Facial Features Manipulation Using Free Form Input

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Motivation

- Many researchers proposed to vary predefined facial attributes:
  - StyleFlow [Abdal et al. 2020]
- A very broad unexplored field of free-form input:
  - DeepFacePencil [Li et al. 2020]
  - MaskGAN [Lee et al. 2020]
  - SC-FEGAN [Jo et al. 2019]

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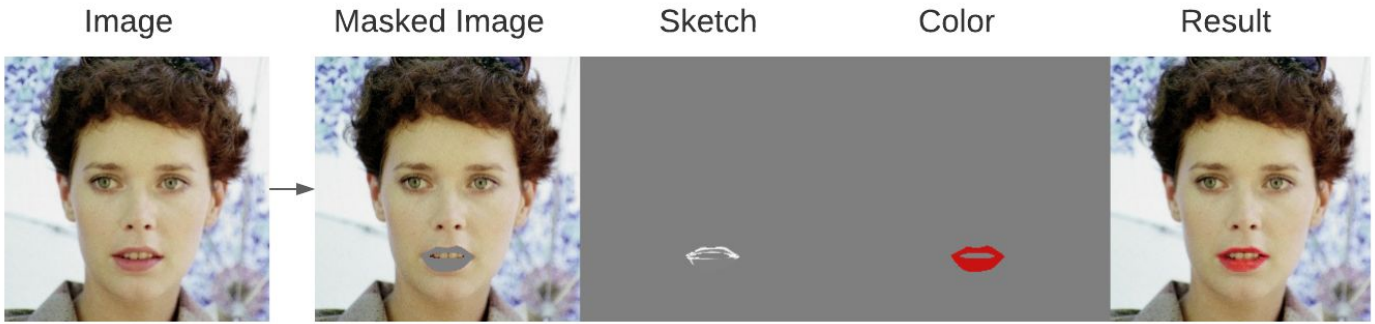
Problem statement

Goal:

Develop a model for free-form facial attributes manimulation



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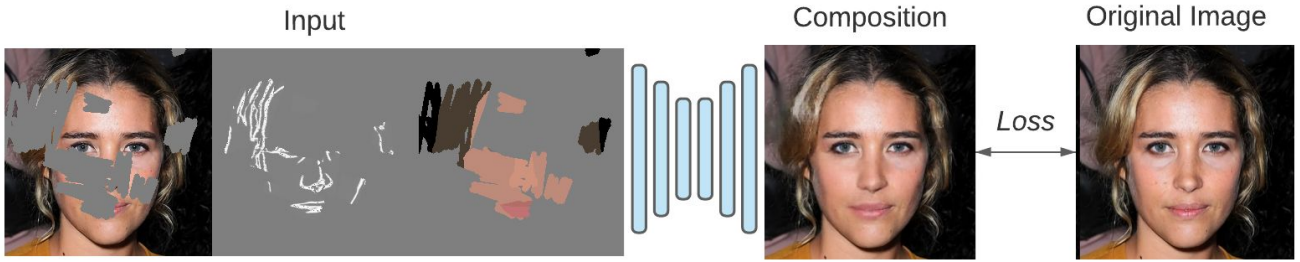

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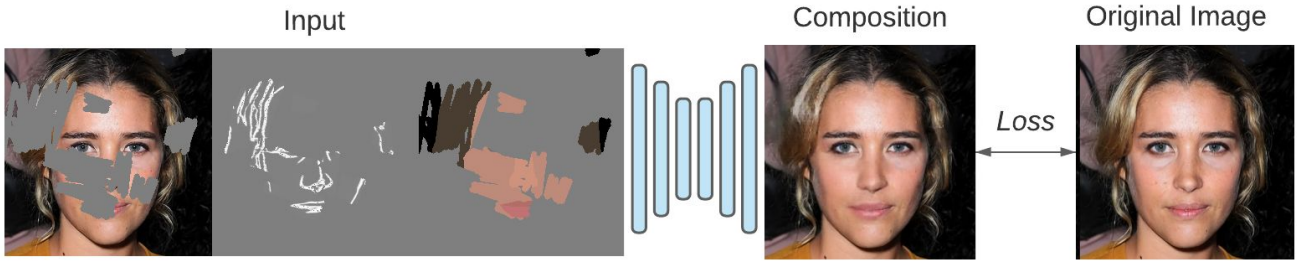

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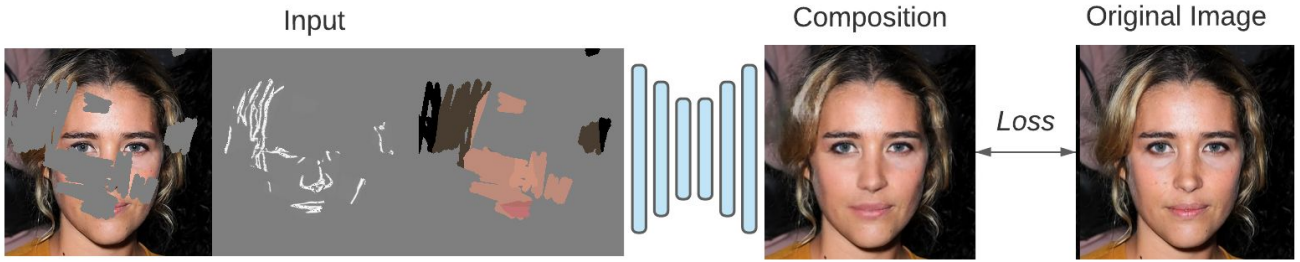

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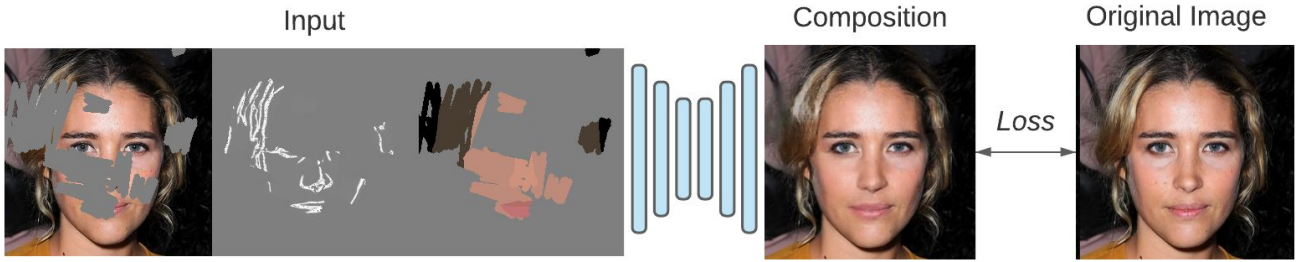
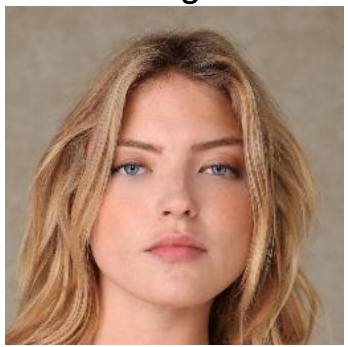
2. Design image inpainting model
3. Validate the trained model qualitatively on synthetic and real user inputs



Dataset

1. FFHQ [Karras et al. 2019]
2. LaPa [Lia et al. 2020]
3. CelebAMask-HQ [Lee et al. 2020]

Image



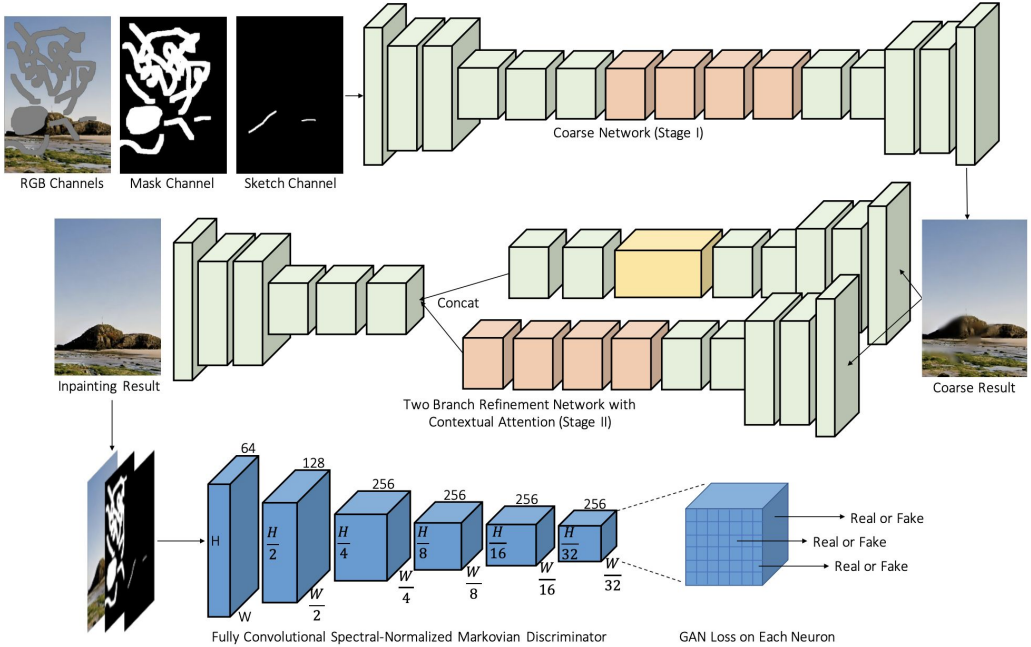
Sketch

Color

Mask generation algorithm

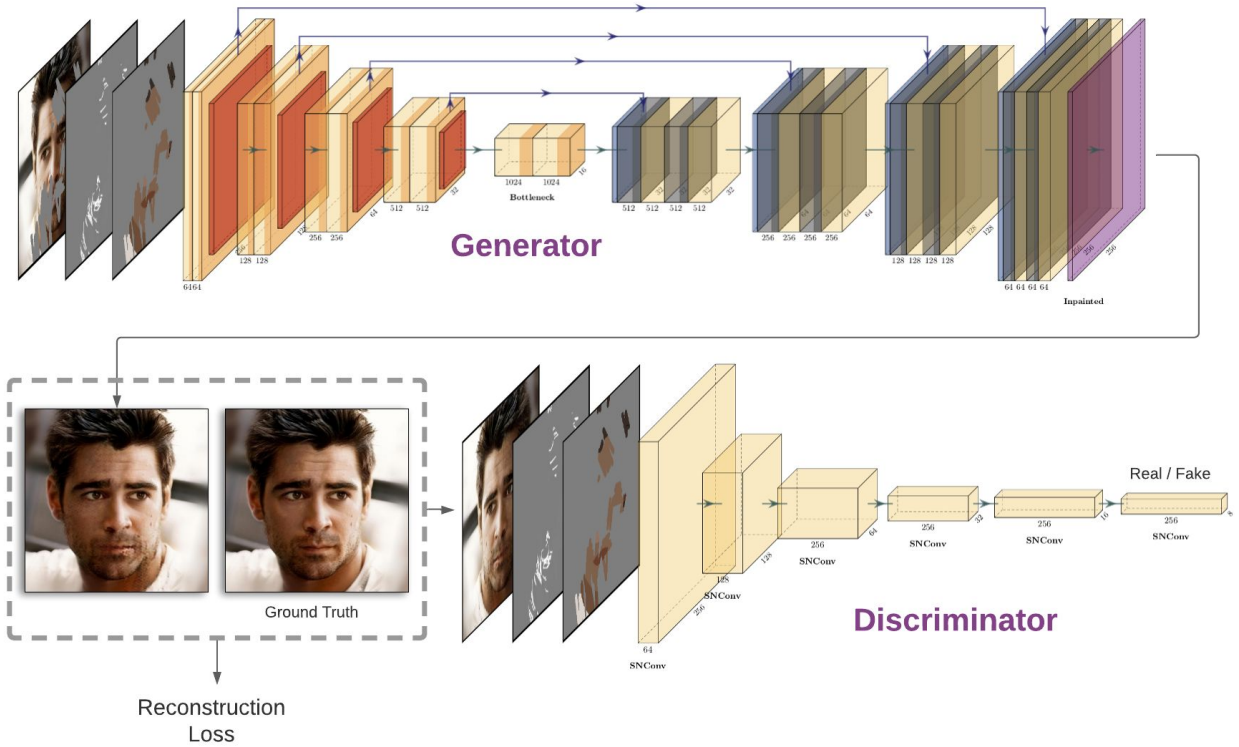
$N_{areas} \sim \mathcal{U}\{\textbf{minAreas maxAreas}\}$;
for $i = 1 \dots N_{areas}$ **do**
  $x_0 \sim \mathcal{N}(H/2, H/4)$;
  $y_0 \sim \mathcal{N}(W/2, W/4)$;
  $\ell \sim \mathcal{U}(0, H/4)$;
  $\rho \sim \mathcal{U}(0, 2\pi)$;
  $N_{actions} \sim \mathcal{U}\{1, \textbf{maxActions}\}$;
  for $j = 1 \dots N_{actions}$ **do**
    $\Delta_\ell \sim \mathcal{N}(0, 1)$;
    $\Delta_\rho \sim \mathcal{N}(0, \pi/20)$;
    $x_j := x_{j-1} + (\ell + \Delta_\ell) \cdot \sin(\rho + \Delta_\rho)$;
    $y_j := y_{j-1} + (\ell + \Delta_\ell) \cdot \cos(\rho + \Delta_\rho)$;
    `Draw line` $(x_{j-1}, y_{j-1}) \rightarrow (x_j, y_j)$

DeepFillv2



Jiahui Yu et al. “Free-form image inpainting with gated convolution” [2019]

Architecture



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Architecture

Generator:

- U-Net
- Gated convolutions
- Outermost `ConvT → UpSample + Conv`

Discriminator:

- PatchGAN
- Spectral Normalization

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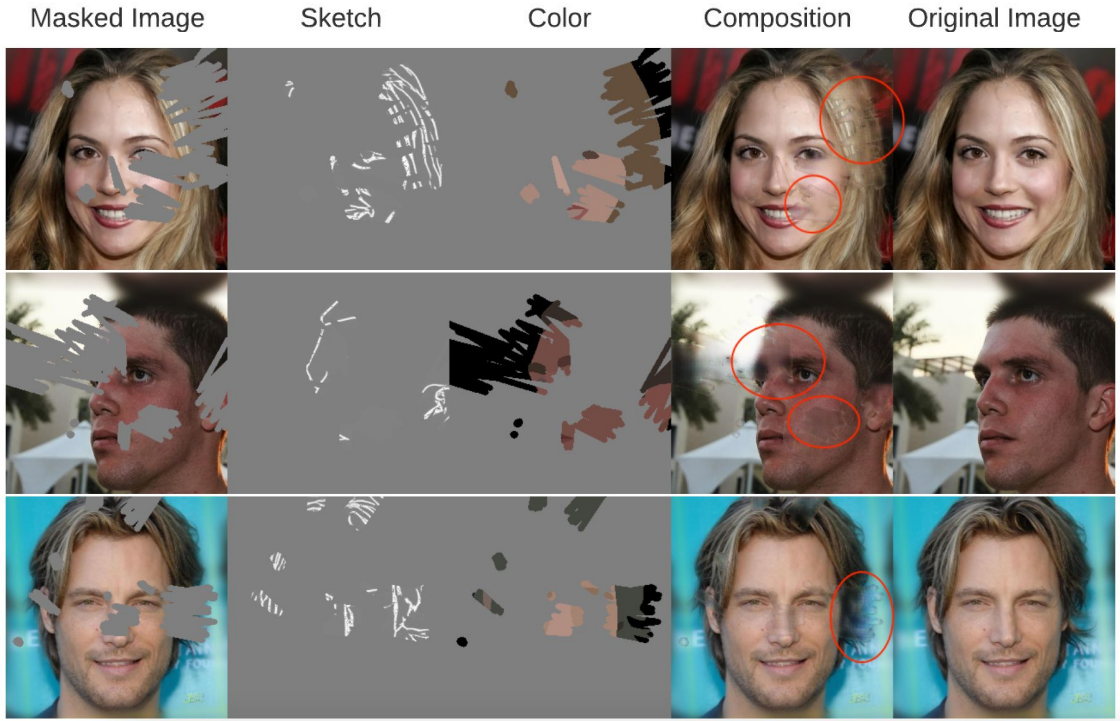
Loss

$$L_D = \mathsf{E}[1 - D(I_{real})] + \mathsf{E}[1 + D(I_{comp})]$$
$$L_G = -\mathsf{E}[D(I_{comp})] + L_{recon}$$
$$L_{recon} = L_1(I_{real}, I_{comp})$$

Droplet artifacts



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Perceptual component

$$L_D = \mathsf{E}[a(1 - D(I_{real}))] + \mathsf{E}[a(1 + D(I_{comp}))]$$
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Tero Karras et al. “Training generative adversarial networks with limited data”. [2020]

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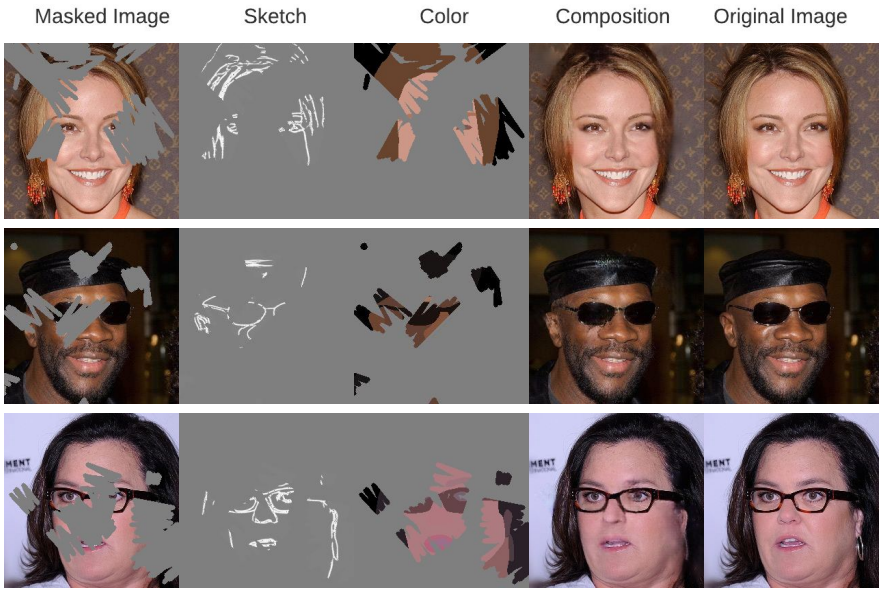
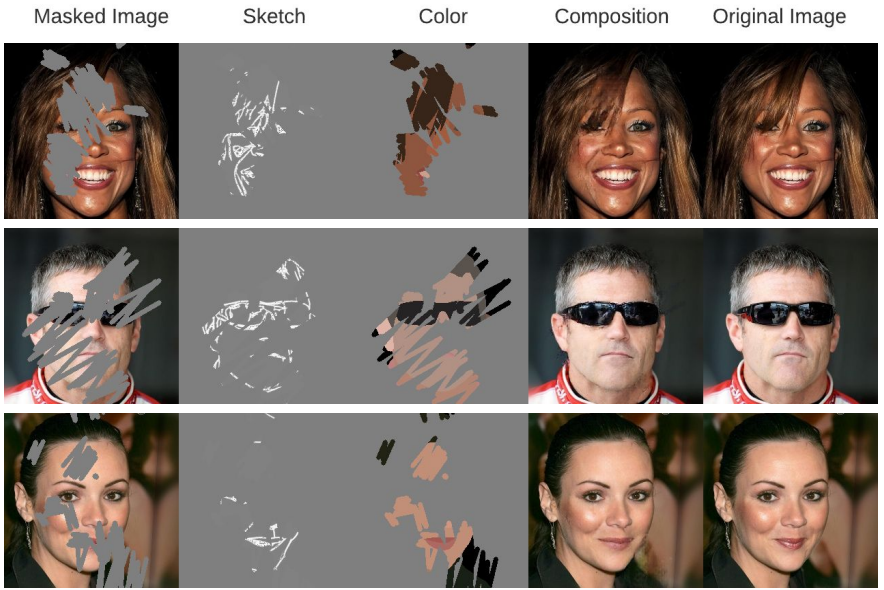
Synthetic input





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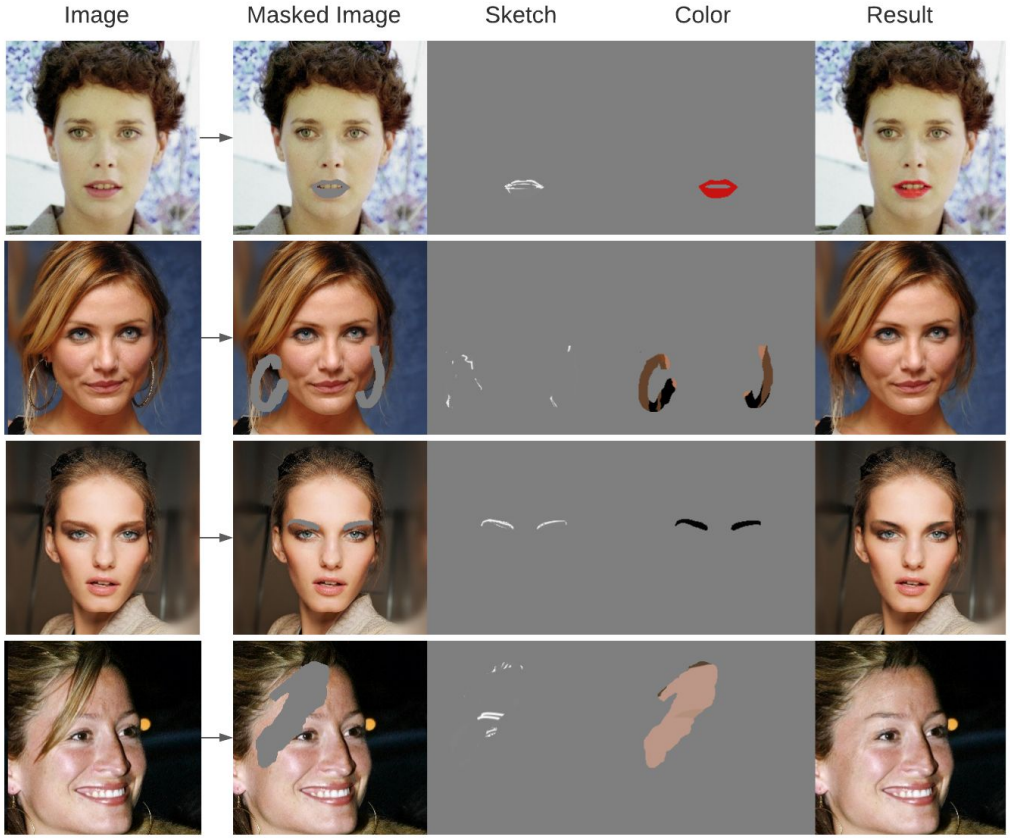
User input



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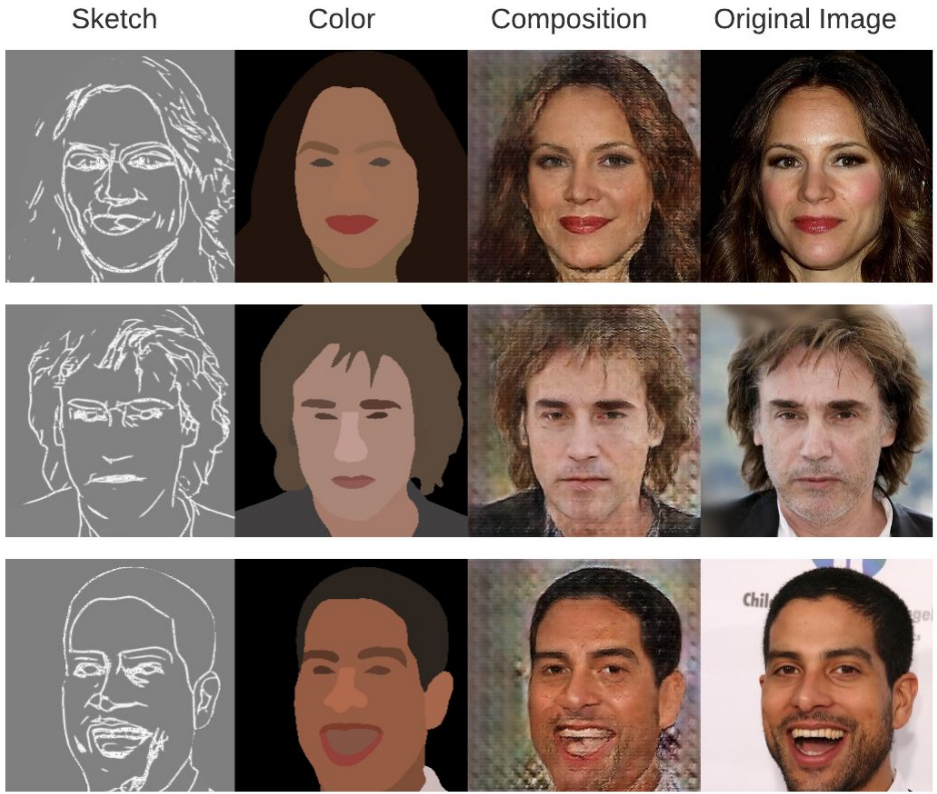
Fullfill experiment



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Quantitative analysis

	PSNR(↑)	SSIM(↑)	L2%(↓)
PatchMatch	21.6649	0.9157	0.95
DeepFIllv1	23.7554	0.9145	0.52
SC-FEGAN	29.4912	0.9543	0.2
Ours	31.3779	0.9322	0.18

The first two methods take as input masked images only, while we supplement our model with sketch and color information. The metrics values for PatchMatch, DeepFillv1, SC-FEGAN were taken from the paper [Jo and Park 2019].

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Contributions

- Proposed data preparation and mask simulation algorithms;

- Developed model capable of dealing with free-form input layers and producing realistic and faithful compositions;

- The proposed method forms a basis for further research in the field of free-form image editing. All-stages source code is publicly available at GitHub:

  https://github.com/angusev/SCGAN

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Further research

- Collect user input example to enhance mask generation algorithm
- Train on real data
- Compress the model to port on device
- Try different free-form input options and reinforce input by additional conditions

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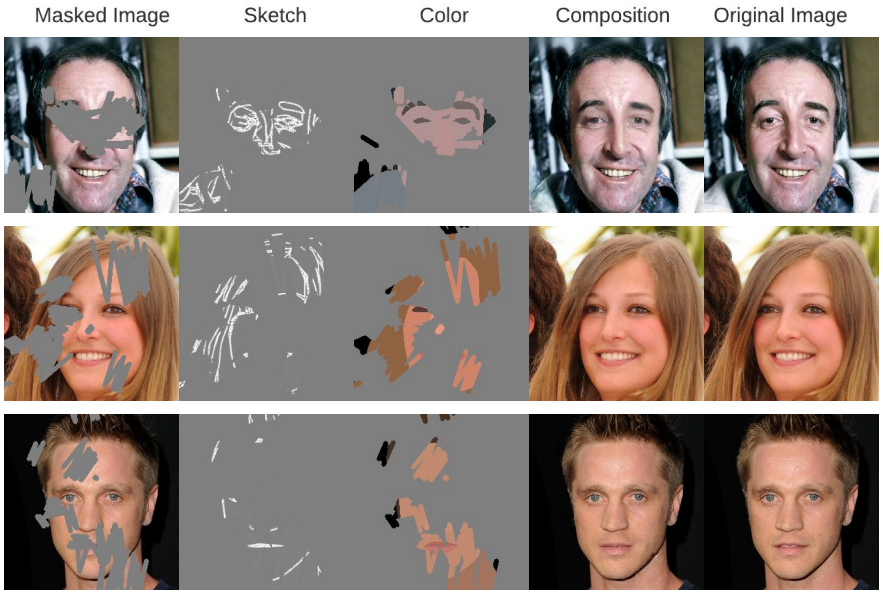
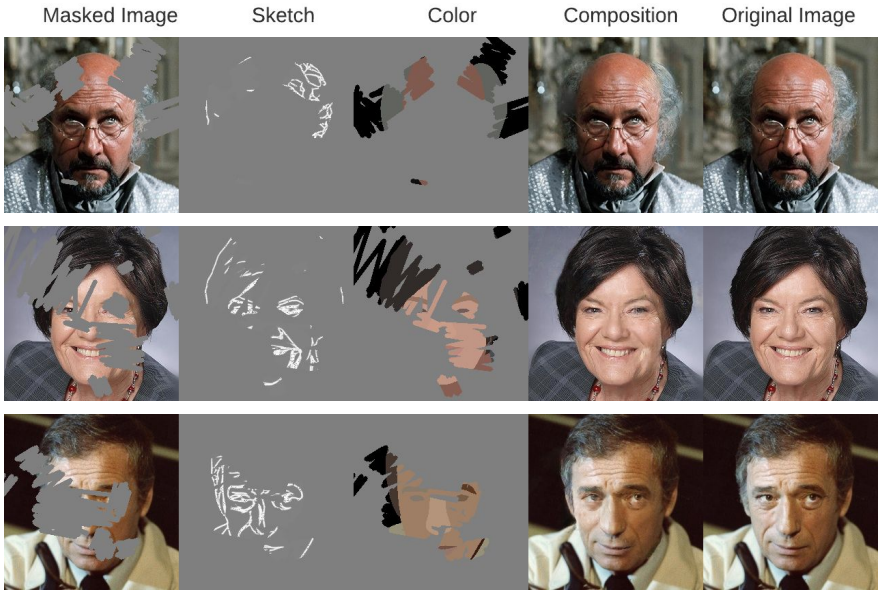
More examples





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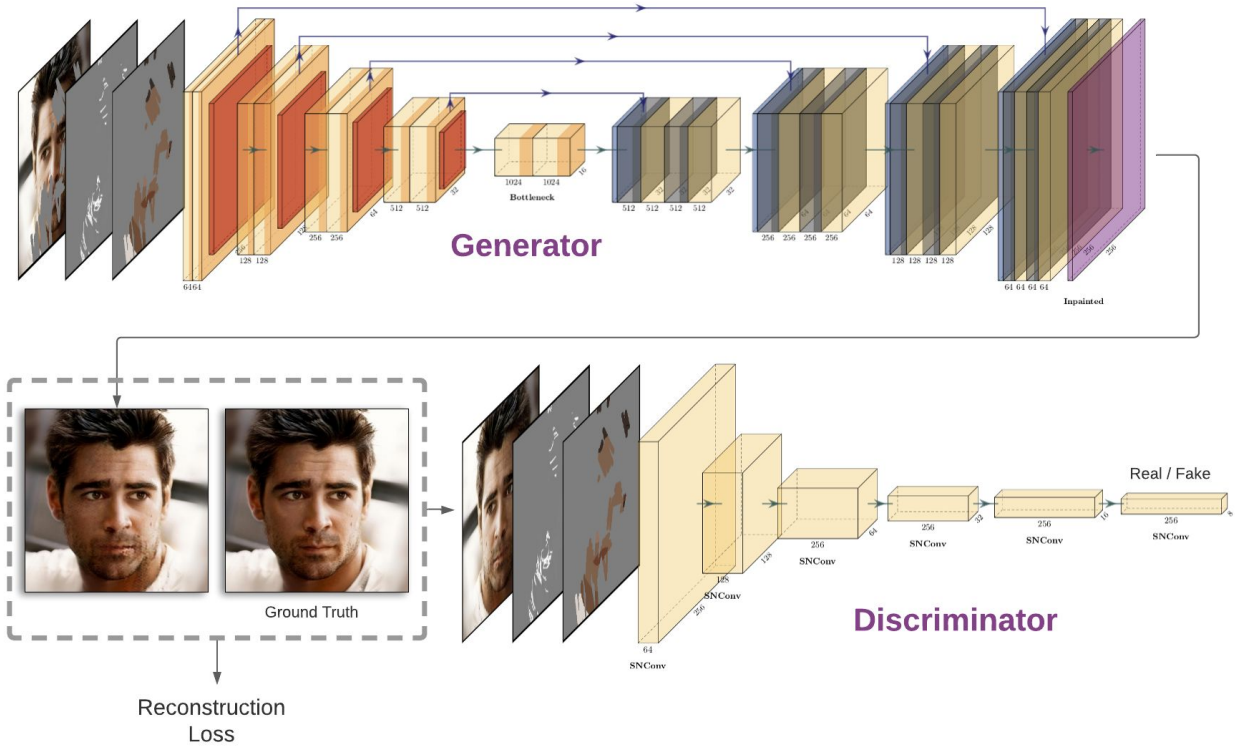

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