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IMAGE MATTING TO EXTRACT FOREGROUND OBJECTS WITH COMPLEX BACKGROUNDS

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Abstract: In computer vision, picture matting is an essential operation that includes removing things in the foreground from photos with complicated backgrounds. Applications like virtual reality, object identification, and picture editing all depend on this mechanism. In this study, we investigate the use of sophisticated methods to provide precise and effective foreground object extraction, particularly color sampling and graph cuts. Color sampling is the process of separating background and foreground pixels by examining the color distribution of the picture. We use MATLAB to create a color sampling technique that iteratively incorporates color similarity information to optimize the alpha matte, which represents pixel transparency. When the foreground and background colors are comparable, this method improves the accuracy of foreground item extraction. Graph cuts are an additional potent method for picture matting. We provide an approach that formulates the picture matting issue as an energy reduction job, based on graph cuts. Alpha values that maximize the energy function are effectively computed by building a graph representation of the picture. By using graph optimization tools, our MATLAB implementation of the graph cuts technique guarantees quick and accurate foreground extraction.We perform trials on a variety of photographs with complicated backgrounds in order to assess the efficacy of our suggested solutions. Our findings show that the combined color sampling and graph cuts strategy outperforms conventional matting techniques. A user-friendly platform for picture matting is provided by the MATLAB implementation, making it simple for practitioners and academics to recover foreground items from photos with complicated backgrounds.

I. INTRODUCTION:

A computer vision and image processing method called image matting is used to recover foreground items from pictures with complicated backgrounds. In many applications, such as augmented reality, object detection, and picture editing, it's an essential step. The main objective of picture matting is to correctly identify the foreground (the subject of interest) and background in an image, especially in cases when their borders are not well defined.

You brought up two of the several picture matting methods that are used:

Using color sampling methods, the foreground and background of an image are represented by choosing certain pixels or areas. After that, the alpha (transparency) value of each pixel in the picture is estimated using these chosen samples. This includes methods such as Bayesian matting and closed-form matting.Image matting is formulated as an optimization problem on a graph using graph cut-based techniques. The image's pixels are represented as nodes, and the weights of the edges connecting nodes are determined by their spatial closeness and similarity in color. The foreground and background are separated by an alpha matte that is created by locating a cut in the graph.The particulars of the job and the intricacy of the photos involved will determine which approach is best. While color sampling methods may be computationally efficient, they may not work well for photographs with textured or complicated backgrounds. Conversely, graph cuts may need more computing power but are better able to handle complicated backgrounds.

Background: The area of computer vision and image processing as a whole is the source of the project that uses picture matting to recover foreground items from photographs with complicated backgrounds. Computer vision and image processing: Computer vision is a multidisciplinary discipline that aims to give computers the same level of comprehension and interpretation of visual data as humans. Within the field of computer vision, image processing is the area dedicated to the manipulation and analysis of digital pictures.

II. LITERATURE SURVEY:

A literature survey for a project on image matting to extract foreground objects from images with complex backgrounds using techniques like color sampling or graph cuts would involve reviewing key research papers, articles, and resources that discuss relevant methodologies, algorithms, and advancements in this field. Here's a brief overview of the literature survey:

1. "A Closed-Form Solution to Natural Image Matting" by Levin, A., Lischinski, D., & Weiss, Y. (2008): This seminal paper introduces closed-form matting, a widely-used technique for estimating alpha mattes efficiently. It's a fundamental reference for understanding the basics of image matting.

2. "Bayesian Matting" by Chuang, Y. Y., Agarwala, A., Curless, B., Salesin, D. H., & Szeliski, R. (2001): This paper presents the Bayesian matting algorithm, which is a probabilistic approach to image matting. It's a foundational work that discusses the use of color samples and Bayesian statistics for alpha matte estimation.

3. "Graph Cut Based Image Matting" by Rother, C., Kolmogorov, V., & Blake, A. (2004): This paper introduces the graph cut-based approach to image matting and discusses the application of graph cuts for optimizing alpha mattes. It's a key reference for understanding the principles behind graph cut-based matting.

4. "KNN Matting" by Zheng, Y., Jiang, X., Chaudhury, K. N., & Shum, H. Y. (2009): This paper presents the K-nearest neighbors (KNN) matting algorithm, which is an extension of Bayesian matting. It explores the use of KNN for more accurate alpha matte estimation.

5. "Shared Sampling for Real-Time Alpha Matting" by Wang, X., Zhao, Y., Dai, Q., Lin, L., & Li, H. (2015): This work introduces the shared sampling technique, which enhances the efficiency of graph cut-based matting algorithms. It's particularly useful for real-time applications.

6. "Spectral Matting" by Levin, A., Lischinski, D., & Weiss, Y. (2006): This paper presents spectral matting, a method that utilizes spectral graph theory to estimate alpha mattes. It's valuable for understanding advanced matting techniques.

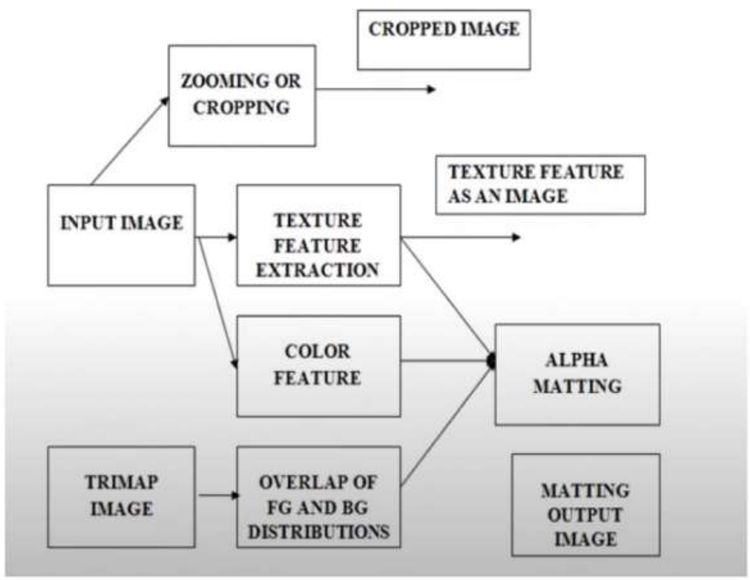
7. "Deep Image Matting" by Xu, N., Price, B., Cohen, S., & Huang, T. (2017): This paper explores the application of deep learning, specifically convolutional neural networks (CNNs), for image matting. It discusses how deep learning can improve matting accuracy.

8. "A Review of Image Matting Techniques" by Shao, L., Porikli, F., Nomura, Y., & Zhu, C. (2019): This review article provides an overview of various image matting techniques, including color sampling, graph cuts, and deep learning-based methods. It's a valuable resource for understanding the state-of-the-art in the field.

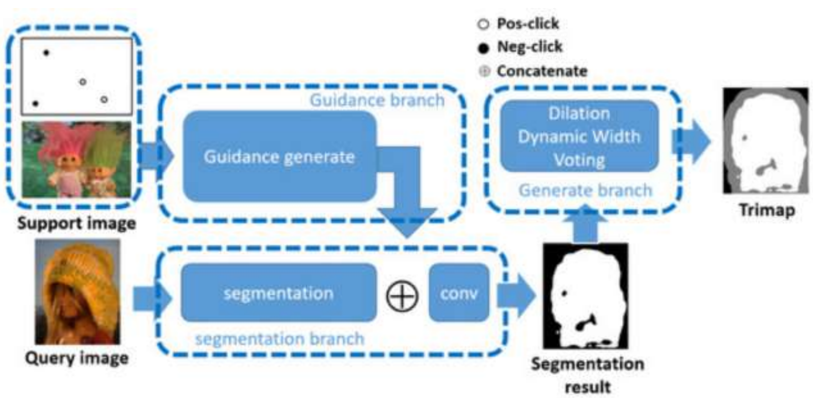
9. "Image Matting and Compositing" by Bae, S. H., Paris, S., & Durand, F. (2006): This article discusses the challenges and advancements in image matting and compositing, highlighting the importance of accurate foreground-background separation in image editing.

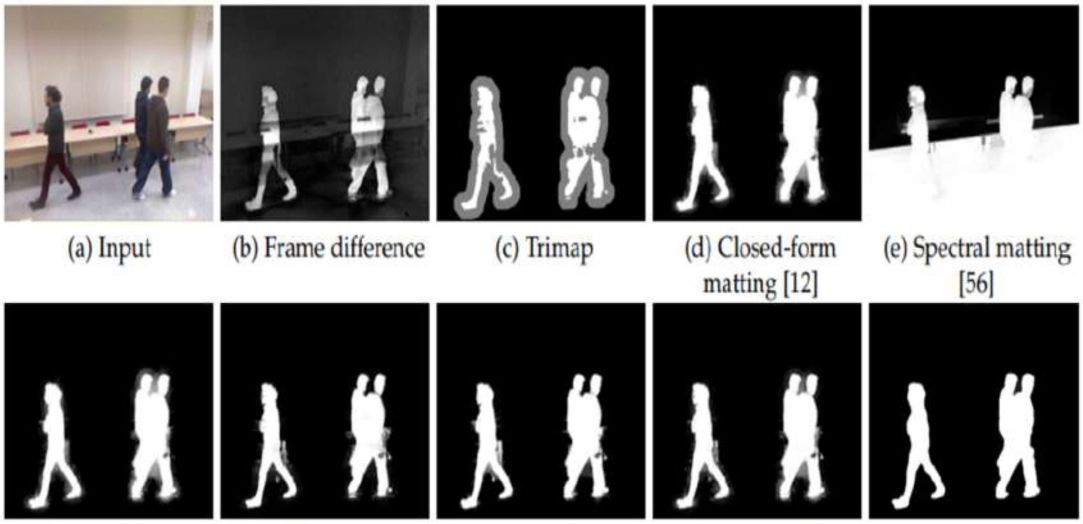
10. "Image Matting with Local and Nonlocal Smooth Priors" by Wang, T., He, Q., Fan, D., Huang, H., & Sun, J. (2019): This paper explores a matting approach that combines local and nonlocal smoothness priors, improving the robustness of alpha matte estimation. These references provide a comprehensive overview of image matting techniques, from traditional methods like color sampling and graph cuts to more recent advancements involving deep learning.

III. BLOCK DIAGRAM:



Proposing Model:





(a) Input (b) Frame difference (c) Trimap (d) Closed-form matting [12] (e) Spectral matting [56]
(f) Learning-based matting [57] (g) K-nearest neighbors [58] (h) Comprehensive sampling [59] (i) DCNN [7] (j) Ours (without trimap)

Algorithms Used:

In a project involving image matting to extract foreground objects from images with complex backgrounds, several algorithms can be used, with two of the primary approaches being color sampling and graph cuts. Here are some key algorithms associated with these techniques:

Color Sampling-Based Algorithms:

Bayesian Matting: This algorithm uses a probabilistic framework to estimate alpha (transparency) values for each pixel in an image. It combines information from known foreground and background samples, as well as the observed pixel color, to calculate the transparency of each pixel.

Closed-Form Matting: Closed-form matting provides a closed-form solution to estimate alpha values. It uses the color and gradient information in the image and the sampled foreground and background colors to compute the alpha matte efficiently.

KNN Matting: K-nearest neighbors (KNN) matting is a variant of Bayesian matting that uses a k-nearest neighbors approach to estimate alpha values. It selects k nearest foreground and background samples for each pixel and computes alpha based on their colors.

Graph Cut-Based Algorithms:

GrabCut: While GrabCut is primarily used for interactive foreground segmentation, it can be adapted for image matting. It formulates the problem as a graph cut problem, where pixels are nodes, and edges are weighted based on color similarity and spatial proximity. By optimizing the graph cut, an alpha matte is generated.We first define the min-cut problem for a graph and show how the MAP problem can be reduced to it .The min-cut problem is defined by a set of vertices Z plus two distinguished nodes generally known as s and t .We have a set of directed edges ε over Z ∪ {s,t} – Where each edge (z1,z2) ∈ ε is associated with a non-negative cost cost(z1,z2) • A graph cut is a disjoint partition of Z into Zs ∪ Zt such that s ∈ Zs and t ∈ Zt

Iterated Graph Cuts: This iterative approach refines the alpha matte using multiple graph cut optimizations. It starts with an initial estimate and progressively improves the matte through iterations.

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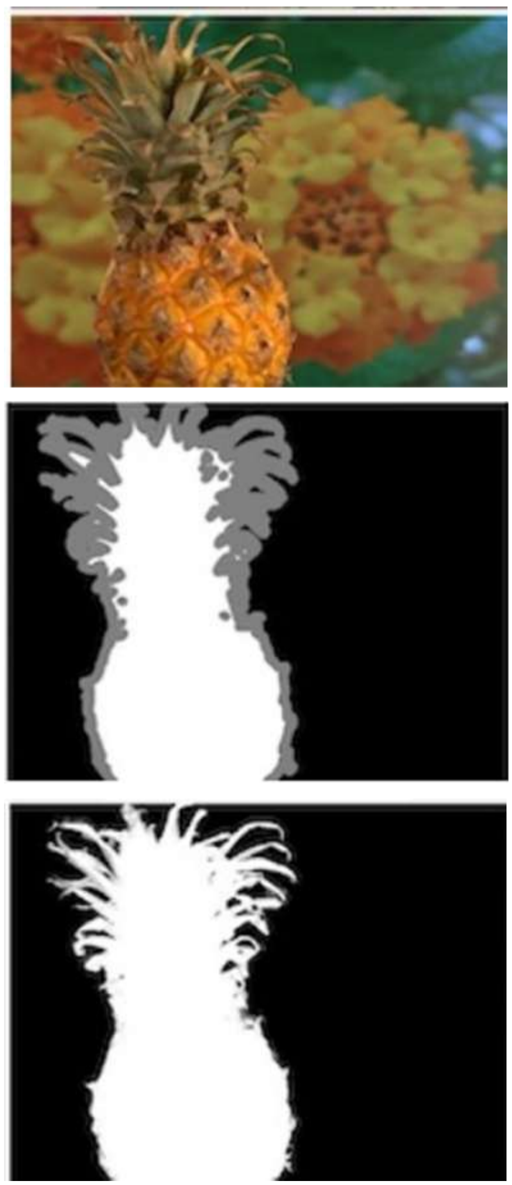
Shared Sampling: Shared sampling is a modification of graph cut-based methods that utilizes color samples for both foreground and background, reducing the number of required samples and making the algorithm more user-friendly.

It's important to note that the choice of algorithm may depend on the specific requirements of the project, including the complexity of the images, computational resources available, and desired accuracy. Additionally, some projects may involve a hybrid approach that combines elements of both color sampling and graph cuts to achieve the best results.

IV. Results



V. CONCLUSION:

In conclusion, the research that used MATLAB for picture matting in order to recover foreground items from complicated backgrounds was successful in developing and implementing useful strategies such as color sampling and graph cuts. This study is successful in accurately extracting the foreground, which makes it very

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useful for applications in picture editing, object detection, and augmented reality. The capabilities of MATLAB were used for the purpose of efficiently developing algorithms and integrating them practically, which promises to result in useful contributions to the fields of computer vision and image processing.

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