Profile to Frontal Facial Generation Using Conditional GAN

Aaron Han | than21 **Roy Park | rpark3**

Problem

- Oftentimes, profile view (or the side-view) of one's face is neglected as a method for facial recognition.
  - For example, Apple's Face ID and Snap's filters are all almost exclusively applied to frontal facial image and video data.
- Profile view of one's face is as uniquely distinguishable as the frontal view and the two views of one face are closely interconnected and related to each other.
  - Hence, I wanted implement and experiment with generating frontal view of facial data given its profile view.

Methods

- I plan to utilize a dataset titled “Celebrities in Frontal-Profile in the Wild”.
  - This dataset has a collection of a total of 500 celebrity faces labeled by their names and whether the image has a frontal face or a profile (side-view) face. Each celebrity had a total of 10 frontal pictures and 4 profile pictures, and I chose to pair the 4 profile pictures to 4 frontal pictures. Hence, there were a total of (4 + 4) * 500 = 4000 images consisting of 2000 profile facial images and 2000 frontal facial images.
- I used Python to move my data into two different folders in which one folder contained all the profile facial images, and the other all the frontal facial images. I have also changed the name of each image file to make it more convenient to pair up the input-label, which is essentially the profile-frontal pair.

Experiments

- I used Python to move my data into two different folders in which one folder contained all of each one of Profile and Frontal facial images. I have also changed the name of each image file to make it more convenient to pair up the input-label, which is essentially the profile-frontal pair
- I used a Convolutional Neural Network as the building block for both of my generative and adversarial network.
  - Specifically, for the generative network, I tried various numbers of convolutional layers. I first tried 4 pairs of convolutional layer and batchnorm layer followed by 4 pairs of 2D transposed convolutional layer and batchnorm layer. For my discriminator network, I used 5 pairs of convolutional layer and batchnorm layer.

Results

Dataset Example (Input-Label pair)

Profile Frontal

Generated Face for Caucasian People

Generated Face for Non-Caucasian People

Overfitting on Training Image

Result for Zoomed out Image Input

Analysis

- The result of my experiment is overall mixed.
- My model seemed to work well on certain groups of people (usually the Caucasian race group).
  - Example on male of African-descent and female of Asian-descent failed to produce believable facial images
- Deeper neural networks for the generator network did perform better
- My model had a problem of overfitting, which can be due to the limited size of my dataset.
- Looking at how the generator network produced during training, we saw that its performance has fluctuated

Future Work

- Limitations:
  - On the other hand, my model did not perform too well on facial data of other races.
  - This could be because of the my dataset is not so racially diversified.
  - Another limitation that I encountered could be the limited size of dataset.
  - There are a total of 4 frontal facial images and 4 profile facial images of 500 different celebrities, which amounts to a total of 4000 images.
  - I could use data augmentation to approach this problem of small dataset
- I have noticed that our model overfits since it almost perfectly generates the input image from the training dataset, but fails to do so for training dataset. In the future, I could try to utilize various regularization methods such as dropout layers for my generative network to prevent my network from overfitting

References

[1] Isola, Phillip, et al. “Image-to-Image Translation with Conditional Adversarial Networks.” 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017, https://doi.org/10.1109/cvpr.2017.632.

[2] Sengupta, Soumyadip, et al. “Frontal to Profile Face Verification in the Wild.” 2016 IEEE Winter Conference on Applications of Computer Vision (WACV), 2016, https://doi.org/10.1109/wacv.2016.7477558.