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COMPRESSION AND CANNY EDGE DETECTION BASED METHODS FOR IMAGE SEGMENTATION

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***ABSTRACT*— Digital image processing is an emerging field in IT industry. Image segmentation is an important and the most challenging task in image processing. The objective of this research work is to propose compression and edge detection based methods for image segmentation. In the CBMCW method a grayscale image is filtered using wiener filter and then filtered image is compressed using wavelet transform and marker controlled watershed method is used to segment the compressed image. In the CEDB method a gray scale image is filtered using wiener filter, then the edges are detected using canny edge detector and finally marker controlled watershed method is applied to segment the image. These methods are successfully implemented and evaluated using various measures. The performances these methods are analyzed and results are discussed.**

***Keywords*— Canny Edge Detection, Image Segmentation, Marker Controlled Watershed Segmentation, Morphological Gradient, Wavelet Transform, Wiener Filter.**

I. INTRODUCTION

An image is an artifact that depicts or records visual perception. An image may be defined as a two-dimensional function, *f(x,y),* where *x* and *y* are spatial (plane) coordinates, and the amplitude of f at any pair of coordinates *(x,y)* is called the intensity or gray level of the image at that point. When *x,y* and the intensity values of *f* are all finite, discrete quantities, the image called digital image.

Image segmentation is the process of separating an image into several parts. This is typically used to identify objects or other relevant information in digital images. Identifying object is an image is the need for every field such as medical imaging, radar imaging, remote sensing imaging, traffic imaging etc [3]. For example, to find if there is a chair or person inside an indoor image, image segmentation is needed to separate objects and analyze each object individually to check what it is. Image segmentation usually serves as the pre-processing before image pattern recognition, image feature extraction and *etc*. There are several well organized methods are produced for segmentation.

II. RELATED WORKS

Research in any field requires literature review. This chapter given related works of image compression, edge detection and segmentation.

Sivappriya, *et al.* [5] have proposed medical image edge detection. Medical images pre-processing is an important step in medical image segmentation and 3D reconstruction. Salt and pepper noise were more prevalent in medical images the conventional methods were not effective in filtering salt and pepper noise. Morphological erosion is the best filter for removing salt and pepper noise. The experimental results were more effective for medical image denoising.

Eapen, *et al.* [2] have discussed a method to enhance the edges and reduce the noise level in the input images before dealing with segmentation process. In the pre-processing module they included image resizing, histogram equalization, ROI selection (Image cropping) and median filtering. In this method, a global histogram equalization was used

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which was a perfect technique for contrast and texture enhancement of medical images.

Afifi *et al.* [1] have studied a system to maintain the quality of image after the image compression process using Wavelet Algorithm. In their work, JPEG and PNG image was used. It was noted that for JPEG image, the size is reduced almost half of original image by using Haar wavelet algorithm, because, JPEG image used lossy compression type, it still maintain the quality and information of the image.

In [4] Saif, *et al.* have presented two techniques of segmentation algorithms such as Canny edge detection and Otsu thresholding. The effectiveness of the proposed algorithms was evaluated for medical and non medical images. For non medical images two algorithms returned in good segmented images. Canny segmentation is more suitable than Otsu to the tested endoscopic images because there is no clear distinction of the objects from the backgrounds and for MRI gray scale image.

In [6] Siddiqui, *et al.* have proposed an algorithm based on merging morphological watershed result with enhanced edge detection result. As a post processing step, to each of the segmented regions obtained, color histogram algorithm was applied, enhanced the overall performance of the watershed algorithm. Their method enhanced the result of marker-controlled watershed for degraded images.

III. PROPOSED METHODS

In this work two methods for image segmentation have been proposed. They are Compression Based Marker Controlled Watershed Method and Canny Edge Detection Based Method.

A. Compression Based Marker Controlled Watershed Method (CBMCW)

The steps involved in proposed CBMCW method for image segmentation. They are pre-processing, compression and segmentation.

1) *Pre-processing*

Digital images are prone to a variety of noise. Generally noise will occur due to if the image is scanned from a photograph made on film grain is a source of noise. Electronic transmission of image data can introduce noise. So remove the noise using pre-processing process.

In this step wiener filter is applied to pre-processing of images commonly involves removing the noise, normalizing the intensity of the individual particles images and enhancing the images prior to computational processing. Image de-noising is very important task in image processing. Wiener filter, it's also known as edge preserving linear filter.

Wiener filter is an excellent filter when it comes to noise reduction or debluring image. Wiener works best when the noise is constant-power "white" additive noise, such as Gaussian noise. The wiener2 function handles all preliminary computations and implements the filter for an input image.

2) *Compression of Filtered Image*

Compressing of image is the process by which a huge image size is converted to a minor image size, such as a 100 KB image converted to a 10 KB image. Decompression is the reverse process of compression. Preprocessing image is compressed using wavelet transform.

The filtered image can be compressed using wavelet transform. The basic idea of wavelet based image compression is to use a threshold to eliminate all the insignificant values, and only transmit the significant coefficients. The compression procedure using wavelet contains the two steps such as Decomposition and Applying Threshold Coefficients.

Morphological gradient method is applied of the compressed image is computed to overcome over-segmentation problem. When the morphological transition is applied to the gray scale image, it returns to high values when sudden transitions in gray level values (along the object edges) are detected, and returns to low values if neighborhood pixels are similar. The morphological gradient is calculated by taking 3x3 neighborhoods window of the given pixel, then the difference between the maximum (dilation) and minimum (erosion) gray level value of the neighborhood is calculated. Calculated gradient value is rounded to the nearest integer.

The next step is computing markers. Marker is nothing but a connected component. There two types of markers, internal and external markers. Internal markers are associated with foreground pixels of an image. External markers are associated with background pixels of an image. There is a procedure for foreground markers, which must be connected blobs of pixels inside each of the foreground objects.

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3) Image Segmentation

After the extraction of foreground and background markers, the image is ready for segmentation. Here watershed segmentation method [8] is applied on marker images.

A watershed region or catchment basin is defined as the region over which all points flow "downhill" to a common point. This might not seem to be applicable to intensity based regions but it makes sense if we apply them to gradient magnitude images. Watersheds are one of the classic regions in the field of topography.

A drop of the water falling it flows down until it reaches the bottom of the region. Monochrome image is considered to be an altitude surface in which high-altitude pixels correspond to ridges and low-altitude pixels correspond to valleys. This idea says if we have a minima point, by falling water, region and the boundary can be achieved. Watershed use image gradient to initial point and region can obtain by region growing. The accumulation of water in the vicinity of local minima is called a catchment basin.

B. Canny Edge Detection Based Method (CEDB)

This CEBD method consists of three steps. They are pre-processing, canny edge detection, and segmentation. This first step in this CEDB method is pre-processing which is explained in CBMCW method. The second step is detecting edges using Canny Edge Detection method [4]. The Canny Edge Detector is one of the most commonly used image processing method, detecting edges in a very robust manner. Edge detection uses the differentiation in color among the background color and the foreground color. The end outcome is an outline of the borders.

The Canny edge detection method has four steps explained as follows: firstly smooth image using Gaussian filter, secondly calculated gradient amplitude and direction is using the first-order finite difference, thirdly non-maximum suppression is used with the image which scanned along the image gradient direction. Finally edge detects and connects in double thresholds algorithm. Final step in this method used to segment the image using watershed segmentation.

IV. *RESULTS AND DISCUSSION*

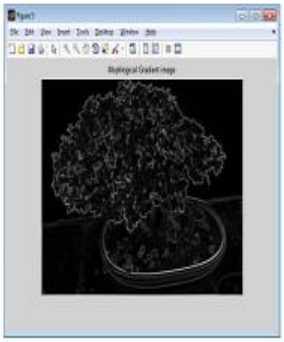
For image segmentation there are various kinds of databases like natural image dataset, medical image dataset and satellite image dataset. In this research work natural images collected from Berkeley Segmentation dataset is used test the performance of these methods [7].This dataset is selected for better comparison with existing method. Latest images taken from various domains can also be tested. This database contains 100 ground truth images in .png (Portable Network Graphics) format of two different sizes 481x321 and 321x481 pixels. The performances of these methods have been evaluated using Peak Signal to Noise Ratio (PSNR) is used as an approximation to human perception of segmentation quality. PSNR has been accepted as a widely used quality measurement in the field of image segmentation. A high PSNR would normally indicate high segmentation quality. And the Mean Square Error (MSE) Mean Square Error is then measurement of average of the square of errors and is the cumulative squared error between the noisy and the original image [9].

Results of CBMCW method and CEDB method using sample image 353013 is shown in Figure1 and Figure2 respectively.

Original image

Grayscale image

Filtered image using wiener filter



Morphological gradient image

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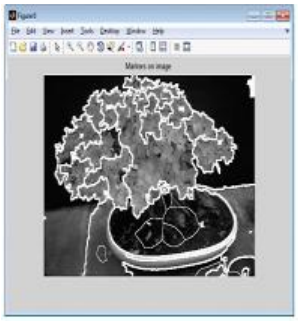
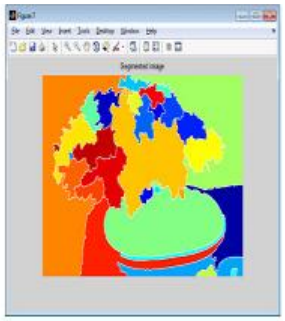
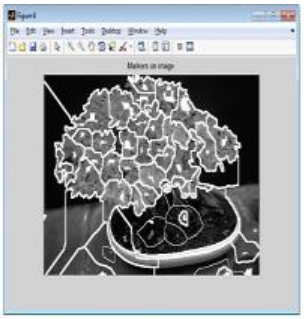


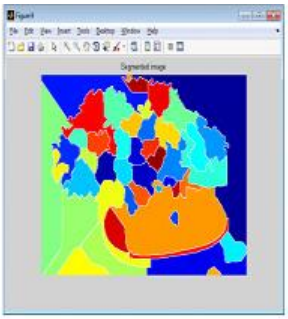
Markers on image



Segmented image before compression

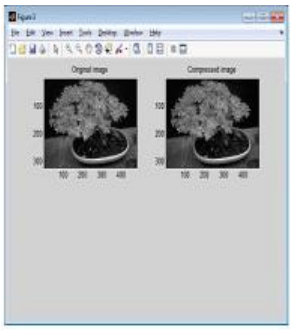


Markers on image

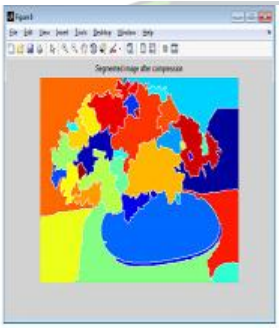


Segmented image

Figure 2: Results of CEDB Method using 353013



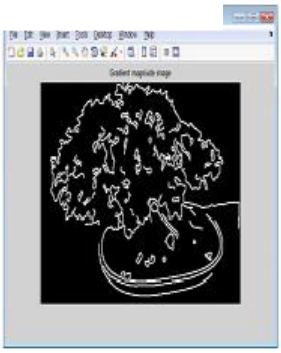
Compressed image



Segmented image after compression

Figure 1: Results of CBMCW Method using 353013

Canny Edge Detection image



Morphological gradient image

These methods are experimentally implemented and the results are tabulated in Table I and Table II.

TABLE I
PSNR AND MSE VALUES OF CBMCW

Image No	MCW method Without Compression		CBMCW method	
	PSNR	MSE	PSNR	MSE
353013	11.08	5106.49	11.59	4544.63
124084	11.09	5094.99	11.35	4801.36
42044	13.52	2911.51	12.64	3567.28
42078	14.79	2176.88	14.90	2122.40
29030	10.61	5698.17	10.74	5526.93

TABLE III
PSNR AND MSE VALUES OF CEDB

Image No	MCW method Without Compression		CEDB method	
	PSNR	MSE	PSNR	MSE
353013	11.08	5106.49	11.63	4506.17
124084	11.09	5094.99	11.64	4459.50
42044	13.52	2911.51	13.47	2944.58
42078	14.79	2176.88	15.12	2015.91
29030	10.61	5698.17	10.85	5388.75

When compared with MCW without compression method, CBMCW method provides better accuracy in terms of PSNR and MSE. When compared with MCW without compression method, CEDB method provides better accuracy in terms of PSNR and MSE. When compared with CBMCW method, CEDB method provides better accuracy in terms of PSNR and MSE.

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V. CONCLUSIONS

Thousands of words are equal to a single image. The Segmentation subdivides an image into its constituent regions or objects. The proposed CBMCW method decreases the over segmentation in gradient image. The CEDB method detects the edges very clearly before applying watershed algorithm so the object extraction is very effective. In this work the PSNR values of CEDB are higher than the CBMCW method. This method can also be tested with other Edge Detection technique such as Sobel and Robert Cross. These methods can be applied to various domains using different images like medical, remote sensing and crime for performance evaluation. The soft computing and optimization techniques can be applied for further research.

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