an automatic and intelligent recommendation and synthesis system in the beauty industry.

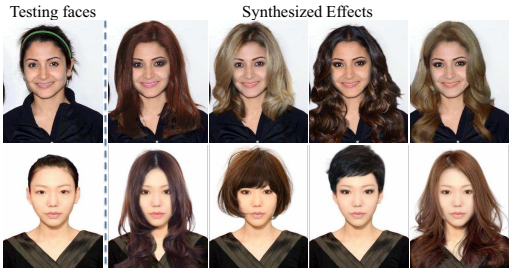


**Figure 4: Some examples of synthesis results with the top 4 recommended hairstyles and makeup.**

## 5. ACKNOWLEDGMENTS

This research is supported by the Singapore National Research Foundation under its International Research Centre @Singapore Funding Initiative and administered by the IDM Programme Office. Also it is partially supported by Singapore Ministry of Education under research Grant MOE2010-T2-1-087 and the "Extreme Facial Analysis" project from Ministry of Home Affairs.

## 6. REFERENCES

[1] F. Bookstein. Principal warps: thin-plate splines and the decomposition of deformations. *PAMI*, 11(6):567–585, 1989.

[2] K. He, J. Sun, and X. Tang. Guided image filtering. In *ECCV*, 2010.

[3] A. Levin, D. Lischinski, and Y. Weiss. A closed-form solution to natural image matting. *PAMI*, 30(2):228–242, 2008.

[4] L. Liu, H. Xu, J. Xing, S. Liu, X. Zhou, and S. Yan. "Wow! you are so beautiful today!". In *ACM MM*, 2013.

[5] S. Liu, J. Feng, Z. Song, T. Zhang, H. Lu, C. Xu, and S. Yan. "Hi, magic closet, tell me what to wear". In *ACM MM*, 2012.