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Color based Edge detection techniques– A review

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Abstract*— This paper presents a review on different color based edge detection techniques. Edge detection has found to be most important step in many critical vision applications. It actually results in the black and white (binary) image where each object is differentiate by lines (either black and white). Edges are basically the area in the image where sharp changes exist. It has been found that the most of the existing techniques has neglected the use of colors while detecting the edges but in many applications a region can be categorized based upon the color. This paper has shown that the most of the existing techniques fails in case of images with complex background.

***Index Terms*— Edge detection, PCA, Hue, Morphological operations.**

I. INTRODUCTION

Edge detection [1] plays a significant role in vision processing. Edge recognition is the name for a set of mathematical methods which target at classifying points in a image at which the image intensity varies sharply or, has discontinuities. The points at which digital image intensity turns sharply are stereotypically ordered into a set of line segments called edges. The similar problem of discovering discontinuities in 1D signal is identified as step detection and the problem of discovering signal discontinuities over the time is called as change detection. Edge detection is essential instrument in vision processing, machine vision and digital image processing, mainly in the areas of feature recognition.

The problem is to find edges in an image [1], so the first step is the process of scene reconstruction. The edges can be used later for segmentation of the image into objects. The most straightforward edge detection can be done by using thresholds: pixels with gray level above some threshold are considered to be in one group and all the other pixels in the second. The edges should appear when you cross the border between the groups. This technique works in very straightforward domains, but by no means can provide as an edge detector in the real world.

More sophisticated approach [2] uses linear operators to find edges. For example if you relate a gradient operator on the image and only then relate the threshold technique, the result that you get is much better. Not only gradient operators can be used for edge detection. There are a lot of linear operators (for eg.Laplacian) that can serve this purpose.

An edge [3] is not a physical entity; it is just like a shadow. It is where the picture ends and the wall starts. It is where the vertical and the horizontal surfaces of an object assemble. It is what happens between a bright window and the darkness of the night. Purely speaking, it has no width. If there were sensor with infinitely small footprints and zero-width point spread functions, an edge would be recorded between pixels within in an image.

In reality, what happens to an edge from the distance [4] may even have other edges when looked closer? The edge stuck between a forest and a road in an aerial photo may not appear like an edge any more in an image engaged on the ground. In the ground image, edges may be originated in the region of each individual tree. If looks a few inches away from a tree, edges may be originate within the texture on the bark of the tree. Edges are basically scale-dependent and an edge may restrain other edges, but at a certain scale, an edge still has no width

Traditionally, edges [5] have been freely defined as pixel intensity discontinuities within an image. While two experiments process the same image for the same purpose may not observe the same edge pixels in the image, two different applications may never agree. In word, edge detection [6] is usually a subjective task. As a user of an edge detector, one should not imagine the software to automatically detect all the edge he or she desires and nothing more, because a program cannot possibly know what level of details the experimenter has in mind.

Usually it is uncomplicated to detect those obvious edges, or those with high S/N ratio. But what about those not very visible? If a program detects all the pixel intensity discontinuities in an image, the result image will not be very much different from one fill of noise. On the other side, as a developer of an edge detector, one should not try to create a program that automatically produces the ideal result each and every user has in mind, because nobody can read other people's mind. Instead, a developer try to: 1) create a good but simple way to let the users express their idea about the edges they have in mind regarding a specific image; and to 2) implement a method to detect the type of edges a user ordered. In another word, an edge detector cannot probably be 100 percent automatic. It must be interactive, requiring a few input parameters at least

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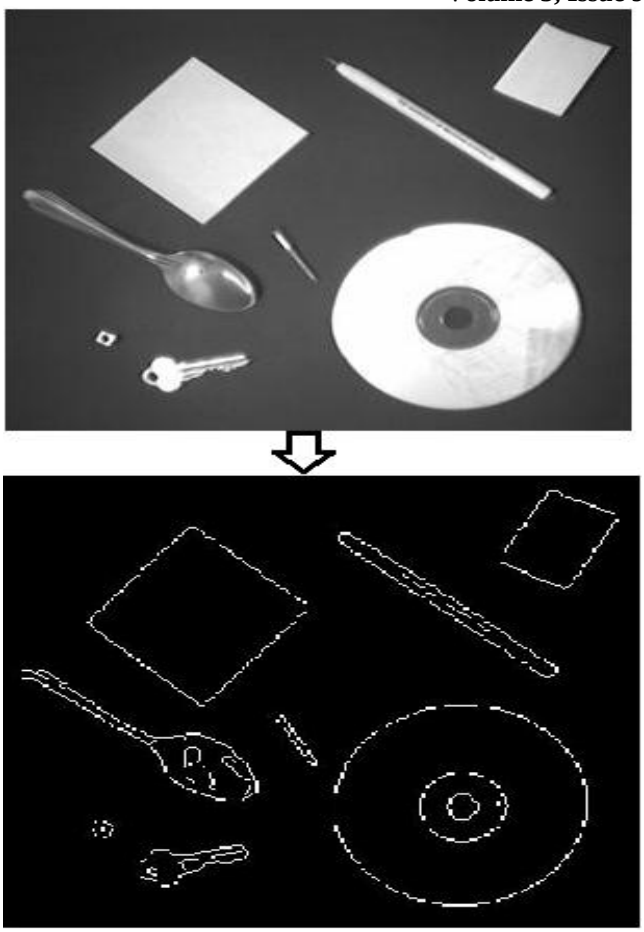

Fig.1 Edge detection

II. PRINCIPAL COMPONENT ANALYSIS (PCA)

PCA [2] is a statistical technique that utilizes the orthogonal change to transform a set of interpretations of probably interrelated variables into a set of principles of linearly uncorrelated variables named principal components. The number of principal components is fewer than or equal to the number of real variables. This conversion is well-defined in such a way that the first PCA has the leading potential variance (i.e., accounts for as much of the variability in the data as possible), and each following module in turn has the maximum variance possible under the restriction that it be orthogonal to (i.e., uncorrelated with) the earliermechanisms.PCA are guaranteed to be autonomous if the data set is mutually generally disseminated. PCA is sensitive to the comparative scaling of the inventive variables

III. EDGE DETECTION TECHNIQUES

A. Edge detection using PCA

First of all the input image will be taken; then PCA transformation will be applied. Now any edge detector operator will be used to detect the edge in the PCA. Figure 1.2 has shown the results of the edge detected using the PCA.

Fig.2: PCA based edge detection

B. Edge detection for hue component

From color image to grey-scale image, leads to the result that some edges are misused. Moreover, most of the missing edges result from hue changes. As a result, we can present a better edge detection model for color image once the problem of edge detection of hue component.

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Fig.3: Edge detection using Hue components

C. Edge Fusion

Fusion is the process of merge insignificant information i.e. edges in our case from two or more images into a single final edge detected image. The resulting image will be more informative than any of the input images.

D. Morphological Thinning

Thinning is a morphological operation that is used to remove selected foreground pixels from binary images. It is commonly used to tidy up the output of edge detectors by reducing all lines to single pixel thickness. Thinning is normally only applied to binary images, and produces another binary image as output. It will be used to remove unwanted points on the edges in an image.

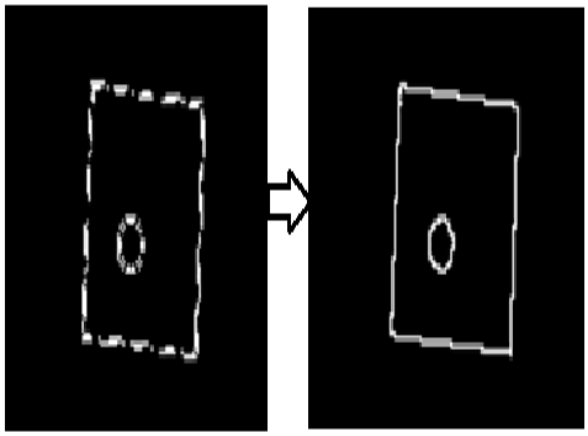

Fig.4: conversion of binary image into output image i.e. using thinning

IV. RELATED WORK

Chen et al. (2010) [1] improved the efficiency and the performance of the color edge detection, a novel color edge detection algorithm has proposed. An improved Kuwahara filter is used to smooth the original image first. After edge detection with each channel independently in RGB color space, an adaptive threshold selection method is applied to predict the optimum threshold value and an edge thinning algorithm is used to extract accurate edge.

XIAO et al. (2011) [2] has proposed a multi-scale edge detection algorithm which took soft threshold method to implement detail enhancement and noise reduction of the true color image. Firstly, obtaining the true color images at different scales through wavelet multi-scale edge detection algorithm, then based on the improved soft threshold filter function, selecting appropriate threshold of the obtained image edges to perform noise reduction while enhance the edge details of the reservation; and finally, carrying out the weighted 2-norm fusion of edges of different-scale-image

Wang and Yan (2012) [3] has presented a new edge detection approach based on vector morphological operators in color image processing. A new vector ordering in RGB color space has proposed. And then by analysing the characteristics of the noise contaminating image, vector morphological operators has proposed and these operators are applied in color edge detection.

Xu et al. (2012) [4] has proposed a novel approach of edge detection for color image in order to efficiently preserve edge in noise appearance. Firstly, multi-structure elements are designed in order to construct morphological gradient operators with performance of noise suppressing. Then, the color image is transformed from RGB to HSV color space due to the latter is consistent with human vision perception. Finally, morphological edge detection operators in HIS color space based on multi-structure elements has been presented.

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Xin and Ki (2012) [5] has proposed an improved Canny algorithm to detect edges in color image. Algorithm is composed of the following steps: quaternion weighted average filter, vector Sobel gradient computation, non-maxima suppression based on interpolation, edge detection and connection. Algorithm is also applied to deal with color images of transmission line icing.

Hao et al. (2013) [6] has studied that the premise of obtaining the clear object contour in traditional Canny operator is to set appropriate parameters, does not have the adaptive ability. An adaptive Canny edge-detection method is proposed which Based on Canny theory. Adopt the 3*3 neighborhood instead of canny algorithm in 2*2 neighborhood to calculate the calculation gradient. Then, the maximum between-class variance (Otsu) method is used to obtain the high and low thresholds

Wang et al. (2013) [7] has discussed the problems that the traditional edge detection algorithms are sensitive to noise and the environment of plate scene is complex, plate image is smoothed with Gaussian filter, and by comparison of edge images from non-sub sampled contour let edge detection algorithm and multi-scale wavelet edge detection algorithm, a new algorithm, pulse coupled neural network edge detection algorithm based on multi-scale wavelet transform is proposed. Firstly, multi-scale wavelet is used to detect edge of smoothed plate image, and then pulse coupled neural network is employed to debar the fake edge, followed by binary calculation with K-means clustering algorithm.

Fu et al. (2013) [8] has compared the two improved methods, which are improved Sobel operator and improved wavelet transform using the multi-scale morphological filtering, subjective visual have achieved better results. However there are advantages and disadvantages in objective evaluations. So improvement is further done by using two improved methods with the wavelet transform fusion technology. The experimental results has shown that the fused image has increased significantly in information entropy and the average gradient compared to the improved Sobel operator, and it also has improved the peak signal to noise ratio and the distortion degree compared to the improved wavelet edge detection method. The fused image can concentrate the advantages of the two improved methods together and make complementary advantages. Eventually, the good de-noising effect and complete edge are achieved.

Ju et al. (2012) [9] has proposed a novel image segmentation algorithm based on the adaptive edge detection and an improved mean shift. According to the ostu method, an adaptive threshold algorithm has been applied to improve canny operator in edge detection. The edge detection method has better performance and strong adaptability. Then the resulting edge information is incorporated into the main two steps of image segmentation based on mean shift. Since the discontinuity and homogeneity information are combined flexibly, the proposed algorithm takes the best of local and global image information.

Abid et al. (2013) [10] has proposed a new method for image edge detection based on multilayer perception (MLP). The method is based on updating a MLP to learn a set of contours drawn on a 3×3 grid and then take advantage of the network generalization capacity to detect different edge details even for very noisy images. The method is applied first to Gray scale images and can be easily extended to color ones. The method works well even for very low contrast images for which other edge operators fail.

Lei and Fan (2014) [11] has proposed a novel color edge detection method based on the fusion of hue component and principal component analysis to solve the problems. First, a novel computational method of hue difference is defined, and then it is applied to classical gradient operators to obtain accurate edges for hue component. Moreover, complete object edges can be obtained by using the edge fusion of the first principal component and hue component of color image with low-computational complexity. The proposed gradient operators are found to be very effective to obtain better edge results for color images.

V. GAPS IN EARLIER WORK

The survey has shown that the following are the various limitations found in existing research.

1. The most of existing researchers has neglected the effect of true color on output images
2. No much effort is done by using improved canny edge detector which is based on8-neighbour approach
3. Edge detection of complex background images is also neglected

VI. CONCLUSION & FUTURE WORK

This paper has shown various techniques for edge detection. Survey has shown that still much research is required in the field of color based edge detection. This paper has focused on detecting the edges for the Hue factor in Human visual system (HSV). Hue is usually represented by position significance, so the existing edge detection techniques are incapable to correctly perceive edges of hue factor in HSV color plane. As a consequence, the most popular approaches of color edge detection typically neglect the role of hue factor, thus misplaced some edges triggered by hue variations.

In near future we will propose a new color edge detection technique based on the mixture of hue factor and principal component analysis to resolve the problems with existing methods.

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