Learning Residual Images for Face Attribute Manipulation

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Motivation:

- Face->attribute tasks are less challenging now. How about the inverse problem attribute->face?

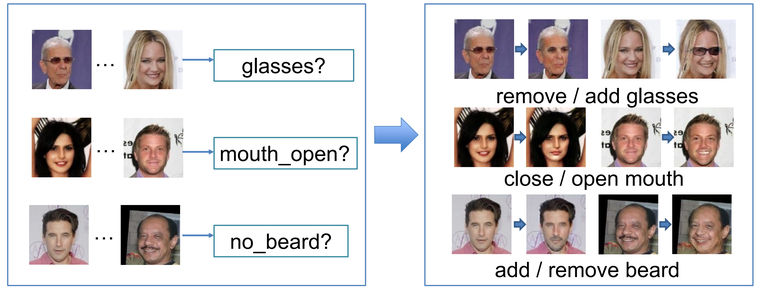
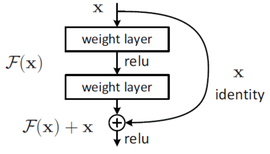
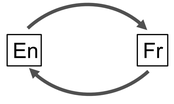


Fig. 1 From face -> attribute to attribute -> face.

- Attribute manipulation should be similar to
  - Residual learning: manipulated images = input images + residual images
  - Dual learning: input images -> manipulated images -> input images



Residual learning
[CVPR'16]



Dual learning for machine translation
[NIPS'16]

Fig. 2 Residual learning and dual learning

Method:

The overall framework is a GAN based framework. The details are as follows.

- Image transformation networks G_0/G_1+ discriminative network D
- G_0/G_1 learns residual images for attribute manipulation
- Network trained in a dual learning scheme

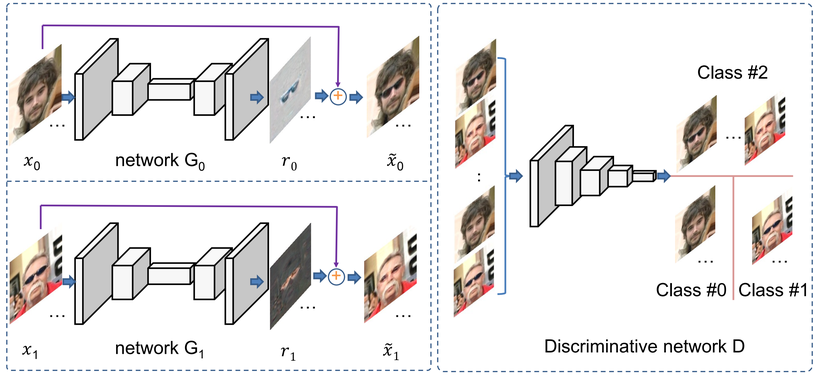


Fig. 3 The architecture of the proposed method.

Fig. 4 The architecture of the proposed method.

Loss function

- G_0/G_1: $\ell_G = \ell_{GAN} + \ell_{dual} + \alpha\ell_{pix} + \beta\ell_{per}$

$$\ell_{GAN} = \begin{cases} -\log(D(G_i(x_i))) & i = 0, \\ -\log(1 - D(G_i(x_i))) & i = 1. \end{cases} \quad \ell_{dual}(\tilde{x}_i) = \begin{cases} -\log(1 - D(G_{1-i}(\tilde{x}_i))) & i = 0, \\ -\log(D(G_{1-i}(\tilde{x}_i))) & i = 1. \end{cases}$$

$$\ell_{pix}(r_i) = ||r_i||_1, i = 0, 1 \qquad \ell_{per}(x, \tilde{x}) = ||\phi(x) - \phi(\tilde{x})||_1$$

- D: $\ell_{cls}(t, p) = -\log(p_t), t = 0, 1, 2$

Results on CelebA:

6 attributes: glasses, no_beard, mouth_open, smile, male, young.

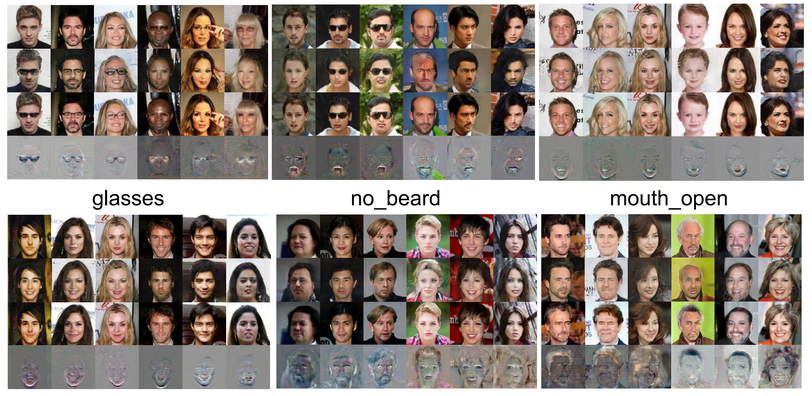


Fig.5 1st row: input images. 2nd row: VAE/GAN[ICML'16] results. 3rd row: ours. 4th row: residual images

(a) (b)

Fig. 6 Applying remove-glasses network on faces without glasses (a) and applying add-glasses network on faces with glasses (b). 1st row: input images. 2nd row: manipulated images. 3rd row: residual images.

Concolusion:

- A GAN based framework for attribute manipulation
- Learning attribute specific area as residual images
- Adopting dual learning to improve image quality