Automated Image Colorization Using Deep Learning

Our project aims to automate image colorization through deep learning. We'll transform black-and-white photos into vivid, realistic color images automatically. This technology has applications in historical photo restoration, film colorization, and enhancing visual content across various industries.

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Problem Definition and Objectives

1 **Problem Identification**

Manual colorization is time-consuming and labor-intensive. It requires skilled artists and significant resources.

2 **Literature Review**

Recent research by Zhang et al. (2016) demonstrates the effectiveness of U-Net and GANs in producing realistic colorized images.

3 **Project Objective**

Develop a deep learning model to automate grayscale image colorization, making it faster and more accessible.

Dataset Selection and Analysis

CIFAR-10

60,000 images across 10 categories. Low-resolution (32x32) images for initial testing and model validation.

Places365

1.8 million high-quality images with 365 scene categories. Varied resolutions for robust model training.

Data Preprocessing

Convert RGB to LAB color space. Normalize input grayscale images for consistent model performance.

Proposed Solution Architecture

1

Input Layer

Accept grayscale images as single-channel input. Preprocess and normalize the data for model consistency.

2

U – Net Encoder-Decoder Structure with Skip Connections

U-Net has an encoder-decoder structure. The encoder captures features by progressively reducing spatial dimensions, while the decoder gradually reconstructs the image in the color space.
Skip Connections connect the encoder and decoder layers directly. These connections allow features at each resolution to be preserved and reused in the decoder, which helps to maintain finer details from the input grayscale image.

3

Output Layer

The final output typically includes two channels (e.g., the A and B channels in the LAB color space), which are then combined with the grayscale L channel.

Performance Metrics and Evaluation

1

Peak Signal-to-Noise Ratio (PSNR)

Measure overall image quality. Higher PSNR values indicate better colorization results.

2

Structural Similarity Index (SSIM)

Quantify similarity between colorized and ground truth images. SSIM closer to 1 indicates higher similarity.

3

Human Evaluation

Conduct subjective assessment of color accuracy and realism. Use a diverse panel of evaluators.