Exploring Color Variations for Vector Graphics

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Figure 1: Recoloring results for an input vector file (top left) and three different references (small insets). The extracted and recolored color palettes show swatches of size proportional to their weight.

ABSTRACT

We propose a novel and intuitive method for exploring recoloring variations of vector graphics. Compared with existing methods, ours is specifically tailored for vector graphics, where color distributions are sparser and are explicitly stored using constructs like solid colors or gradients, independent from other semantical and spatial relationships. Our method tries to infer some of them before formulating color transfer as a transport problem between the weighted color distributions of the reference and the target vector graphics. We enable creative exploration by providing fine-grain control over the resulting transfer, allowing users to modify relative color distributions in real-time.

CCS CONCEPTS

• **Computing methodologies → Image processing**;

KEYWORDS

Re-Coloring, Vector Graphics, Gradients

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1 INTRODUCTION

Color is a fundamental component of any visual design, and designers usually employ inspiration boards to explore different themes and variations. However, manually recoloring complex vector graphics can turn into a tedious process, apart from the expertise required to assess which colors need to be altered and how. This greatly limits designers in exploring the space of possible results.

Thus, our main goal is to provide a simple and intuitive solution for enabling the exploration of color variations for vector graphics. Such color variations can be provided by the user in the shape of reference color palettes, images or other vector graphics; whose colors are to be transferred to the target vector graphics (Figure 1).

Color transfer between images is an extensively researched problem, and several approaches have been proposed over the years: statistical methods [Reinhard et al. 2001], palette-based ones [Nguyen et al. 2017] or more recent neural networks [Li et al. 2018]. However, these methods are mainly devised for natural images, needing extra steps for its optimal application to vector graphics (Figure 2).

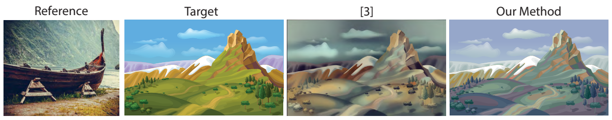

Figure 2: Example of a neural color transfer that, while looking plausible, does not match the explicit geometry and colors of the target vector graphics.

2 OUR APPROACH

Color distributions in vector graphics are way sparser than in photos, making it more challenging to assess whether a color is a variation of another one (typically a shade or a tint) or it has its own entity. Not taking this into account often leads to recolorings that may be numerically right, but do not preserve the original structures properly.

Our approach includes this process during an initial palette extraction step, producing smaller but more perceptually relevant palettes. Then, we use the Earth Mover's Distance to map the reduced reference and target color palettes, before finally recovering the tints and shades to preserve the original color relationships.

2.1 Color Extraction

Target Vector Art. The target vector graphics can contain any number of vector paths arbitrarily stacked on top of each other. We compute a planar arrangement of paths [Asente et al. 2007] to ensure parity with visual appearance. Then, for each face in the arrangement we compute the number of pixels for its associated color, which gives us a weighted palette. To ensure real time performance, we leverage the stencil buffer in the programmable GPU pipeline to accumulate the pixel count of each face in the arrangement. The weights are then normalised for all the colors extracted. Non trivial color constructs such as gradients are discretized into their constituent color components (Figure 3b) in order to compute their weighted distribution. Finally, a reduction pass is performed on the set of colors to reduce tints and shades to a single bin (Figure 3a). Tints and shades are mixtures of a color with white and black respectively, so we put them into the same bin, and take its the weighted mean as the reduced color.

Figure 3: a) Our palette reduction clusters shades and tints into single colors to obtain a reduced palette (bottom) for the original one. b) Color gradient specified by different color stops.

Reference colors. For reference images, we compute a weighted distribution from the source image using a K-Means clustering approach, with k being the same number of bins in the reduced palette from the previous section. However, sometimes the reference can be a manually curated color palette with uniform weights.

Figure 4: a) Target vector graphics. b) Reference image and its extracted palette. c) Recoloring from the reference palette with original weights. d) Variation achieved by editing the weights in the reference palette.

As mentioned previously, it is critical for designers to have control over the recoloring process and the resulting variations. We enable this by allowing them to edit the weights of the reference palette interactively (Figure 4).

2.2 Color Transfer

We use Earth Mover's Distance [Rubner et al. 1998] to find the optimal flow between the weighted color palettes from the source image to the target vector graphics. After recoloring the reduced target palette, we propagate the edits to the full palette to recover the final tints and shades using [Nguyen et al. 2017].

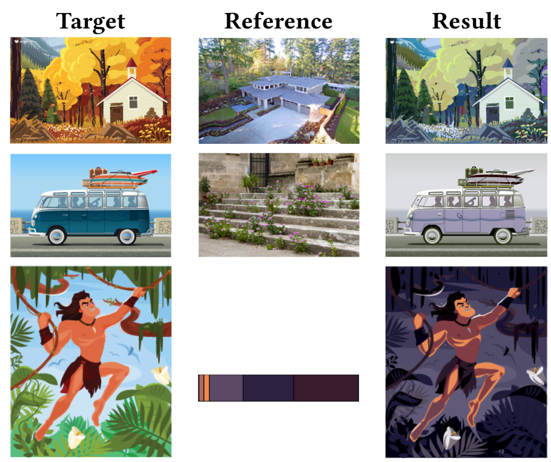

Table 1: From top to bottom: Different results from the proposed method using images or color themes as the reference.

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