RECOGNIZING MINIMAL FACIAL SKETCH BY GENERATING PHOTOREALISTIC FACES WITH THE GUIDANCE OF DESCRIPTIVE ATTRIBUTES

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Introduction

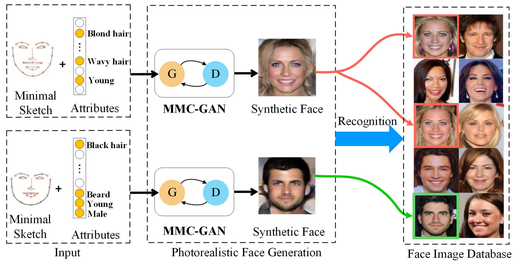


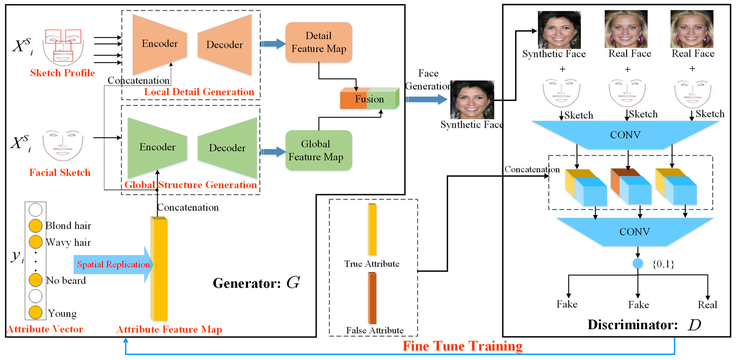
Figure 1: The workflow of facial sketch recognition based on the proposed procedure.

Recognizing a face based on its facial sketch along with the natural language description is an important, yet challenging problem in the face recognition community. We propose to recognize faces in a large scale photo database by generating synthetic facial images with descriptive attributes and minimal facial sketches.

Contributions:

1. To the best of our knowledge, this is the first attempt to perform face image generation and recognition by jointly utilizing the information provided by visual sketch and verbal description.
2. We propose a generative model (MMC-GAN) to generate photorealistic facial images from sketch and high-level descriptive information, achieving facial attributes manipulation given a specific attribute value.
3. Face recognition can be implemented effectively based on the synthetic faces since we preserve the facial structures and local details during the generation.

Methods



$$\min_G \max_D E_{X_i \sim P_{data}, y_i \sim P(y)}[\log(D(X_i^R, X_i^S, y_i))] +$$
$$E_{X_i \sim P_{data}, y_i \sim P(y)}[\log(1 - D(G(X_i^S, y_i), X_i^S, y))] +$$
$$E_{X_i \sim P_{data}, \bar{y}_i \sim P(\bar{y})}[\log(1 - D(X_i^R, X_i^S, \bar{y}_i))]$$

Multi-Modal Generator

Conditional Discriminator

Figure2. The architecture of the proposed MMC-GAN for photorealistic face generation, which includes modules of face generator and conditional discriminator. The generator integrates the minimal sketch and descriptive attributes into a hidden incorporation, which complements each other for face synthesis. Note that the global and detailed information of a facial sketch is embedded into the feature space via different feature generators, respectively. The local detail generator recovers landmark details with skip connections, and the global generator is designed to produce face structures with the guidance of facial attributes. As for the discriminator, we first produce positive and negative inputs by incorporating the synthetic and real faces with the alternative facial attributes. The generated patches are fed into the conditional discriminator to distinguish the real/fake faces, with the loss fine tuning the generator.

Results

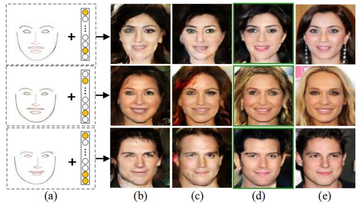


Figure 3: Sample results of face synthesis, where column (a) is a subject input, and column (b) are synthetic faces by pix2pix (Isola et al. 2017), and column (c) and (d) are the synthetic faces based on the proposed MMC-GAN without or with the attributes information, respectively. Ground-truth images are shown in (e).

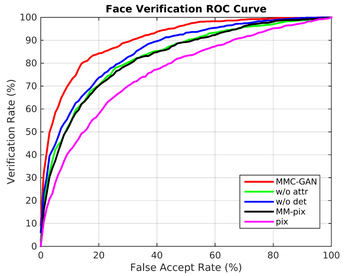
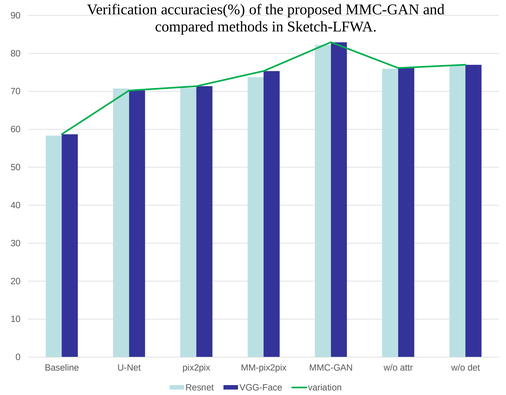


Figure 4: Synthesis results based on the proposed MMC-GAN conditioned on different attributes. Given sketch and different attributes, we only flip one attribute value for each synthetic face image. The labels are: Black hair, Blond hair, Bald, Bangs, Beard, Eyeglasses, Hat, Old, Gender, respectively.



Conclusions

An effective Multi-Modal Conditional GAN (MMC-GAN) is proposed to generate photorealistic facial images from sketch and high level descriptive information. Simultaneously, we make the global structure and local details of a face respectively join in different channels of the generator, and then fuse them together with the guidance of the corresponding descriptive attributes, which can effectively reduce the generation uncertainties. Based on the synthetic faces we can implement face recognition effectively since the facial structures and local details are preserved during the generation. Extensive experiments including a perceptual one demonstrate the effectiveness of the proposed MMC-GAN algorithm in tasks of facial sketch generation and recognition.

Reference:

1.Phillip Isola, Jun-Yan Zhu, Tinghui Zhou, and Alexei A Efros, “Image-to-image translation with conditional adversarial networks,” in CVPR,2017.

2.Ian Goodfellow, Jean Pouget-Abadie, Mehdi Mirza, Bing Xu, David Warde-Farley, Sherjil Ozair, Aaron Courville, and Yoshua Bengio, “Generative adversarial nets,” in Advances in neural information processing systems, 2014