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Transition Regions Based on Threshold Filter Approaches for Image Segmentation and Morphological Opertation

Sameer Kumar Sharma[1*], Bharti Chourasia[2]

[1,2]Department of Electronics and Communication, RKDF Institute of Science & Technology, SRK University, Bhopal

Corresponding Author: sameer.sharma091@gmail.com

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Abstract— The proposed method breaks the color image into its individual color component and then fuzzy filter based canny Edge detection technique is applied. This technique depends on the fuzzy rule-based system using 2 X 2 window mask which is used to modify membership value of the image in different fuzzy sets (which means it will smoothen the image), and this filtered image is given as input to canny edge detection technique and finally after this morphological processing is used. The Performance Parameter becomes better by combining Fuzzy and Canny Edge Detection and also morphological operations. The results were compared with other edge detection techniques like interactive image segmentation by maximal similarity based region merging (MSRM) and Image segmentation using transition region. Therefore it is evident that the developed Algorithm provides Improved Performance parameters for detecting the edge against the wide range of Applications.

***Keywords*: -** Image Segmentation, Fuzzy-canny Method, Morphological Operation, Misclassification Error,

I. INTRODUCTION

An image is basically two dimensional signal defined by mathematical function, F(x, y) where x and y gives value of horizontal and vertical co-ordinates. Digital image processing[1] deals with system that perform various operation on digital image to improve the quality of the image by removing noise and unwanted pixels and to obtain intentional information from an image. Image segmentation is a key step in digital image processing that subdivides an image into its constituent region or object that share homogeneous attributes [2]. The main purpose of the segmentation process is to get more information in the region of interest in an image which helps in annotation of the object scene [3].
Image segmentation fundamentally works on two properties [2]:
Discontinuity: Division of the digital image predicated due to sudden changes on intensity. For example, edge detection, point detection and line detection.
Similarity: Dividing the digital image into region based on predicated on set of predefined criteria. For example, thresholding, region growing, region splitting and merging.
The image segmentation methods are categorized as [4]:

An edge is defined as boundaries of objects or sudden change in an image which is not in a continuous form that helps to detect and identify the objects in a given image [5]. The main aim behind edge detection [6, 7] method is to identify and locate the points in a digital image at which intensity of the image changes. Among various technique of various edge detection technique Canny [8] operator gives better output than Sobel [9], Prewitt [10], and Laplacian method. In Thresholding method grayscale value of the image is checked out with predefined value of the threshold. If grayscale value of the input pixel is large then output value of that pixel becomes 1 or else 0.

Fundamental steps in digital image processing are shown in Figure 1. Image acquisition digitizes the image captured by camera. Image enhancement is the process of manipulating an image so that the results are more suitable for specific applications. Image restoration improves an appearance of an image which tends to probabilities model of image degradation Morphological processes are the tools of extracting image components that are useful in the description and presentation of an image.

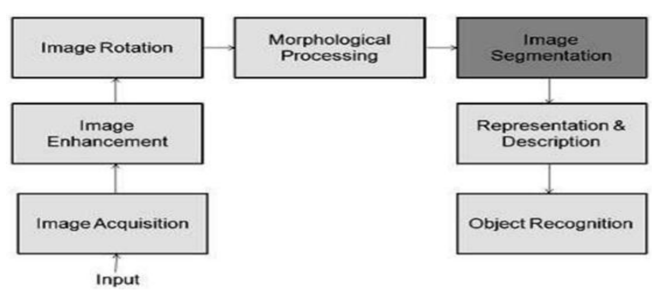


Figure 1: Fundamental Steps in Digital Image Processing

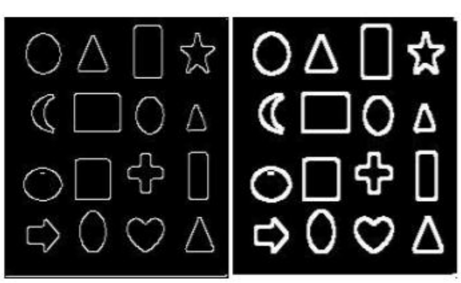
Image segmentation is the most difficult ask in digital image processing which separates objects from the background. Representation makes the decision whether to represent data as boundary or as a complete region. Recognition is the process that assigns label to an object based on information provided by its descriptor.

II. MORPHOLOGICAL OPERATIONS BASED SEGMENTATION

Binary images may contain countless defects. In some circumstances binary regions constructed by simple thresholding are buckled by noise and textures. Morphology is a vast extent of image processing operations that modifies the images based on shapes. It is considered to be one of the data processing methods useful in image processing. It has many applications like texture analysis, noise elimination, boundary extraction etc. Morphological image processing follows the goal of eliminating all these defects and maintaining structure of image. Morphological operations are confident only on the associated ordering of pixel values, rather than their numerical values, so they are focused more on binary images, but it can also be applied to grayscale images such that their light transfer functions are unknown and thus their absolute pixel values are not taken into consideration. Morphological techniques verify the image with a small template called structuring element. This structuring element is applied to all possible locations of the input image and generates the same size output. In this technique the output image pixel values are based on similar pixels of input image with is neighbors. This operation produces a new binary image in which if test is successful it will have non-zero pixel value at that location in the input image. There are various structuring element like diamond shaped, square shaped, cross shaped etc. The base of the morphological operation is dilation, erosion, opening, closing expressed in logical AND, OR notation and described by set analysis. Among them in this paper only two operations are used dilation and erosion. Dilation adds pixels while erosion removes the pixels at boundaries of the objects. This removal or adding of pixels depends on the structuring element used for processing the image.

Dilation

Dilation is one of the basic operators in mathematical morphology. It is applied to binary image but can also be applied to grayscale image. Dilation causes the objects to grow in size. The effect of this operation will gradually increase the boundaries of foreground pixels, thus areas grow in size and holes in that region become smaller [6].



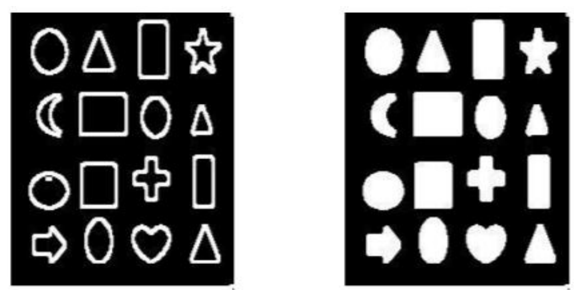
(a) Fuzzy-Canny image (b) Diluted image

Figure 2: Dilation image

Dilation takes two parts as data. First one is the input image to be dilated and second is the structuring element also known as kernel. With the help of this structuring element only it determines how much the image is to be dilated. The mathematical definition of dilation can be as follows [1]: Suppose A be a set of input image coordinates and B be a set of structuring element coordinates and Bx is a translation of B so that its origin is at x. Thus dilation of A by B is set of all points of x such that intersection of Bx with A is not null. In terms of set operations dilation of A by B is defined as [7]:

Filling the region

Dilation operation makes the boundaries of the object thick so for segmenting the object the next step is to fill the holes. The flood fill operation is most commonly known to fill the holes in the given input image. For binary images, it basically changes the background pixels to foreground pixels until it reaches the object boundaries and for grayscale images it makes the intensity level same i.e. it makes the dark areas surrounded by lighter areas to same intensity levels [2]. In binary images and gray-scale images the boundaries of the objects need to be specified by connectivity. In binary images the starting point for filling can also be specified. If we specify holes as an argument then it is of no need to specify any starting points [2]. In this paper fill operation is used on binary image with arguments holes so it automatically fills the holes of different objects in image. Below image shows the flood fill image on diluted image output:



(a) Diluted image (b) Flood filled image

Figure 3: Flood fill image

Erosion

Erosion is also one of the basic operators in mathematical morphology. Erosion causes the objects to shrink or become thin in size. Erosion basically erodes away the boundaries of the foreground which results in areas of those pixels shrink in size and holes of those areas become larger [8]. So, after dilution and filling the holes of object in some images the boundaries get mixed up so to somewhat separate the boundaries erosion is applied so as to make the boundaries of the objects thinner for better output. Erosion like same dilation takes two parts as data. First one is the input image to be eroded and second is the structuring element. With the help of this structuring element only it determines how much the image is to be eroded. The mathematical definition of erosion can be as follows [1]: Suppose A be a set of input image coordinates and B be a set of structuring element coordinates and Bx is a translation of B so that its origin is at x. Thus dilation of A by B is set of all points of x such that Bx is a subset of A. In terms of set operations erosion of A by B is defined as [9]:

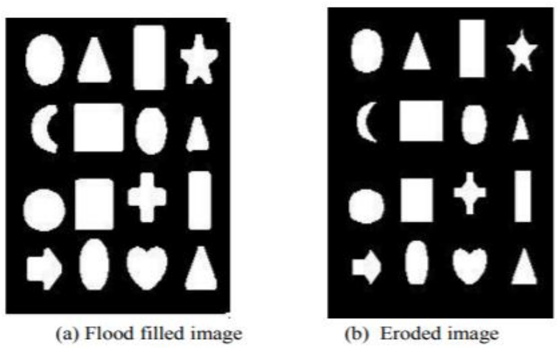


Figure 4: Erosion Image

III. PROPOSED METHODOLOGY

In gray-level images, edges have been typically modelled as brightness discontinuities. From an intuitive sense, it can be said that an edge is an apparent boundary between two pixels with significantly different brightness values. Here “significantly different” may depend on local pixel brightness statistics for example. This variation usually occurs because an edge usually represents a physical boundary between two objects having different intensities. The word edge is used to refer to a location on the image where the brightness value appears to jump. These jumps are associated with high values of the first derivative and are the kinds of edges that were originally detected by Roberts.

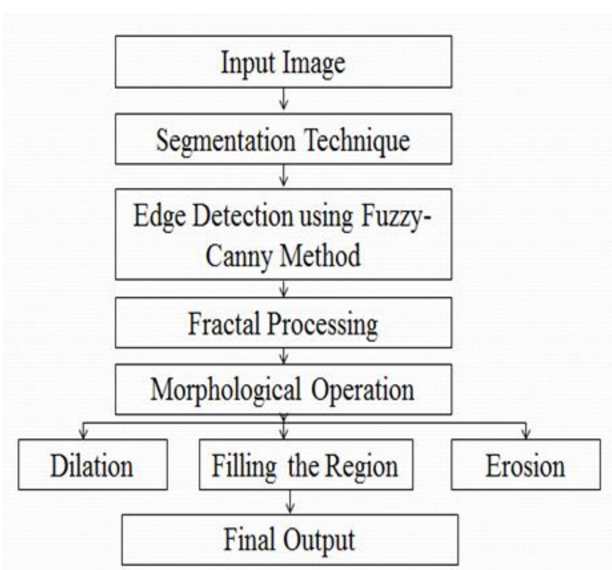


Figure 5: Flow Chart of Proposed System

IV. SIMULATION RESULT

As shown in table 1 the error, smoothness, uniformity and processing time are obtained from the proposed image segmentation using fuzzy canny method algorithm.

Figure 6: simple background & simple foreground Original Image

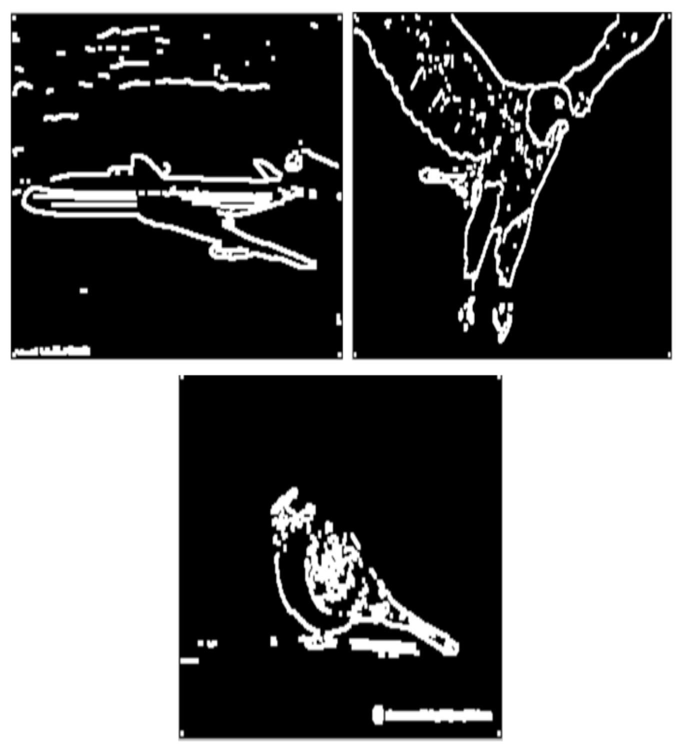


Figure 7: Output Image of simple background & simple foreground

Table 1: Results of simple background & simple foreground Image

Image	ME		FPR		FNR	
	Previous Algorithm	Proposed Algorithm	Previous Algorithm	Proposed Algorithm	Previous Algorithm	Proposed Algorithm
Airplane Image	0.0179	0.0163	0.0089	0.0072	0.1670	0.1503
Eagle Image	0.0065	0.0058	0.0047	0.0043	0.0378	0.0297
Bird Image	0.0274	0.0271	0.0192	0.0185	0.1684	0.1582

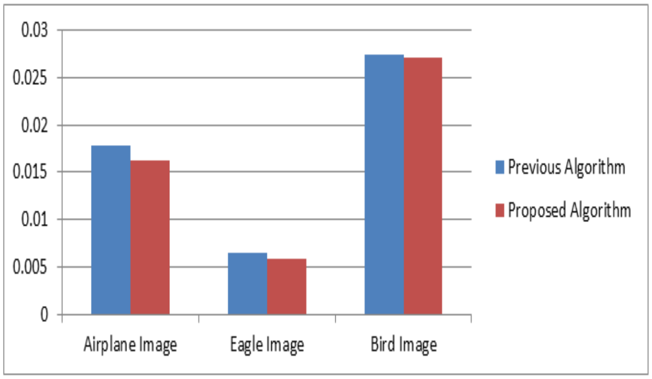


Figure 8: ME of the simple background & simple foreground Image

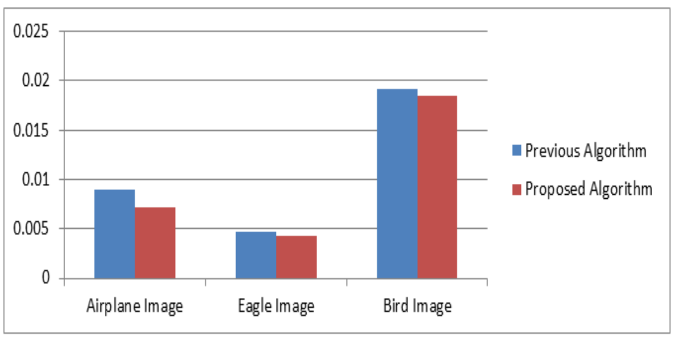


Figure 9: FPR of the simple background & simple foreground Image

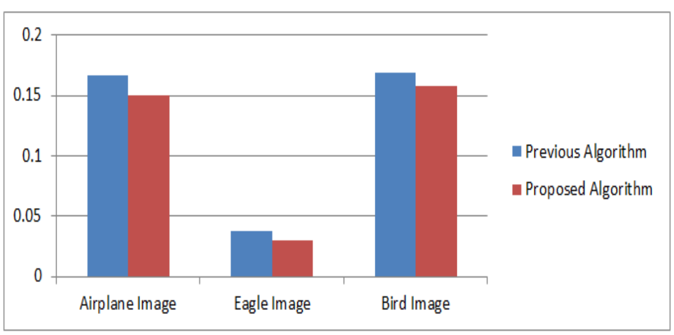


Figure 10: FNR of the simple background & simple foreground Image

From the analysis of the results, it is found that the proposed image segmentation using threshold filter gives a good smoothness for simple background & simple foreground Image.

V. CONCLUSION

In this paper a new segmentation technique is review using morphological operations. In first step edge is detected using Fuzzy Canny method which can give better results compared to classical techniques of edge detection and in second stage, after edge detected, basic morphological operators are applied which are dilation and erosion and also flood fill is used to segment the image. It has been concluded that Segmentation using morphological basic operators can also segment the image. It is more simple and easy method than different segmentation methods.

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