# Image Colorization Using Generative Adversarial Networks for Manga Art

***Abstract*—In the dynamic realm of manga, the utilization of grayscale artwork stands as a prevailing artistic choice that beckons readers into a world of boundless imagination. However, the prospect of infusing colors into these monochromatic canvases, though promising heightened visual allure, is fraught with a host of intricate challenges, spanning both technological and artistic domains. This scholarly endeavor endeavors to proffer an innovative avenue, introducing a pioneering methodology that harnesses the power of Generative Adversarial Networks (GANs) to mechanize the intricate process of manga colorization. By amalgamating technological prowess with artistic finesse, the proposed approach seeks to not only alleviate the burden on artists engaged in the meticulous task of colorization but also to transcend the boundaries of traditional manga consumption, fostering an enriched and immersive narrative experience for the readership.At the crux of this research lies a deliberate fusion of technological innovation and artistic ingenuity, aimed at addressing the multifaceted complexities inherent in the art of manga colorization. By capitalizing on the capabilities of Generative Adversarial Networks, the proposed framework aspires to automate the painstaking process of color infusion, thereby facilitating artists in their creative pursuits and enabling them to focus on the core aspects of storytelling. This innovative methodology stands poised to revolutionize the manga landscape, ushering in a new era of visual storytelling where the vibrant hues complement the nuanced narratives, ultimately creating an unprecedented synergy between the artist's vision and the reader's engagement. As the boundaries of artistic expression and technological advancement blur, the potential to unlock fresh dimensions of creativity within the manga domain becomes an exciting and compelling prospect, one that promises to reshape the very contours of this timeless art form.**

## I. Introduction

Manga, a popular form of Japanese comics, has captivated readers worldwide with its intricate stories and visually engaging artwork. Manga primarily employs grayscale, leaving hues and tones to the reader's imagination. While this form has its own charm, the addition of color can enhance the emotional and visual impact of the story. However, a prevalent challenge in the manga industry is the labor-intensive process of coloring, time-consumsion which places significant strain on artists and leaves readers to imagine scenes in grayscale. This paper presents a novel solution leveraging deep learning techniques to automate the process of manga colorization without compromising the artistic integrity .

Recognizing the demanding workload and artistic commitment of manga creators, our approach aims to alleviate their burden by providing an automated tool for adding colors to grayscale manga pages. We propose a GAN (CNN)-based model trained on a data set of both colored and grayscale manga images. The model learns to infer color patterns and styles from existing colored pages, enabling it to accurately predict and apply suitable colors to grayscale illustrations.

## II. Related Work

Traditional methods of image colorization have often relied on manual input or resulted in colors that lack vibrancy and context-awareness[^1^]. In the domain of image colorization, two prominent and impactful approaches have emerged, each contributing distinctive advancements to the field. These methodologies encompass the "Colorful Image Colorization" technique and the "Image-to-Image Translation with Conditional Adversarial Networks" framework, both of which have significantly enriched the landscape of image transformation.

The "Colorful Image Colorization" method employs Convolutional Neural Networks (CNNs) to transform grayscale images into vibrant color representations. Through a process of feature extraction, fusion of local and global features, and color regression, the network learns intricate relationships between grayscale and color images. This enables it to predict suitable color distributions for pixels in the grayscale input, resulting in coherent and visually pleasing colorizations. The architecture's success lies in its ability to generalize color patterns from training data, effectively bridging the gap between grayscale and color imagery using deep learning techniques.

## III. Methodology

### A. Dataset:

In the pursuit of developing an effective deep learning solution for manga colorization, the initial phase involved curating a dedicated dataset through web scraping from various freemanga platforms. This process, while promising, was not without its challenges. One significant hurdle was encountered when dealing with mangas that presented both grayscale and colored versions. As an insightful solution, the team identified the manga "Demon Slayer" as a suitable source that met the dataset requirements. This judicious selection laid the foundation for further progress.

Upon acquiring the dataset, the team embarked on the intricate journey of data preprocessing. However, during this phase, memory exceptions emerged as a recurring issue. The large dimensions of the images, measuring 1400 by 979 pixels, presented resource constraints that demanded a strategic approach. The team exercised adaptability and decided to resize the images to a more manageable scale of 120 by 120 pixels. Although this adjustment eased memory constraints, it unveiled another challenge: the model's ability to discern intricate details was hindered, and a significant amount of noise surfaced due to pixelation.

### B. Approach :

In a commendable display of problem-solving, the team approached this dilemma with innovation. The decision to

divide each image into eight smaller sections addressed the noise issue and paved the way for more precise feature extraction. This strategic maneuver was complemented by the introduction of a meticulously processed dataset. The team normalized the images to optimize brightness and contrast, a step that greatly enhanced the quality and coherence of the data. This orchestrated refinement produced substantial improvements in the quality of the colorized outputs.

In summary, the team's journey in the creation and preparation of the dataset for manga colorization is marked by resourceful problem-solving and an adaptive mindset. The challenges posed by memory constraints, pixelation, and noise were met with strategic decisions such as image resizing, partitioning, and meticulous preprocessing. These measures reflect the team's dedication to producing a high-quality dataset that serves as a robust foundation for the subsequent stages of deep learning model development.

*1) GANs Overview:* Generative Adversarial Networks (GANs) constitute a revolutionary paradigm in the realm of deep learning, particularly in the creation of realistic content across diverse domains. Comprising two integral components, GANs engender a dynamic synergy that facilitates the production of refined and authentic outputs. The crux of this framework lies in the interplay between the generator and the discriminator.

The generator, akin to an imaginative artist, orchestrates the task of crafting content that emulates real data from a specific domain. In the context of manga colorization, the generator is tasked with transforming grayscale manga images into vividly colorized renditions, capturing intricate details, color palettes, and artistic nuances. By undergoing an iterative learning process, the generator evolves its proficiency in synthesizing visually appealing colorization that resonate with the original artwork's essence.

In counterbalance, the discriminator, acting as a discerning critic, evaluates the authenticity of the artworks presented to it. Its role involves discriminating between genuine instances from the dataset and the synthetic creations spawned by the generator. Through this evaluative process, the discriminator develops a keen acumen for identifying even subtle divergences between the two categories. The adversarial dynamics between the generator and discriminator induce a continual refinement process, leading to increasingly compelling and realistic colorized manga outputs. This interwoven harmony and competitive tension between these components exemplify the GAN's prowess in generating content that harmonizes creativity and realism in a symbiotic manner.

"Image-to-Image Translation with Conditional Adversarial Networks" is a groundbreaking approach that extends Generative Adversarial Networks (GANs) into conditional settings for diverse image transformations, including colorization. This architecture comprises two main components: a generator and a discriminator. The generator learns to map input grayscale images to corresponding colorized versions, while the discriminator evaluates the realism and alignment of generated images with the target color domain. The conditional aspect enables the generator to capture intricate relationships between grayscale and color images, producing contextually accurate colorizations. This method's adaptability has led to transformative advancements in image