B&W Colorising Models
Project Report 2
Team MMM

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1 Current Direction of the Work

Having previously acquired the dataset we intend to run colorization task on, we started searching for applicable models we could implement and maybe improve, as well as testing them on portions of the aforementioned dataset.

2 Picking the Models

Image colorization is the technique of adding color to grayscale or black-and-white images. This process involves converting intensity values to a color space like RGB and filling in missing color data to create a full-color image. Various methods, including image segmentation, texture synthesis, and machine learning, are used for this purpose. One popular method employs deep learning, specifically convolutional neural networks (CNNs), trained on a dataset of color images. Another approach utilizes Generative Adversarial Networks (GANs), where a generator network produces color versions of grayscale images, and a discriminator network distinguishes between generated and real color images. Recent advancements in deep learning-based methods have yielded impressive and high-quality colorization results across diverse images. For this reason one of the models we picked for our project is Pix2Pix - a generative adversarial network. Another model that has been picked and will be tested later is the residual encoder network and VGG16 pre-trained model from Automatic Image colorization repository [2]. Finally, we have picked a simple 4-layered CNN

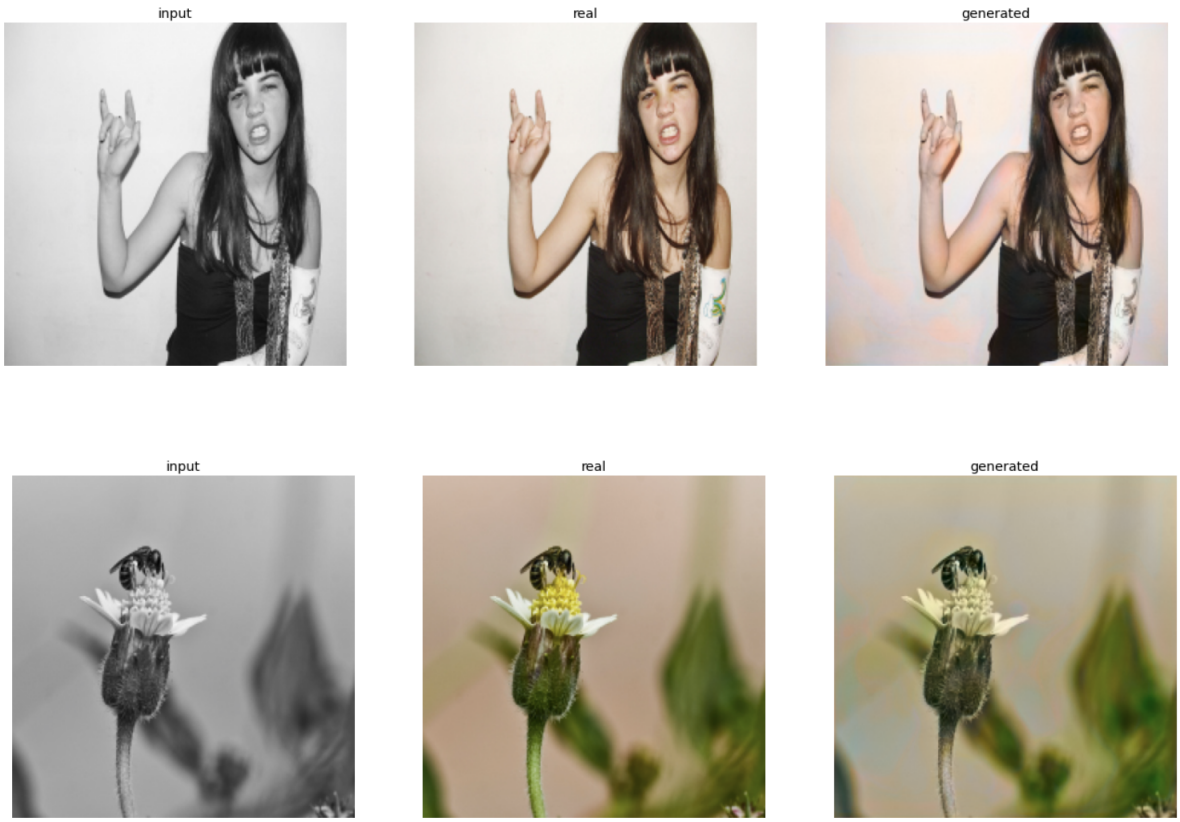
model from Image Colorization CNN on Kaggle to test the performance of more advanced models in this task against it.

3 Pix2Pix

Authors of the "Pix2Pix : Image Colorization with Conditional WGAN" (pix2pix) [1] paper have introduced a novel technique for image-to-image translation using a conditional Generative Adversarial Network (GAN) framework. This method employs a generator network trained to transform images from one domain, such as sketches, to another, such as pictures. The training involves adversarial loss and L1 loss. The generator takes an input image from the source domain and random noise, producing an image in the target domain. Simultaneously, a discriminator network assesses the authenticity of the generated image by comparing it to a target image from the desired domain, using a patch GAN architecture with 70x70 patches. Their study has proven the effectiveness of their approach across multiple tasks, which is why we have selected this model to colorize a portion of our dataset.

Two methods to boost the performance of Pix2Pix model include employing Wasserstein GAN (WGAN) and utilizing a U-Net architecture with residual blocks. WGANs use the Wasserstein distance metric for generator and discriminator training, improving stability of the pictures produced, as well as enhancing their realistic feel. U-Net is integrated and tailored specifically for image segmentation, while residual blocks enable detailed learning from input images - it is especially useful in colorization tasks. This approach enhances stability and the capacity to discern complex image edges, leading to more authentic-looking photos.

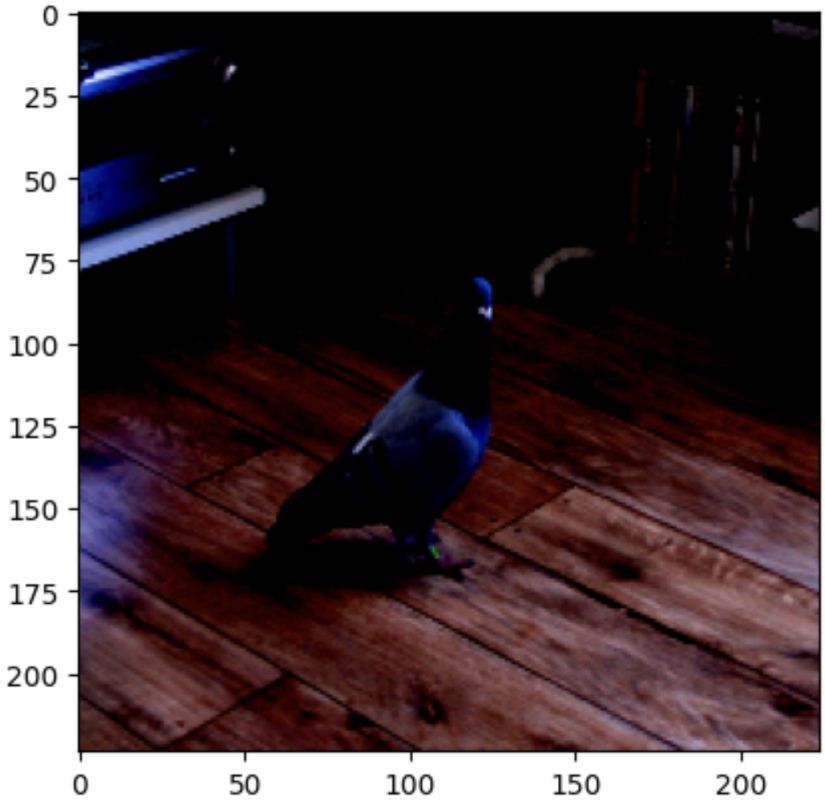
Examples of colorization by Pix2Pix are given below:



4 CNN

The CNN model was trained and tested on a portion of the dataset - 2500 images. Training took several minutes and 5 epochs, and when it finished the loss was still fairly high. If we look at the results of colorization by this model and compare them to Pix2Pix, we can definitely see that the images are of a lower quality, they seem darker and colours are less well-defined.

Examples of colorization by our CNN model are given below. The first image is test image, the second is the result of colorsing with the help of our model: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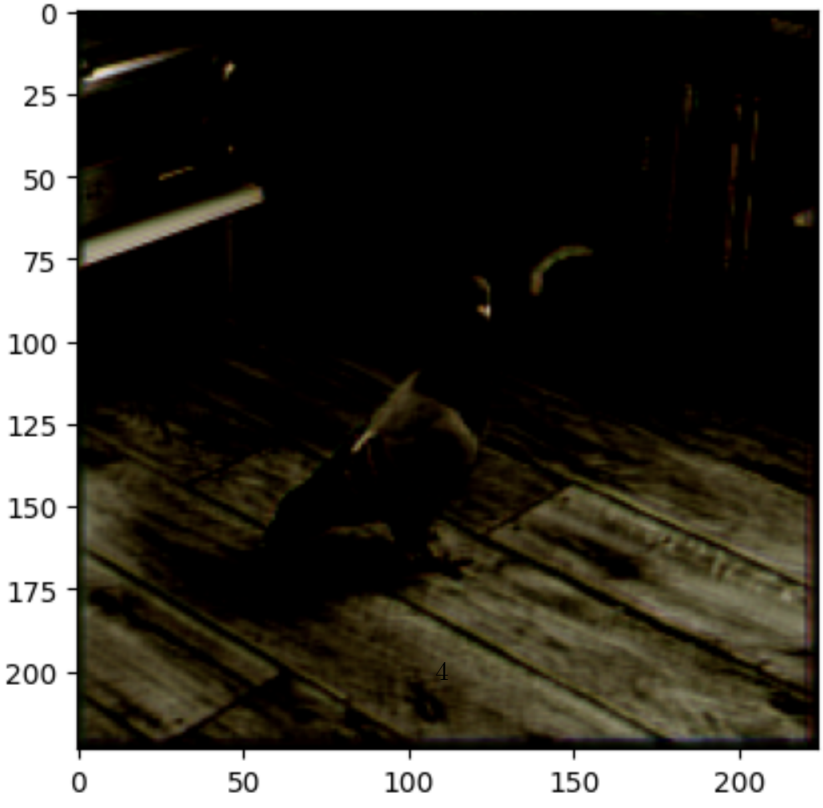
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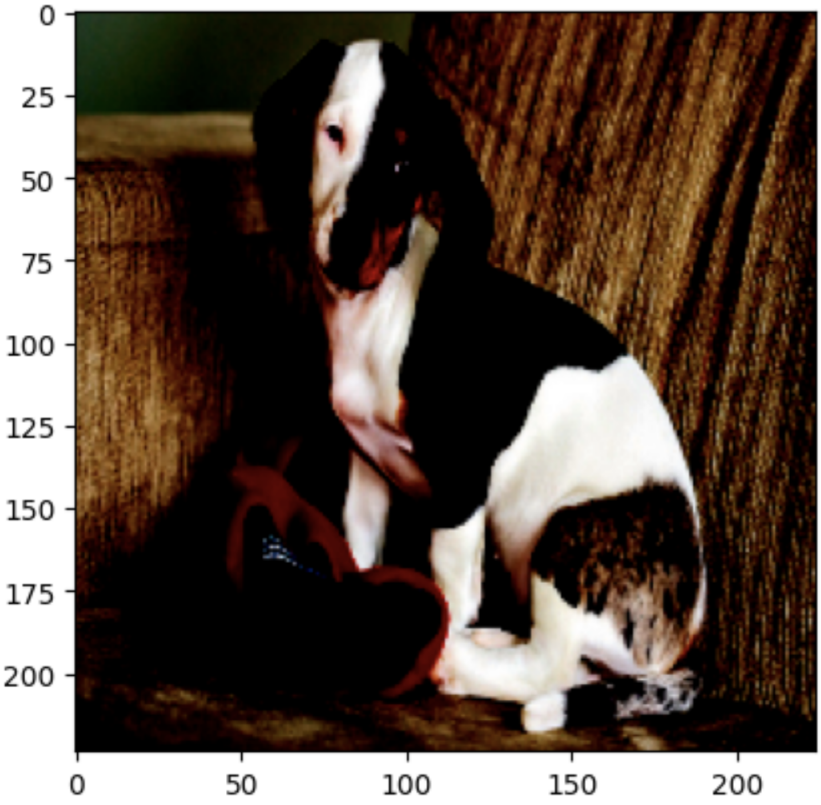
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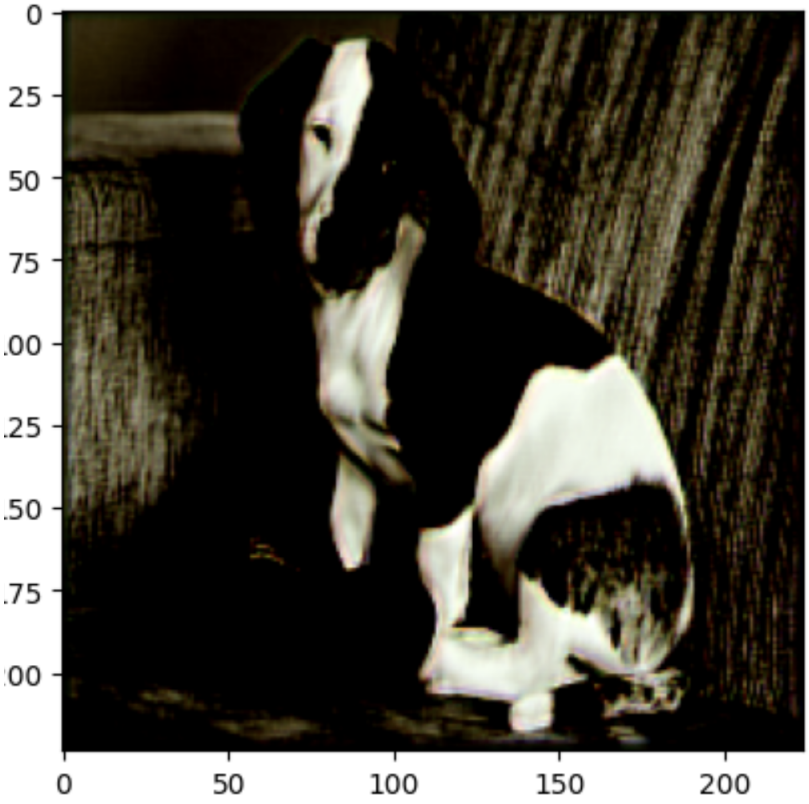

As we can see, the CNN colorization tends to use more brownish tones, rather than bright ones we would expect.

5 Plans for Future Weeks

In the future weeks we intend to implement the aforeimentioned model from Automatic Image Colorization repo, test our models on larger portions of the dataset, as well as modify the CNN to try to get some better results in the task.

References

[1] https://www.kaggle.com/code/salimhammadi07/pix2pix-image-colorization-with-conditional-wgan/notebook

[2] https://github.com/Armour/Automatic-Image-Colorization

[3] https://www.kaggle.com/code/adithyakag/image-colorization-cnn/notebook