Deep learning Project:
Changing Hair colour using GANs

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Abstract :

Generative Adversarial Networks (GANs) have been used in many different tasks of image to image translation. Our goal was to use conditional GANs to create a model that changes the hair colour to any desired colour. We did analysis on Hair GAN[1] and found that it was not generalizing well and not giving good results on asian's so, we created our own dataset by using this model and tried different configurations of swish activation (introduced by google in 2017) on pix2pix GAN [2] and compared the results.

Literature Review:

The most recent work [1] was done by Stanford cs230 class 2020. [1] used cycleGAN with some changings. They used one generator and one discriminator instead of two and gave target hair color range as input. They used both adversarial loss from discriminator and identity loss from the cycle of cycleGAN. The Identity loss is calculated by giving the generated image back to the generator with actual labels and by taking L1 distance of the actual image and generated image from the cycle.

Other popular works include AttGAN[3] where they created a model that did face editing not only for hair colour but also other categories such as (age , sunglasses , eye brows , etc). AttGAN[3] uses the same dataset as [1], but they don't restrict themselves to one action only. AttGAN's generator is divided into two parts, Encoder and Decoder. The Encoder converts the image into a latent representation "Z" while the decoder converts it back to the original image and image with changed attributes. It uses Attribute

Constraint Classifier to stop the generator from converting more than one Attribute. It uses a reconstruction loss to reconstruct the image (Identity loss used in cycle gan is a close match to Reconstruction loss). One Good thing they managed to pull off was that they specified the variable that could control the Degree of change of an Attribute, in a sense they can control the intensity of style in their image. The AttGAN[3] came out in 2018 and beat all of the previous state of the art models like VAE/GAN [4] , IcGAN [5] and StarGAN [6].

Another recent research in image translation is pix2pix GAN[2]. They proposed to use conditional GANs for the image to image translation. They use U-Net for Generator and Patch GAN for the discriminator. Their main idea is to encourage the discriminator to take account of crispness in images as L1 and L2 distances as losses fail to encourage

high-frequency crispness. For this reason, they formed PatchGAN which takes small N X N patches from images and predicts them as L1 distance works fine for low frequencies. They combine all of the predictions from patches to make the final prediction.

Methodology:

We made our own data set of hair color translation by using hairGAN [1] and CelebA dataset [7]. The data consists of 25,000+ train and test image pairs. We trained a pix2pix GAN [2] with our dataset and compared the results with HairGAN[1] then we tried to use a swish activation function which was proposed by google in 2017 in pix2pix GAN's generator and trained the model on our dataset. We found a slight change in accuracy then the hairGAN.
We tried different configurations of activation functions in pix2pix and reported the changes. We tried to use swish activation in the generator (U-Net) of pix2pix then in discriminator (PatchGAN) and then in both the generator and discriminator.

Experimental Setup:

<u>HairGan :</u>

- Sigmoid Discriminator (he created his own discriminator)
- Epoch : 30
- generator (Res-net)
- Batch size = 1

<u>Pix2Pix</u>:

- Epochs : 30
- Generator (U-net)
- Batch size = 1
- Activation : Leaky relu , Tanh

<u>Swish in D:</u>

- Epochs : 30
- Generator (U-net)
- Batch Size = 1
- Activation : Swish in discriminator (same for generator as in pix2pix)

<u>Swish in G :</u>

- Epochs : 30
- Generator (U-net)
- Batch Size = 1
- Activation : Swish in generator (same for discriminator as in pix2pix)

<u>Swish in GD :</u>

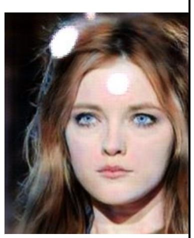
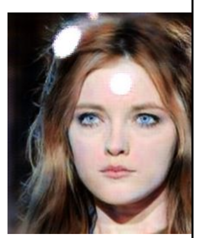
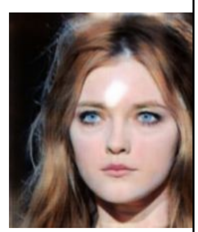
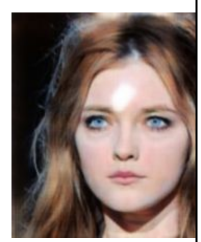
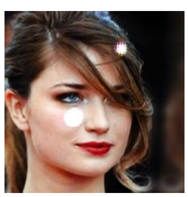
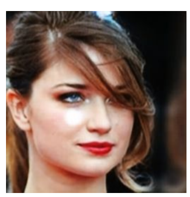
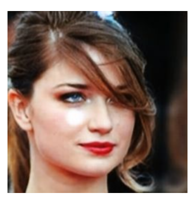
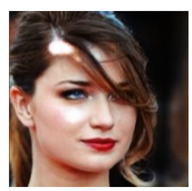
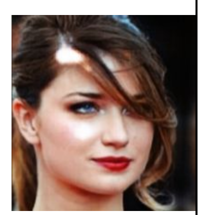
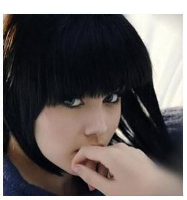
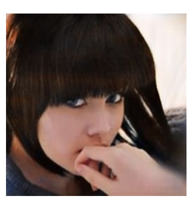
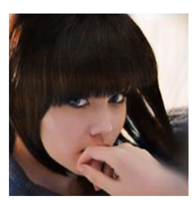
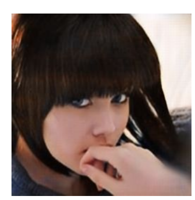
- Epochs : 30

- Generator (U-net)
- Batch Size = 1
- Activation : Swish in both generator and discriminator

Results:

We found that the best approach is to use swish in the generator of the model pix2pix as it gives more sharp and better results. Following is a comparison of all approaches.

The results of simple pix2pix GAN and pix2pix with swish in generator are almost the same and are better then other approaches.

Real Image	HairGAN	Pix2pixGAN	Swish in D	Swish in G	Swish in GD
					
					
					

Conclusion :

We created our own Dataset and checked its performance on open source models like Pix2Pix and hairGan. We then modified Pix2Pix by adding Swish activation to it and found that Pix2Pix with swish in the generator gave considerably good performance.

Our experiments concluded that swish does increase the performance of GAN's when used in the Generator.

Reference :

[1] Clemens Macho. Changing people's hair color in images. CS230, Department of Computer Science, Stanford University.

[2] Phillip Isola, Jun-Yan Zhu, Tinghui Zhou, Alexei A. Efros Image-to-Image Translation with Conditional Adversarial Networks.

[3] Zhenliang He, Wangmeng Zuo, Meina Kan, Shiguang Shan, Xilin Chen. AttGAN: Facial Attribute Editing by Only Changing What You Want.

[4] Guim Perarnau, Joost van de Weijer, Bogdan Raducanu, Jose M. Álvarez. Invertible Conditional GANs for image editing.

[5] Guim Perarnau, Joost van de Weijer, Bogdan Raducanu, Jose M. Álvarez Invertible Conditional GANs for image editing

[6] Anders Boesen Lindbo Larsen, Søren Kaae Sønderby, Hugo Larochelle, Ole Winther. StarGAN: Unified Generative Adversarial Networks for Multi-Domain Image-to-Image Translation.

[7] Dataset