G H PATEL COLLEGE OF ENGINEERING & TECHNOLOGY

COLORING LINE-ART USING DEEPLEARNING

POSTER NO.: **GROUP NO.:**

ABSTRACT

Colorization of line-art images is a popular image-to-image translation problem. Manga is the Japanese comic format popular all over the world.

Manga is traditionally produced in line-art or monochrome, and colorization takes a lot of manual effort. This makes the process very time consuming and costly.

We propose a semi-automated method to colorize line-art using deep learning.

We use state of art deep learning algorithms to automize the colorization process, cutting down on the production cost and time consumed to publish the manga.

INTRODUCTION

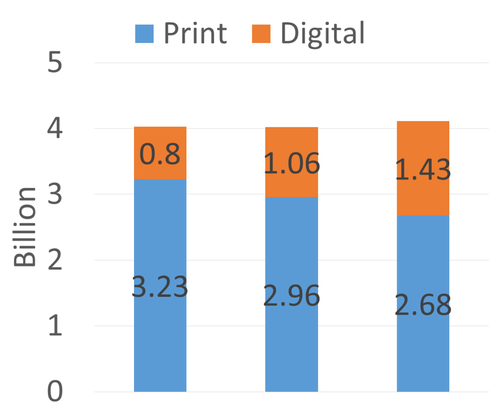
Traditionally, manga (Comic book) is produced in black and white. Even though the colored manga is more attractive and entertaining.

However, to color the manga, it has to undergo many steps, such as, cleaning the artifacts (noise), adding color and shade.

This colorization process increasing the production cost of colorized manga, due to the time and efforts, making it economically inefficient in the competitive market. Hence, more than 99% of manga is still published in black and white.

MARKET SCOPE

Sales in Japan:



- Combined printed and digital sales of manga industry in Japan amounted to USD 4.04 billion.
- Sales of printed manga dropped by 9.3%.
- Sales of digital manga grew by 27.5%.
- Same trend observed in publishing industry globally, 3.4% decrease in print and 27.1% increase in digital.

Sales worldwide:

- France & Germany: USD 212.6 million
- U.S. & Canada: USD 175 million

SYSTEM WORKFLOW

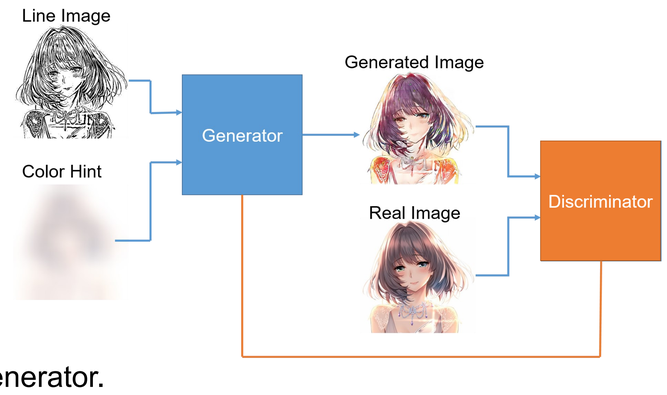
Training:

Line-art and color hint is automatically generated using the real image.

These are passed to generator model which produces the colored output.

The generated image and real image is passed to discriminator model.

The discriminator tries to identify the generated image among the two.



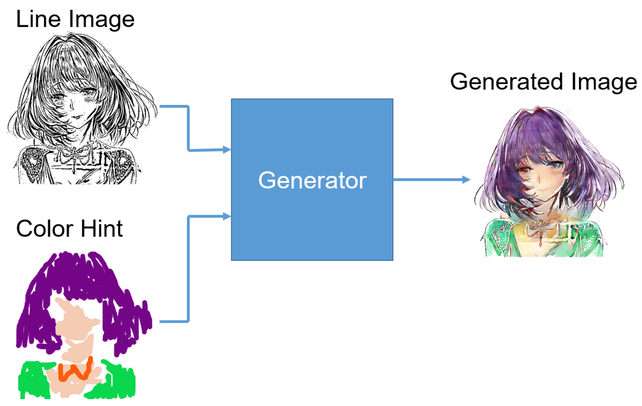
The discriminator returns a loss to the generator.

The generator tries to minimize the loss, in turn generating more realistic image.

Sampling:

User gives color hint along with the line art to the trained generator model.

The generator model uses these as input and generates a colored image.

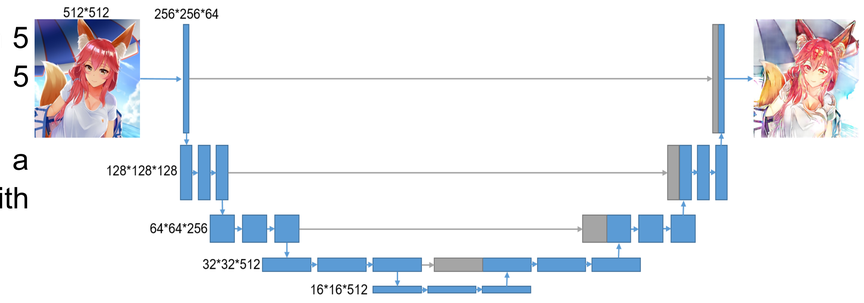


MODEL ARCHITECTURE

Generator:

Generator is a U-Net with 5 encoding layers and 5 decoding layer.

Each encoding layer has a convolutional network with stride of 2.



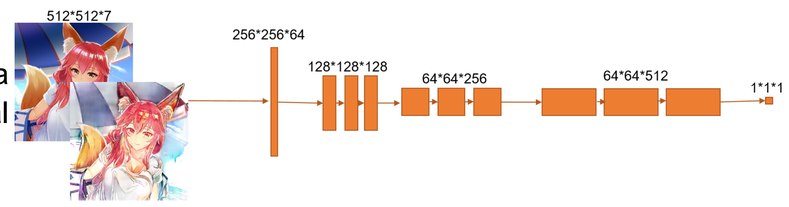
Each convolutional layer is followed by a leaky recited linear unit (LReLU) and Batch Normalization (BN) layer.

Recited linear unit (ReLU) is applied and passed through a convolutional transpose layer with stride of 2 in each decoding layer.

Additionally, residual connections are formed between decoding and its corresponding encoding layers. Finally, colored image (512*512*3) is generated.

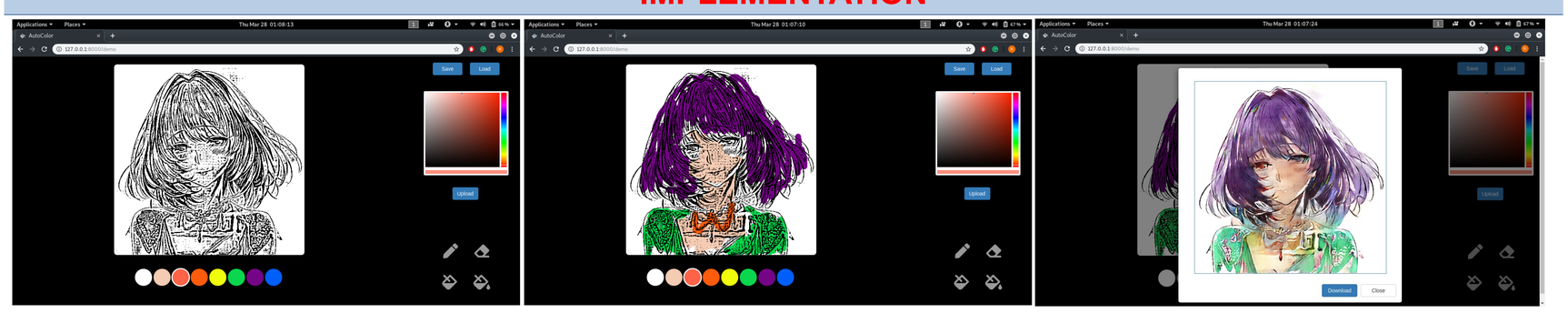
Discriminator:

Discriminator is a convolutional neural network with 5 layers.



Each layer has a convolutional network with stride of 2 followed by BN and LReLU. It finally outputs a single value and a loss back to the generator. Generator uses this loss to adjust its weights and improve results.

IMPLEMENTATION



Step 1: Upload line-art. If line-art is not uploaded, the image is automatically converted to line art.

Step 2: Use the color pallet to give color hint.

Step 3: Use auto-color. The model will automatically generate colored image using the color hint provided.

TECHNOLOGY STACK

- Tensorflow
- OpenCV
- JQuery
- Bottle

CONCLUSION

The implementation shows the possibility of using deep learning to automatically generate colored manga.

The black and white drawing can be used to generate colored image even if user is not a professional manga artist.

Though the results are yet to satisfy industry standards, the project demonstrates the possibility of such application and its scope in todays market.

FUTURE WORK

Our implementation currently works with stand alone images. A more sophisticated image pipeline with multiple models can be used to colorize whole manga panel.

Add shadow to generated images using a shadow model.

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