Painting Photolization

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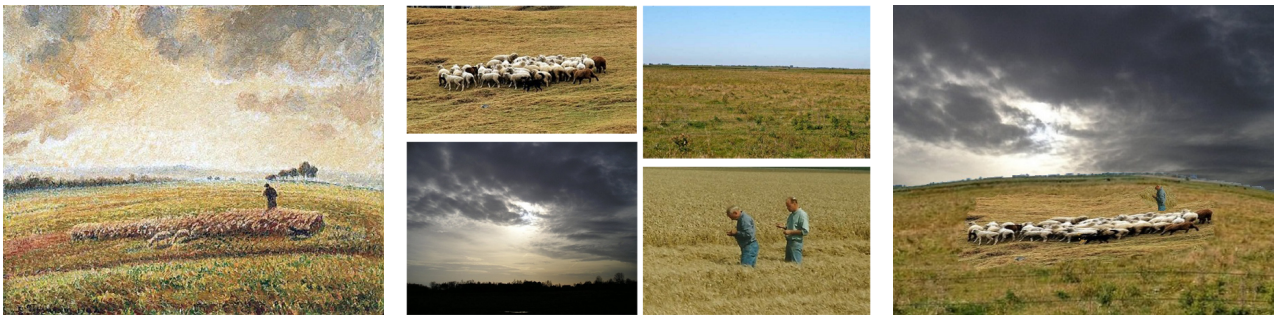

(a) (b) (c)

Figure 1: *We present a method that transfers a painting (a) into a photorealistic appearance (c) by referring four photos (b) which are partly similar to the painting.*

1 Introduction

Before the widespread of modern capture devices, painting served an important role in recording and depicting the real world for human. These painting artworks not only preserve the immediate depiction but also with good aesthetic sense. However, most of the the depictions in the painting are impossible to be reproduced in modern devices. In this extend abstract, we present a method that *photolizes* an input painting artwork. Our method generates an image which resembles the scene of the painting and has a photo-realistic appearance. A user provides a number of photos which are partly similar to the painting, and specifies a number of corresponding edge strokes in the painting and one of the photos indicating corresponding object edges. Our method automatically deforms these corresponding edges and composites these photos together.

2 Painting Photolization

Given an input painting image I_p and N photographs,our goal is to make this painting photo-realistic while maintaining the structure of the painting. A user first specifies a number of edge stroke pairs. For each stroke pair, one stroke locates on the painting image, indicating the object edges in the painting; and the other stroke locates on one of the input photos, indicating the corresponding object edges in the photo. Then two processes are performed according to the user-specified strokes:

Structure-aware warping. For each stroke pair S and S' locate on the painting I_p and one of the photos I_i, we sample a number of corresponding points $\mathbf{P}$ and $\mathbf{P}'$ on both strokes according to their relative positions on the strokes. Then we deform the photo I_i so that the corresponding sample points on the two strokes are aligned. We build a triangle mesh $\mathbf{M}$ on I_i, and let $\mathbf{U}$ denote the set of all the vertices of the mesh. The goal is to seek the deformed vertex set $\tilde{\mathbf{U}}$ satisfying the following constraints:
(1) *Edge alignment*: For each pair of corresponding sample points, we encourage the point on the photo I_i to close to the point on the painting I_p.
(2) *Triangle shape distortion*: This term encourages that the triangles should not be distorted too much. We follow the definition proposed by [**?**] to formulate the term.

Painting-guided compositing. After warping these input photos, this step composites them to get compelling result. First, we generate a number of labelling points around each user-specified stroke if the colors of the corresponding pixels in the painting and photo are similar. In order to generate a seamless composite image, we minimize an energy function which measures the discontinuity according to the compositing with different photos. To achieve this, we prefer that the seams are better to walk along the edges of the photos, and the colors across them are similar. Let $\mathbf{p}_1$ and $\mathbf{p}_2$ be two neighboring pixels in the final composite, the energy function is defined as:

$$\sum_{\mathbf{p}_1,\mathbf{p}_2} \Phi(\mathbf{p}_1, \mathbf{p}_2, L(\mathbf{p}_1), L(\mathbf{p}_2)), \tag{1}$$

respecting the previously stated label constraints, where

$$\begin{aligned}
\Phi(\mathbf{p}_1, \mathbf{p}_2, L(\mathbf{p}_1), L(\mathbf{p}_2)) &= \frac{D(\mathbf{p}_1, \mathbf{p}_2, L(\mathbf{p}_1), L(\mathbf{p}_2))}{G(\mathbf{p}_1, \mathbf{p}_2, L(\mathbf{p}_1), L(\mathbf{p}_2))}, \\
D(\mathbf{p}_1, \mathbf{p}_2, L(\mathbf{p}_1), L(\mathbf{p}_2)) &= \min(\left\|I_{L(\mathbf{p}_1)}(\mathbf{p}_1) - I_{L(\mathbf{p}_2)}(\mathbf{p}_1)\right\|^2, \\
&\qquad \left\|I_{L(\mathbf{p}_1)}(\mathbf{p}_2) - I_{L(\mathbf{p}_2)}(\mathbf{p}_2)\right\|^2) \\
G(\mathbf{p}_1, \mathbf{p}_2, L(\mathbf{p}_1), L(\mathbf{p}_2)) &= \left\|I_{L(\mathbf{p}_1)}(\mathbf{p}_1) - I_{L(\mathbf{p}_1)}(\mathbf{p}_2)\right\|^2 \\
&\quad + \left\|I_{L(\mathbf{p}_2)}(\mathbf{p}_1) - I_{L(\mathbf{p}_2)}(\mathbf{p}_2)\right\|^2 \\
&\quad + 2\left\|I_p(\mathbf{p}_1) - I_p(\mathbf{p}_2)\right\|^2,
\end{aligned} \tag{2}$$

where the function D measures the minimal color differences across the seam if the labels of neighboring pixels are different, and the function G determines the edge strengths in the photos and the painting.

3 Conclusion and Future Work

We present a method for *photolizing* an input painting artwork using multiple photos. Our method deforms and composites these photos based on user-specified edge strokes and compositing refinement strokes.

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