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Review of Suppression of Artifacts for Example-Based Video Color Transfer

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Abstract: *In today's technological era human beings are mostly interested in quality and purity of photographs or images. With the digital camera's invention, capturing images has become extremely easy and widespread, while image data has become more robust and easy to manipulate. Among the many possible image-processing options, users have become increasingly interested in changing an image's tone or mood by altering its colors such as converting a tree's leaves from green to yellow to suggest a change of season. This could be achieved with the help of image manipulation by digital image processing. Even the product image consists of some artifacts such as Grain effect, Loss of details, Color distortion. One of the most common tasks in image processing is to alter an image's color (color transfer), because color has a large impact in forming the quality of image. Often this means removing a dominant and undesirable color cast. Example based video color transfer is a difficult technique which applies a unified framework to remove such artifacts. Proposed framework achieves fine grain suppression, Color fidelity and Details preservation. As an extension this method could be applied to each frame of video for video color transfer.*

Keywords: *Color transfer, artifacts, image manipulation, grain suppression, color fidelity*

1. Introduction

For image editing the most important parameter that can be changed is nothing but its color. This could be preferred as most common tasks in image editing. Generally Image editors generally prefer photo editing tools to overcome deficiencies. This proposed technique of example based image color transfer [1] is a critical method but still the image suffers from some corruptive artifacts such as Grain effect, color distortion effect and loss of details of image which causes the image to show some deficiencies in the mapping process. This framework which performs iterative probabilistic color mapping with self-learning filtering scheme and multiscale detail manipulation scheme is a better solution to suppress such artifacts. This proposed framework achieves good grain suppression [2], color fidelity and detail appearance. Still it shows some limitations such as inharmony of color appearance and second is color bleeding like artifacts difficulty in video color transfer is color consistent problems in continuous frames, due change in content sequences. Generally example-based color transferring involves a 'reference' image and a 'target' image, and copies the color appearance of reference image to a target image to rectify the deficiencies of target image. In previous decade lot of development has been recorded in image color transfer applications such as Example-Based color transfer using Gradient Mesh, classical histogram matching approach, N-dimensional probability distribution transfer, progressive transfer etc. These approaches are effective in color transfer operation but still usually produce unwanted results like color deficiencies, and problems related to image content distribution.

2. Methodology

2.1. Block Diagram

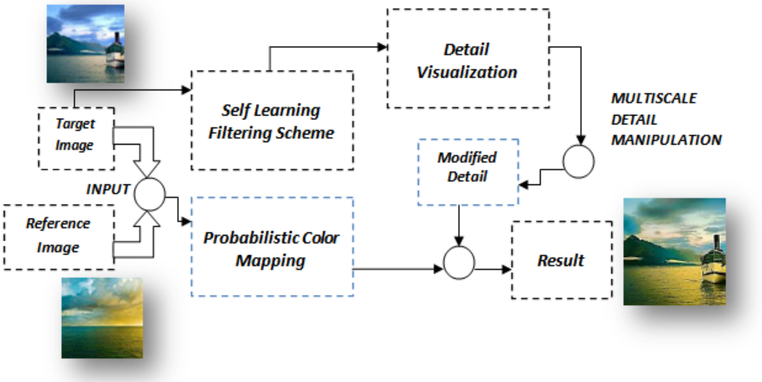

Fig2.1. *Color transfer incorporates; self-learning filtering scheme integrated into the probabilistic color mapping to achieve triple functions, including color fidelity, grain suppression and detail manipulation.*

2.2. Related Work

2.2.1. Color Transfer

Researchers have conducted number of studies on histogram matching; it shows ability to specify the shape of referred histogram that could be applicable to targeted image. Basically histogram matching algorithm is effective for to modify color components of an image separately. Due to this it may cause unsatisfactory look of the image such as grain effect, color distortion etc.

In previous studies Reinhard [3] firstly proposed a strategy to match the means and variances between the target image and the reference image by means of the low correlated color space. This method was efficient enough, but calculating the simple means and variances matching may susceptible to small grain effect and permanent color distortion. To prevent from the grain effect, strategy is to choose a suitable color space and then apply simple operations. When a typical three channel image is represented in any of the most well-known color spaces, there will be correlations between the different channels' values. For example, like in RGB space. To rectify the grain effect Chang [5] proposed a new approach. This color category-based approach categorized each pixel as one of the basic color categories. Then a convex hull was generated in $L\alpha\beta$ color space for each category of the pixel set, and the color transformation was applied with each pair of convex hull of the same category.

2.2.2. Integrated Color Mapping Model

As mentioned earlier we require a perfect color transfer approach that should satisfy three aims at the same time, which includes the color fidelity, grain suppression and image details preservation. The color transfer problem lies in seeking the reasonable mapping relationship between reference image and target image. Our proposed unique algorithm is motivated by probability-based mapping and edge-preserving decomposition. Overview of our approach follows as

- **Color mapping stage** In this stage a probabilistic color mapping is applied along with a self-learning filtering is embedded to achieve the basic color corresponding and to avoid the artifacts and separate the transferred target into levels.
- **Detail manipulation stage** This stage involves a multiscale detail manipulation scheme applied to preserve loss of details in an image.
- **Integrated optimization stage** The color transferred result and the modified details of image are combined into an optimization solution with the normalization Kullback-Leibler measurement to give the final output.

2.2.3. Edge-Preserving Smoothing

The grain effect in an image output is considered as a special type of noise [3], and it could be removed by linear smoothing. Although the linear smoothing removes the grain effect, the over-blurring may destroy the original image details and lower the sharpness of edges. Edge-preserving smoothing (EPS) filters [3] are proposed to overcome this problem. They could be used to prevent the edge blurring effect by applying linear filtering according to their intensity or gradient- aware properties. Joint bilateral filter (JBF) [3] is the first guided edge-preserving smoothing approach. The JBF improvises the pixel intensity of the reference which is correlated to the target to improve the filtering effect.

2.2.4. Self-learning Filtering Scheme

However, there still exists a defect that, it is likely to produce the grain effects occasionally. To take care of this critical problem, we incorporated a self-learning filtering scheme and applied it into the aforementioned iterative probabilistic color mapping

2.2.5. Multiscale Detail Manipulation Scheme

Our next aim is the details in the original target should be preserved after the color transfer. Basically, details usually correlate to the style appearance, and this characteristic is related to the color-related applications. Since we have incorporated the self-learning filtering scheme into the color mapping, we can exploit its property of edge-preserving decomposition [6].

3. RESULTS

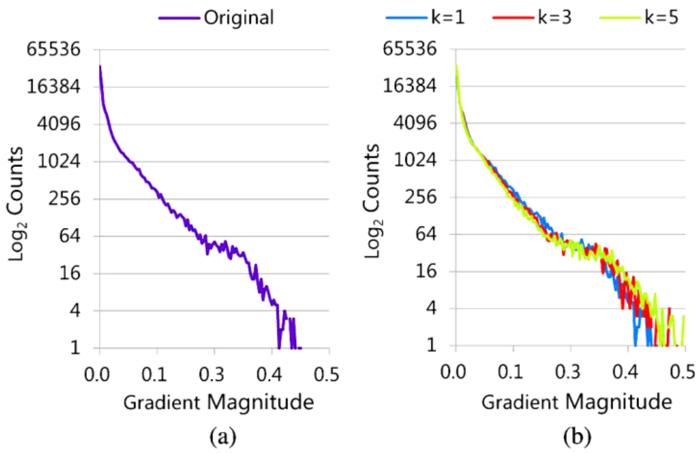

Fig3.1. *Statistical gradient distribution. (a) Original target. (b) Proposed work results. It is observed that our results were very close to the original target in the gradient distributions.*

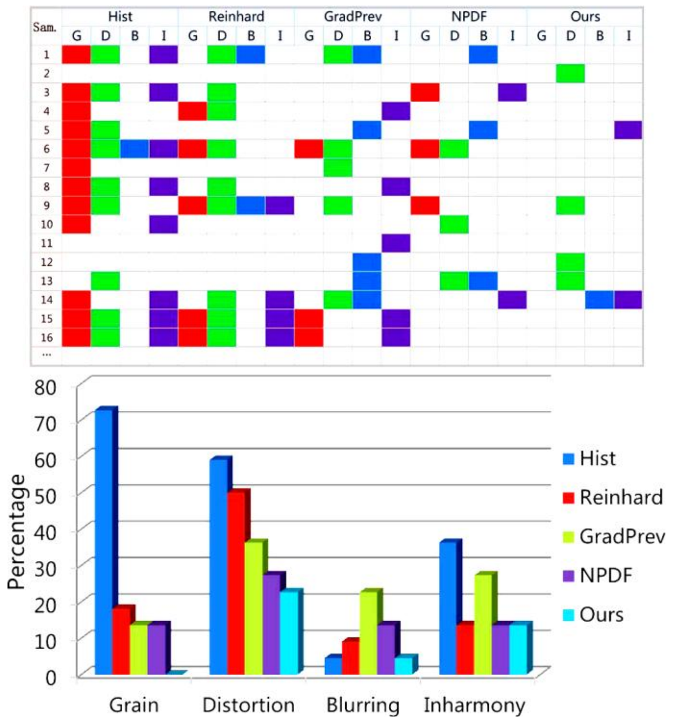

Fig3.2. *User investigation. The top figure is a record in our experiments. Grain effect (G), color distortion (D), blurring (B) and inharmony (I) are evaluated by users' visual perception. The bottom figure is a statistical analysis for our investigation. The lower percentage means the better visual performance.*

4. Discussion and Conclusion

To transfer the colors of the given reference image to the target image effectively is a challenging job and is effective in color transfer. Due to the complex color distribution, it is difficult to avoid the corruptive artifacts such as color distortion, grain effect or loss of details in the result of color transfer. Such problems could be conquered by applying post-processing methods to rectify them, but, the post-processing operations are not that effective and would cause other artifacts sometimes. This proposed framework can achieve the color fidelity, prevent the grain effect and preserve the details of image. It gives good runtime response. Our framework presents the convenience in dealing with the complicated colors.

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