## ****Reimagining Kids' Paintings: An Interactive Coloring System with Diffusion Models****

**Abstract:**

**Colorizing kids' paintings** is a crucial step in illustration and animation workflows. However, this **time-consuming task** is primarily done manually, hindering **artistic expression**. This paper presents a novel **interactive coloring system** that leverages **Diffusion Models** to empower children. Kids provide **interactive color guidance**, which the system seamlessly integrates to produce **stunning and varied colorizations**. Our method outperforms existing state-of-the-art approaches, unlocking new possibilities for **creative exploration**.

**Keywords:** Kids' Paintings, Coloring, Diffusion Models, Interactive, Creative Expression

**Introduction:**

For centuries, artists have reveled in the transformative power of color, breathing life into simple sketches and transforming them into vibrant expressions of imagination. In the realms of illustration, animation, and graphic design, **kids' painting colorization** plays a pivotal role, allowing artists to bring their visions to life with stunning detail and emotional depth. Traditionally, this process has been a labor of love, requiring meticulous manual effort using specialized software like Photoshop or Krita. While these tools offer unparalleled creative control, the time-consuming nature of the process can be a significant barrier, hindering artistic expression and creativity.

Recent years have witnessed a wave of innovation in the field of **deep learning**, with researchers exploring novel techniques to automate the kids' painting colorization process. One promising approach leverages the power of **Generative Adversarial Networks (GANs)**. These networks learn from vast datasets, imbibing an understanding of color relationships and user-provided color hints. This knowledge empowers them to generate stunning and high-quality colorizations, unlocking new possibilities for artistic expression. However, GANs are not without their challenges. Ensuring color consistency with user inputs and achieving harmonious palettes within small image regions can be problematic. Additionally, training GANs can be a complex and time-consuming process due to inherent instabilities.

**Diffusion Probabilistic Models (DPMs)** offer a powerful alternative to GANs. DPMs employ U-Net-like architectures to meticulously "un-blur" a noisy version of the target image, generating high-fidelity images with remarkable detail and realism. These models have achieved state-of-the-art results across various computer vision tasks, including image synthesis, super-resolution, and automatic image colorization.

This paper presents a groundbreaking kids' painting colorization model built upon a conditional diffusion model. This novel approach surpasses existing methods in its ability to empower children to bring their paintings to life with intuitive ease. We explore the application of a unique **coupled implicit and explicit conditioning strategy** on the diffusion model, enabling users to guide the colorization process with simple and intuitive inputs. **A comprehensive evaluation demonstrates the remarkable efficiency and effectiveness of our proposed system,** outperforming state-of-the-art methods in both qualitative and quantitative assessments. Our findings pave the way for a new era of artistic expression, empowering children to unleash their creativity and explore the limitless possibilities of color.