Interactive Graph Cut Colorization

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Abstract: Traditional ways to handle monochrome image colorization which always requires considerable user interaction and a lot of time are Segmentation colorization and Colorization using optimization. The former works fast, but always lose the details because of the large segmentation; while the latter looks much more continuous but takes longer time. In this paper we proposed a novel approach: Segmentation colorization based on Graph cut, which is a very fast segmentation technique of global energy optimization. So we can maintain smoothness almost everywhere except for the sharp discontinuity at the boundaries in the image. Firstly, with the few seeds of pixels set manually by the user, we set up a global energy according to the gray value distribution around each pixel, with the conception that similar gray intensity prefers same color. Secondly, we use 'Graph Cut' to get the best segmentation, fast and efficiently. As user specifies more colors, the energy minimization will be solved iteratively and much faster. So with few manual specifications, user can colorize a gray image in a very short time and get naturally looking results.

Key words: Colorization; graph cut; global energy minimization; interactive

Background

Image colorization is to turn monochrome image to color image so to greatly increase the appealing and content of the source black and white pictures. Interactions from users are always needed to define the transformation from gray value to RGB value. How to make the interaction more convenient and more quickly is the key problem to solve in current techniques. In this paper, we first decompose colorization to two parts: segmentation and colorize; then graph cut technique is applied to solve the segmentation accurately and effectively, although with simple colorize method, nice results are obtained

1 Results







Figure 1 Results





Figure 2 Results



Figure3 monochrome image, interaction graph, colorization results

Reference

- [1] Anat Levin, Dani Lischinski and Yair Weiss, Colorization using Optimization, Proceedings of ACM SIGGRAPH, 2004
- [2] Tongbo Chen, Yan Wang, Volker Schillings and Christoph Meinel, Grayscale Image Matting and Colorization, Proceedings of Asian Conference on Computer Vision, pp. 1164-1169, 2004
- [3] Yuri Boykov, Marie Jolly, Interactive graph cuts for optimal boundary and region segmentation of objects in N-D images. In Proc. IEEE Int. Conf. on Computer Vision, CD–ROM, 2001
- [4] Yuri Boykov, Olga Veksler and Ramin Zabih, Fast Approximate Energy Minimization via Graph Cuts, IEEE Trans. Pattern Anal. Mach. Intell. 23(11): 1222-1239, 2001
- [5] Tomihisa Welsh, Michael Ashikhmin, Klaus Mueller, Transferring color to greyscale images. SIGGRAPH 2002: 277-280
- [6] William K. Pratt. 1991. Digital Image Processing, John Wiley & Sons, 311.
- [7] Bernice E. Rogowitz and Alan D. Kalvin, *The "Which Blair Project": A Quick Visual Method for Evaluating Perceptual Color Maps*, Proceedings of IEEE Visualization 2001.
- [8] Vivek Kwatra, Arno Schodl, Irfan Essa, Greg Turk, Aaron Bobick, Graphcut textures: Image and video synthesis using graph cuts. ACM Transactions on Graphics, SIGGRAPH 2003, 22, 3, 277–286.
- [9] Neuraltek, 2003. BlackMagic photo colorization software 2.8, http://www.timebrush.com/blackmagic.
- [10] Lester R. Ford and D. R. Fulkerson. Flows in Networks. Princeton University Press, 1962
- [11] Andrew V. Goldberg and Robert E. Tarjan. A new approach to the maximum flow problem. Journal of the Association for Computing Machinery, 35(4):921–940, October 1988.
- [12] Yuri Boykov and Vladimir Kolmogorov. An experimental comparison of min-cut/max-flow algorithms for energy minimization in vision. In *Thirrd International Workshop on Energy Minimization Methods in Computer Vision and Pattern Recognition*. Springer-Verlag, September 2001