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An Automatic Approach Towards Coloring Videos Using Monochrome Texture Descriptor & Parallel Processing: A Review

Gauri R. Joshi[1], Mayur S. Burange[2]

[1, 2]Amravati University, P.R. Pote college of Engineering and Technology, Kathora Naka, Amravati, Maharashtra, India

Abstract: ***We present a new scheme for video colorization using optimization in rotation-aware Gabor feature space. Most current methods of video colorization incur temporal artifacts and prohibitive processing costs, while this approach is designed in a spatiotemporal manner to preserve temporal coherence. The parallel implementation on graphics hardware is also facilitated to achieve realtime performance of color optimization. By adaptively clustering video frames and extending Gabor filtering to optical flow computation, we can achieve real-time color propagation within and between frames. Temporal coherence is further refined through user scribbles in video frames. The experimental results demonstrate that our proposed approach is efficient in producing high-quality colorized videos.***

Keywords: Gabor feature space, parallel optimization, user strokes, video colorization

1. Introduction

Colorization is a computer-assisted process of adding color to a monochrome image or movie. The process typically involves segmenting images into regions and tracking these regions across image sequences. Neither of these tasks can be performed reliably in practice; consequently, colorization requires considerable user intervention and remains a tedious, time-consuming, and expensive task [1]. Colorization is a term introduced by Wilson Markle in 1970 to describe the computer-assisted process he invented for adding color to black and white movies. The goal of all colorization processes is to replace scalar value or luminance, saved in each pixel of black and white image with a vector in three dimensional color space (for example a red, green, blue vector in the RGB color space) [7]. Even if lots of effort has been taken to color propagation within a single image, very little research has focused on videos. This is probably because of the increasing complexity of video colorization, which must balance the constraints between spatio-temporal [9] color coherence and processing costs [1], [2]. Optimization over an entire video will be very slow because video data appear in a 3-D space (2-D frames arranged in linear time). The existing video colorization methods [1], [12] make the color propagation from keyframes to subsequent frames easier by relying on optical flow. But optical flow [8], [10] creates some artifacts in the cetain frames which creates error in color propogation. Such errors can br eliminated by the user inputs [1].

In this paper, a more efficient video colorization optimization method using parallel color propagation is proposed. since color propagation assigns similar pixels with similar colors, video colorization developes a smooth function in a higher-dimensional pixel feature space rather than in a video space. spatio-temporal pixel subgraphs in the feature space is the function to approximated this with. In this method iteratively propagates the colors among the pixels in the graphs, which results in greater refinement, unlike previous methods that solve color optimization in a very large linear system. When static image colorization methods are applied to moving images special attention should be paid to the temporal coherence. Colors may shift improperly or show no consistency between frames, causes visual fatigue for viewers. To solve these problems, user scribbles through a new feature space formed by rotation-aware Gabor filtering. In this new feature space, color similarity is established and Gabor flow is then used to compute the temporal connectivity of the pixel graphs. By optimizing colors on a per-pixel basis, color mismatch between different region and same texture is also minimised [14]. In comparison with previous work, two notable contributions are made in this paper:

1) A method for maintaining temporal color coherence using optimized Gabor flow;
2) For fully solving the optimization of video colorization a parallelized strategy.

Figure 1: Colorization results of the *River-Bank* video using parallel optimization in the Gabor feature space.

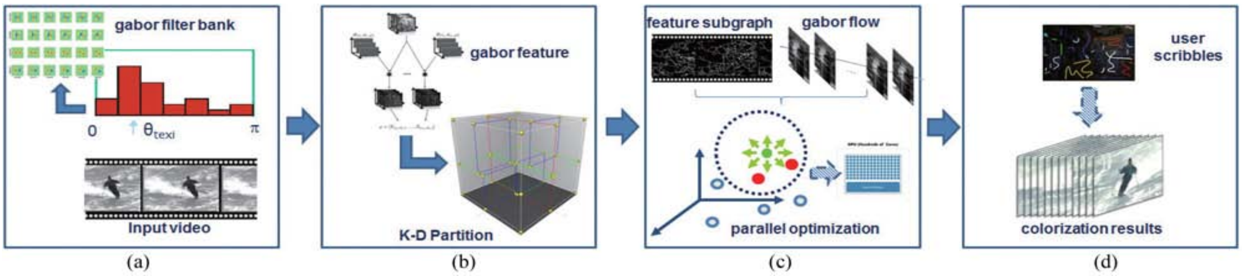

Figure 2: Pipeline for our video colorization approach. (a) Given a set of source video frames, we set up rotation-aware Gabor filtering for texture discrimination and resolution detection. (b) Feature space generated by Gabor filtering is then adaptively partitioned into K-D tree subgraphs. (c) Gabor flow is constructed to represent temporal correspondence among different subgraphs. (d) We then propagate the colors directly to the pixels of these subgraphs in parallel.

2. Previous Work

The method is based on a simple premise: neighboring pixels in space-time that have similar intensities should have similar colors. In this approach an artist only needs to annotate the image with a few color scribbles, and the indicated colors are automatically propagated in both space and time to produce a fully colorized image or sequence. In this paper method describe a new interactive colorization technique that requires neither precise manual segmentation, nor accurate tracking. The technique is based on a unified framework applicable to both still images and image sequences. The user indicates how each region should be colored by scribbling the desired color in the interior of the region, instead of tracing out its precise boundary. Using these user supplied constraints our technique automatically propagates colors to the remaining pixels in the image sequence. This colorization process is demonstrated in Figure 3. [1]

In the later method, they present an interactive system for users to easily colorize the natural images of complex scenes. In this system, colorization procedure is explicitly separated into two stages: Color labeling and Color mapping. Pixels that should roughly share similar colors are grouped into coherent regions in the color labeling stage, and the color mapping stage is then introduced to further fine-tune the colors in each coherent region. Within each coherent region obtained from the color labeling stage, the color mapping is applied to generate vivid colorization effect by assigning colors to a few pixels in the region. A set of intuitive interface tools is designed for labeling, coloring and modifying the result. [2]

After that Given a grayscale image to colorize, we first determine for each pixel which example segment it should learn its color from. This is done automatically using a robust supervised classification scheme that analyzes the low-level feature space defined by small eighborhoods of pixels in the example image. Next, each pixel is assigned a color from the appropriate region using a neighborhood matching metric, combined with spatial filtering for improved spatial coherence. Each color assignment is associated with a confidence value, and pixels with a sufficiently high confidence level are provided as "micro-scribbles" to the optimization-based colorization algorithm. We present a new automatic example-based colorization technique, meaning that once a reference image with some marked regions has been provided, any number of sufficiently similar grayscale images may be colorized without requiring any further input from the user. [4].

After the example based colorization a new colorization method, based on GrowCut image segmentation algorithm [13]. In this approach a user just marks some pixels with desired colors, and the algorithm propagates these colors to the remainder of the image. After the initial colorization is computed, the user can interactively adjust and refine the colors of the image. The main advantage of the proposed method over the existing ones is that modification and refining of the image colors doesn't lead to full recomputation of the image colorization and is performed very fast [5].

After that an effective approach for colorizing images using optimization on rotation-invariant Gabor filters. Current colorizations based on image segmentation make it difficult to add/update color reliably, and require considerable user intervention. In this approach, they suggest that the pixels showing similar texture features should have similar colors. Technique formalize this objective using rotation-invariant Gabor filter banks, and apply optimization in feature space [6].

After that a novel method for machine-based black and white films colorization is presented. The kernel of the proposed scheme is a trained artificial neural network which maps the frame pixels from a grayscale space into a color space. We employ the texture coding method to capture the line/texture characteristics of each pixel as its most significant gray scale space feature, and using that feature, expect a highly accurate B/W to color mapping from the ANN. The ANN would be trained by the B/W-color pairs of an original reference frame [7].

A general technique for "colorizing" greyscale images by transferring color between a source, color image and a destination, greyscale image. Although the general problem of adding chromatic values to a greyscale image has no exact, objective solution, the current approach attempts to provide a method to help minimize the amount of human labor required for this task. Rather than choosing RGB colors from a palette to color individual components, just transfer the entire color "mood" of the source to the target image by matching luminance and texture information between the images. Choose to transfer only chromatic information and retain the original luminance values of the target image. Further, the procedure is enhanced by allowing the user to match areas of the two images with rectangular swatches [3].

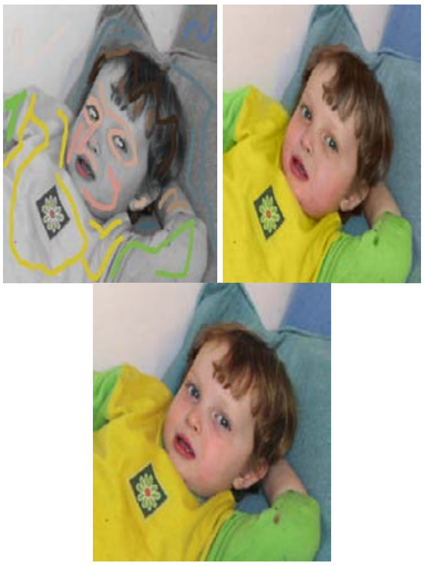

Figure 3: Given a grayscale image marked with some color scribbles by the user (left), our algorithm produces a colorized image (middle).For reference, the original color image is shown on the right.

3. Proposed Work

The essential task of video colorization is to assign colors to pixels based on the intuition that pixels with high similarity should have similar colors. The key to our approach is to establish pixel similarity in the video's grayscale channel. To accomplish this, a novel pipeline is introduced that measures pixel similarity across video frames and allows parallel color optimization among pixels. The proposed work can be divided in to the following modules.

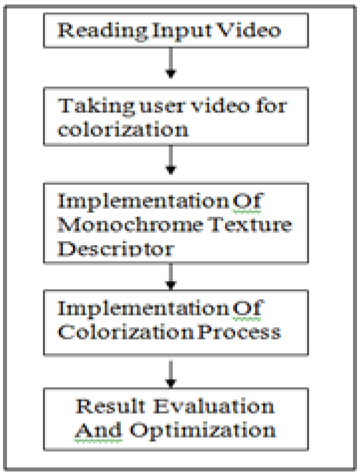

Figure: Flow diagram of proposed work

3.1 Module 1: Reading Input Video

In this module the input videos will be read and stored in local variables. This is the first and very basic step in the project. The video is nothing but the sequence of images and images are read in the form of grayscale and these images are stored in 8-bit in local variables.

3.2 Module 2: Taking User Input For colorization

In this module user input will be taken, as to which portion of the video has been colorized with which particular color. In this module, the user comes in action, whatever the color the user want that can be given to particular image frame.

3.3 Module 2: Implementation of monochrome Texture Descriptor

In this module the various monochrome texture descriptor will be evaluated so that automated coloring can be done with the input video. This module is used to color the video optimally. By using this module the time complexity of the project is minimized.

3.4 Module 4: Implementation of Colorization Process

In this module rotation aware Gabor feature, feature space clustering, temporal coherence with Gabor flow and efficient color propagation will be implemented to colorize the input video.

3.5 Module 5.Result Evaluation and Optimization

In this module the accuracy of the implemented project will be evaluated and in case of un-optimized colorization the algorithm will be optimized to perform perfect colorization.

4. Conclusion

The main challenge of colorization is to assign similar colors to texture-similar regions. In this paper, a novel approach to video colorization is proposed, which uses the Gabor feature space to achieve good matching results. This method is highly parallelizable. This is applicable to various video data, especially the videos of natural scenes. Especially we are using more sophisticated monochrome texture descriptors in video sequences to improve the color propagation capabilities of the approach. In future there is lot of scope to improve colorization of video.

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Author Profile

Gauri R. Joshi received B.E from D.E.S.C.O.E.T in 2013 from Amravti and pursuing M.E from P.R.Pote College of Engineering & Technology, Amravati, Maharashtra, India

Mayur S. Burange received B.E from H.V.P.M College of Engg & Technology in 2009 and M.E from the Prof. Ram Meghe college of Engg and management in 2012. Currently doing lectureship in P.R.Pote College of Engineering and Technology,