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Study on Image Matting using Alpha Matte

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Abstract: *The method of accurately approximating the foreground object in images and videos is known as Image Matting. It is an awfully technique in applications like image editing and video editing, where-in particularly film production for creating visual effects. In this paper the foreground object in images through Digital Matting Algorithms by employing a Bayesian Approach is estimated. A decent alpha matte with minimum labelling efforts using most informative sequence of regions for user input is provided in this paper. In this process a trimap is created first after that background and foreground regions are compared.*

Keywords: *Image Processing, Image Segmentation, Digital Matting Algorithms and Bayesian Approach.*

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I. Introduction

Matting is used to re-produce the foreground image to a brand-new background. Compositing and Matting can be used for film production development and video production development [1]. Nevertheless, “pulling a matte” remains a bit of a necromancy, extremely notorious in tough cases like thin snippet of hair or fur. More number of clarifications are to be considered between color and opacity to process or to impose foreground image on the background image.

In each pixel color and ambiguity are to be considered and calculated whenever the foreground image is removed from background image in digital image matting. In this alpha matte technique, each pixel’s ambiguity value is considered as alpha. Using this alpha matte opacity image is remarked [2].

For creating complex digital images, Porter and Duff showed the use of synthetic images with alpha.In 1984, Porter and Duff introduced the digital analog of the matte--the alpha channel.

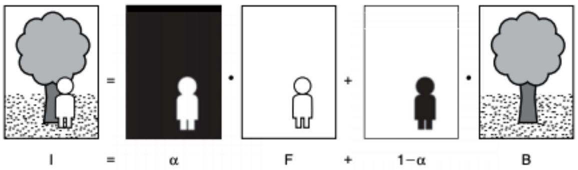


Fig-1: An illustration of the matting equation

$I = \alpha F + (1 - \alpha) B$

when α is 1, the image pixel color comes from the foreground, and when α is 0, the image pixel color comes from the background [3].

where I, B, and F are the pixels composite, background, and foreground colorsrespectively, and α is that pixel’s opacity component which can be applied to linearly blend between background and foreground.

Through this paper, the most successful previous approaches to digital mating are being surveyed and demonstrated cases in which each of them fails. Based on the Bayesian framework, new principle to approach matting has been introduced. Bayesian method appears to give improved results in each case, while no other algorithm gives the perfect results in all such cases.

II. BAYESIAN FRAMEWORK APPROACH

Bayesian matting is an interactive input matting where some of pixel's foreground(F), background(B), and alpha values of picture C are known [3-4].

The goal is to make the F, B, and alpha values solved by the known C value meet the maximum probability:

$$arg \max_{F,B,\alpha} P(F,B,\alpha|C) = arg \max_{F,B,\alpha} \frac{P(C|F,B,\alpha)P(F)P(B)P(\alpha)}{P(C)} \qquad (2)$$

The optimal parameters F, B and alpha must be solved to maximize probability of the above formula.

The grab cut algorithm uses the Gaussian mixture model to establish a model for the known background and foreground. In order to ensure the continuity of the space, Bayesian method uses the N neighborhood points of each of unknown pixel to cluster. For the sake of simplicity, it was assumed that there is only one type of foreground color and only one type of background color.

For example, the statistics derived from the square region overlap with the labeled foreground and background can be used to evaluate the segment with in the unknown region.
The starting term in Equation above could be a data term that reflects how likely the image color is given values for
F, B, and α. Since for a good solution the matting equation should hold, the primary term will be modeled as:

$$logP(I|F,B,\alpha) = -\frac{1}{\sigma_d^2}||I-(\alpha F+(1-\alpha)B)||_2^2 \qquad (3)$$

where σ and d may be a tunable parameter that reflects the expected deviation from the matting assumption.

The other terms are prior probabilities on the foreground, background, and alpha distributions. The chance that a color value be the property of the foreground through the known pixels input by the user was calculated.

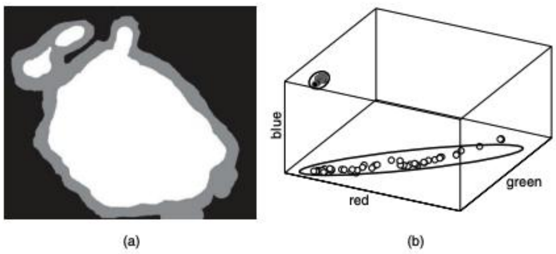


Fig-2: (a) A trimap corresponding to the upper left image is shown and (b) a scatterplot of the colors within the labeled foreground and background regions. Foreground represent white dots and background represent Black dots. Since the image was taken in a blue screen, the background colors are firmly clustered in one corner of RGB space. Both the foreground and background color distributions are well approximated by ellipses.

Gaussian distributions to each collection of intensities, for a color B by estimating a pdf for the background given by:

$$f_B(B) = \frac{1}{(2\pi)^{3/2}|\Sigma_B|^{1/2}} exp\left(-\frac{1}{2}(B-\mu_B)^T \Sigma_B^{-1}(B-\mu_B)\right) \qquad (4)$$

With this support the differential was solved through the probability maximization equation and make it capable 0, the subsequent simultaneous equations were obtained as:

$$\begin{bmatrix} \Sigma_F^{-1} + \alpha^2/\sigma_d^2 I_{3x3} & \alpha(1-\alpha)/\sigma_d^2 I_{3x3} \\ \alpha(1-\alpha)/\sigma_d^2 I_{3x3} & \Sigma_B^{-1} + (1-\alpha)^2/\sigma_d^2 I_{3x3} \end{bmatrix} \begin{bmatrix} F \\ B \end{bmatrix} = \begin{bmatrix} \Sigma_F^{-1} + \alpha^2/\sigma_d^2 I_{3x3} \\ \Sigma_B^{-1} + (1-\alpha)^2/\sigma_d^2 I_{3x3} \end{bmatrix} \qquad (5)$$

$$\alpha = \frac{(I-B).(F-B)}{(F-B).(F-B)} \quad (6)$$

To solve the Bayesian matting problem, α at each pixel is randomly chosen. Then, the value is altered between solving equation to urge F and B, then fix the worth of F and B, solve equation to induce the value of alpha, then on until the estimates for F, B, and alpha converge [5-9].

III. TRIMAP ADAPTATION

At first, the background of the trimap image must be varied. The most focus of the matting problem may be a very close detachment of the foreground image from the background image. Thus, matting doesn't actually care much about what kind of an object is depicted on the image. This problem is decoupled from the particular semantic segmentation and since lots of matting algorithms require segmentation mask – or trimap image– as an input. Basically, the trimap could be a rough segmentation of a picture into three region types: certain foreground, unknown, certain background.

(a) **(b)**

Fig-3: a) **Input Image** ***b)*** **Trimap Image**

Let α_{gt} be the bottom truth alpha mattes. The corresponding optimal trimapT_{opt} of a picture can be written as:

$$T_{opt}(a,b) = \begin{cases} \text{background} & \text{if } \alpha_{gt}(a,b) = 0, \\ \text{unknown} & \text{if } 0 < \alpha_{gt}(a,b) < 1, \\ \text{foreground} & \text{if } \alpha_{gt}(a,b) = 1 \end{cases} \quad (7)$$

where (a,b) defines the location for each pixel on the image.

The goal of the trimap method is to predict the trimap optional for a given input picture which is conditioned with a trimap. Basically, separation of the semi-transparent regions from the background and the foreground is known as trimap adaption [6]. From the above T_{opt} equations defined; the image matting can be done precisely in two manners:

(a) knowing if the value of alpha is either 1 or 0 or neither

(b) Computing alpha, if the region is to be taken into account semitransparent.

IV. RESULTS

In this paper, a normal image has been considered as an input image. A trimap image of the given input image has been extracted. After extracting the trimap image, foreground and background of the image were separated and an alpha image was produced using the equations (1-7). After separating the images, the same process was reversed to create and a new background will be given to the separated image which finally produces output image [10].

4(a) 5(a)


4(b) 5(b)


4(c) 5(c)


4(d) 5(d)


4(e) 5(e)


4(f) 5(f)

Fig -4 Input Image **Fig -5 Trimap Image**

(a) (b) (c)

(a) (b) (c)

(a) (b) (c)

(a) (b) (c)

(a) (b) (c)

(a) (b) (c)

Fig-6 (a)Foreground ,(b)background , (c)unknown

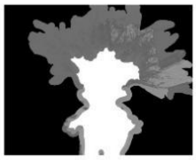
Fig-4(a) (b) (c) are the given input images. Fig-5(a) (b) (c) are the trimap images extracted for the given input images, respectively. Fig-6(a) Foreground (b) Background (c) unknown are separated from the given input image and Fig-7 is the produced Alpha matte image. Fig-8 is the new background image that is given to the separated images. Fig-9 is the final output image for the given input image.

7(a)

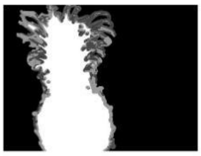
8(a)


7(b) 8(b)


7(c) 8(c)




7(d) 8(d)




7(e) 8(e)


7(f) 8(f)

Fig-8 Alpha Matte **Fig-9 Background image**

While image matting for foreground and background is helpful as a standalone technique in image processing, it gained significant attention from researchers. Peak signal to noise ratio, Mean square error, Normalized Absolute error and Normalized cross correlation for all the images was calculated and presented in table 1.

9(a)

9(b)

9(c)

9(d)

9(e)

9(f)

Fig-9 Output Image

V. CONCLUSION

For solving image matting problems, a method has been developed in this paper called Bayesian Approach. The problems associated with Bayesian approach are difference matting, natural image matting and constant-color matting. Though dividinganear probabilistic perspective with Bayesian algorithm, way of approach is different in various aspects. For example, it employs a different Bayesian approach to optimizealpha, foreground (F) and background (B) simultaneously known as MAP estimation.

In the future, there is scope to explore variety of research under supervision. In the present paper use of priors on alpha using Bayesian are excluded. These priors can be learnt by the statistics of ground truth alpha mattes. This survey is used to judge spatial dependencies which may drive a Markov Random Field (MRF) approach and State of the Art (SOTA).

REFERENCES

[1]. A. Levin D. Lischinski and Y. Weiss,"A Closed Form Solution to Natural Image Matting".

[2]. M. T. Orchard and C. A. Bouman,"Color Quantization of Images", IEEE Transactions on Signal Processing, 39(12):2677– 2690, December 1991.

[3]. A. Berman, A. Dadourian, and P. Vlahos,"Method for removing from an image the background surrounding a selected object", U.S. Patent 6,134,346, 2000.

[4]. Yung-Yu Chuang, Brian Curless, David H. Salesin, and Richard Szeliski,"A Bayesian Approach to Digital Matting", In Proceedings of IEEE Computer Vision and Pattern Recognition (CVPR 2001), Vol. II, 264-271, December 2001.

[5]. Y. Zheng, C. Kambhamettu,"Learning Based Digital Matting", ICCV, 2009.

[6]. E.Shahrian, D.Rajan,"Weighted Color and Texture Sample Selection for Image Matting", IEEE Transaction on Image Processing, Volume:PP, Issue: 99, 2013.

[7]. XiaoChen;Fazhi He;Haiping Yu, " A Three-Stage Matting Method", IEEE Access, Volume: 5, 2017.

[8]. Wang, G., Li, W., Aertsen, M., Deprest, J., Ourselin, S., Vercauteren, T,"Aleatoricuncertainty estimation with test-time augmentation for medical image segmentation with convolutional neural networks", NEUROCOMPUTING 338, 34–45,April2019.

[9]. Xiaoqiang Li;Jide Li;Hong Lu, "A Survey on Natural Image Matting With Closed-Form Solutions" IEEE Access, Volume: 7, 2019.

[10]. Yung-Yu Chuang, Brian Curless, David H. Salesin, Richard Szeliski, "A Bayesian Approach to Digital Matting"Conference on Computer Vision and Pattern Recognition (CVPR), 2001.

Table:1 Parameter's comparison for all the images

Parameter Reading	Figure 1	Figure 2	Figure 3	Figure 4	Figure 5	Figure 6
PSNR (Peak signal to noise ratio)	-36.4515	-36.2858	-35.4837	-30.7796	-32.9236	-32.1949
MSE (Mean square error)	4.4172e+03	4.2519e+03	3.5349e+03	1.1966e+03	1.9605e+03	1.6576e+03
NAE (Normalized absolute error)	0.4904	0.2898	0.3814	0.2932	0.4992	0.1698
NCC (Normalized cross Correlation)	0.514866	0.67696	0.7958	0.8808	1.0248	0.8839

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