Project Title: **Deep Comic Screening via Tone-aware Semantic Layer Analysis**

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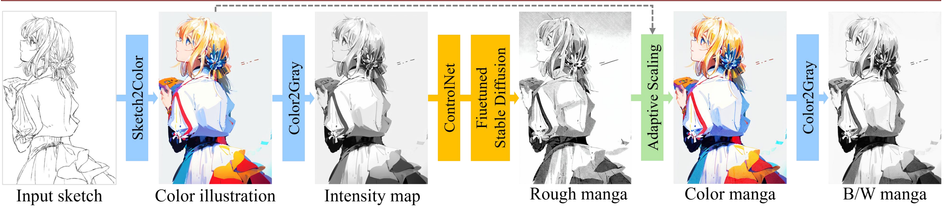
Project Overview

Comic is a world-wide popular art form enjoyed by people of all ages. However, creating a comic book is time-consuming, especially the screening process. There still lacks automatic tools to release the artist from this tedious process. So, an automatic comic screening system is highly desired in the comic industry for saving time and labor. Recently, the deep learning technologies have greatly advanced the development of various image analysis and image synthesis applications. Nevertheless, the existing deep learning methods generally fail to generate screentones with intensive strokes from simple line drawings due to the large information gap between line drawings and screentoned manga. In this project, we propose a novel learning-based solution to automatically generate screentones for an inked line drawing. The key idea is to split the difficult line-to-screentone process into two easier-to-solve problems by taking the tones as an intermediate representation between line drawings and screened comics. So, the line-to-screentone task now consists of two processes, a line-to-tone process and a tone-to-screentone process.

Project Objectives

1. Develop a new deep learning network to predict the tones of an inked line drawing.
2. Design a new algorithm to extract the semantic layers based on a tone map.
3. Develop a new deep learning network to generate a screened comic from a stack of semantic layers.
4. Prepare a large supervised training dataset of line drawings and screened comics for training.
5. Evaluate the system via quantitative experiments, user study, and ablation study.

Methodology



Training Dataset Preparation

We obtain 289k high-quality manga images by scraping from the Internet and restoring the high-resolution versions of Manga109 dataset [1] using a manga restoration method [2]. We extract structural lines from for all collected manga images using the state-of-the-art deep structural line extraction method. We also adopt an edge-aware smoothing method based on relative total variation to acquire the tone image for each manga image. The triplets (line image, tone image, screentoned manga) will be used for training.

Screened manga Tone image Line image

Tone Prediction from Line Drawings

We propose to generate a color illustration from the input sketch with standard diffusion models fine-tuned on color illustrations and then obtain the intensity values derived from the grayscale version of the color illustration to guide the manga generation.

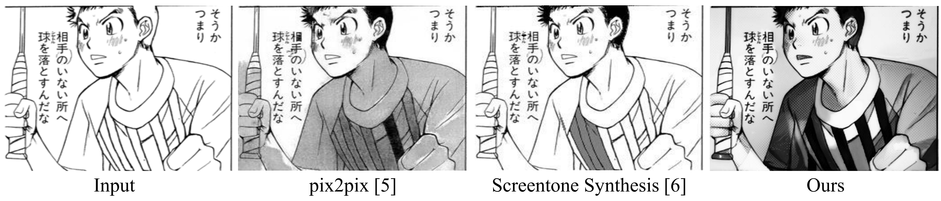
Tone-guided Manga Generation

We finetune both denoise diffusion U-Net and the VAE decoder components in stable diffusion. We find that removing the LPIP loss from the objective function significantly enhances the quality of the generated screentones.

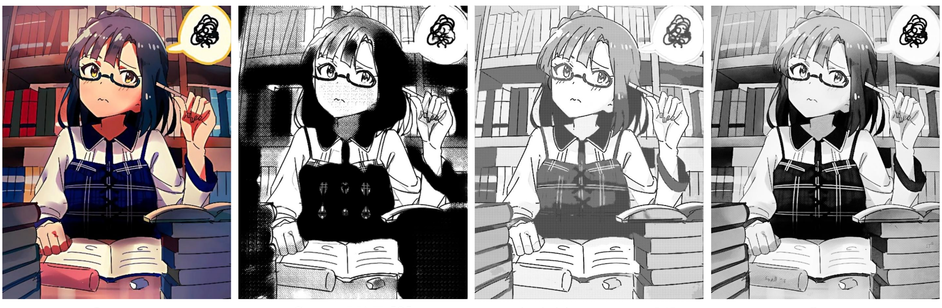
Adaptive Scaling

We propose a color-screentone integration scheme to integrate the generated color illustrations and the generated rough manga with shaded high-frequency screentones to produce the final manga image.

Results



Input pix2pix [5] Screentone Synthesis [6] Ours



Input ScreenVAE [3] Mimicking Manga [4] Ours

User Study

Sketch-to-manga methods	Preferred
Screentone Synthesis [6]	16.2%
Ours	**83.8%**

Illustration-to-manga methods	Rank 1	Rank 2	Rank 3
ScreeenVAE [3]	3.0%	6.4%	90.6%
Mimicking Manga [4]	32.9%	66.5%	0.6%
Ours	**64.1%**	**27.1%**	**8.8%**

References

[1] Fujimoto et al. Manga109 dataset and creation of metadata. MANPU 2016.
[2] Xie et al. Exploiting aliasing for manga restoration. CVPR 2021.
[3] Xie et al. Manga filling style conversion with screentone variational autoencoder. ACM TOG, 39(6), 1-15, 2020.
[4] Zhang et al. Generating manga from illustrations via mimicking manga creation workflow. CVPR 2021.
[5] Isola et al. Image-to-image translation with conditional adversarial networks. CVPR 2017.
[6] Tsubota et al. Synthesis of screentone patterns of manga characters. ISM 2019.

Related Publications

1. Vectorizing Line Drawings of Arbitrary Thickness via Boundary-based Topology Reconstruction. Computer Graphics Forum, 41 (2), 433-445, 2022.
2. Multi-scale flow-based occluding effect and content separation for cartoon animations. IEEE Transactions on Visualization and Computer Graphics, 29 (9), 4001-4014, 2022.
3. Panel-Page-Aware Comic Genre Understanding. IEEE Transactions on Image Processing, 32, 2636-2648, 2023.
4. Sketch2manga: Shaded manga screening from sketch with diffusion models. 2024 IEEE International Conference on Image Processing (ICIP), 2389-2395, 2024.