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A Paper On Edge Detection In Images Using Fuzzy K Means Clustering Approach

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Abstract:

Edge Detection plays a major role in Image processing applications. K means clustering using fuzzy logic is a technique which produces high quality images. There are existences of many edge detection methods. Among these this approach using Fuzzy logic elevates the performance in the output for Gray scale images. The features considered for edge detection are Mean, Standard Deviation, Entropy and image gradient. Using these features the image quality has been improved by this Fuzzy K means Clustering approach.

Keywords:

Image Processing, Edge Detection, Fuzzy K means clustering, Gray Scale Images, Image Features.

Introduction:

Edge Detection is the most basic step in Image processing [4]. This Process are widely applied in applications such as feature extraction, image segmentation, image enhancement, pattern recognition, image compression etc…Some of the previous procedures employed in detecting edges are Canny, Sobel, Robert's, Prewitt, LoG, etc… These approaches have its own limitations which are overcome by using this Fuzzy approach. In this paper Edges detection are processed by using the features such as Mean, Standard Deviation, Entropy, Image Gradients in K means clustering approach with improved performance.

The main advantage of this process is to obtain the segmentation along with the features. This Proposed technique doesn't depend on the file format or the type of the image. This work concentrates on Gray Scale images. This technique can be employed for color images in future.

Literature Review:

Edge detection acts as an exemplary role in Feature Detection and extraction. This is done with the help of human interaction. Many research works had been done previously to identify these edges [1] . Most approaches concentrated on homogeneous regions in digital images [2]. Markov random field approach was the initial approach depending on region based technology. Then Canny introduced a wide approach using local gradients.

Sobel et al applied Prewitt operator approach in noisy images. In this approach there were certain limitations where the images are corrupted by Poisson Noise. Also the borders of the images are thick and partially connected with the detected regions and are unstable with noise.

Romberg et al. (1997) has given the seed based region growing (SBRG) algorithm for edge detection method. The edges found by this algorithm are far better than the previous approaches based on gradient and derivation method. Not only that, it shows its stability in case of noise also. Ngah et al., 2002, Venkatachala et al., 2002, Fan et al., 2001, Tuduki et al., 2000, Ooi et al., 2000, Lim et al., 1999, Justice & Stokely, 1997, Venturi, 1993, Belstaff, 1993. Though few but not ignorable drawbacks make it fall in a risk of facing trapped seed point problem, which can yield incomplete edge detection. Especially, this algorithm requires the manual input of segmentation threshold one at a time. So for detecting the full edges of an images user need to input several threshold values.

To overcome this problem a modified approach is given by Nor Ashidi Mat Isa where automated edge detection is done using moving K-means clustering algorithm [3]. These clusters will be the threshold values for the modified SBRG algorithm.

Proposed work:

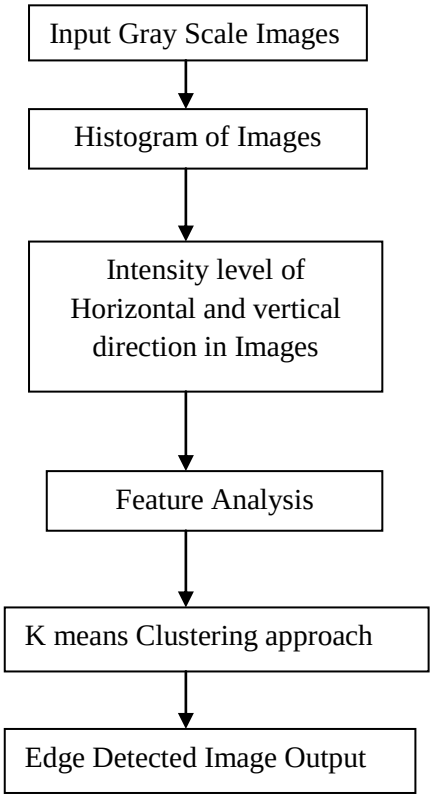

Figure 1: Methodology of Work

The images taken for analysis has 3X3 matrix of mean with neighborhood pixel intensities. The features of the image taken for analysis are obtained by specific manipulations with image data (i.e., Intensity level of images are considered as digital values) [5].Thereby they are used to calculate the features Mean, Standard Deviation, Entropy, Image Gradients. At the conclusion of these features detection these values are fed to the K means algorithm for clustering.

An Input image file is given by C Program. The height and Width of image is calculated as it depends on the size of the image and number of pixels. Then the intensity matrix has been obtained [7]. Then in the next

step the features are calculated which is fed to the proposed clustering algorithm. Finally the edge detected output is obtained.

Program:

ED_ MAIN( ).

INPUT FILE.

CALL ED_ FEATURE EXTRACTION (INPUT FILE).

CALL ED_CLUSTERING (STANDARD DEVIATION, ENTROPY, IMAGE GRADIENT).

CALL ED_OUTPUT_PIXEL WRITING (OUTPUT FILE, CLUSTER CENTRES, STANDARD DEVIATION, ENTROPY, IMAGE GRADIENTS).

RETURN.

Mathematical Interpretation of the Program:

In the algorithm edges are calculated by four features as μa_o , Standard deviation ($\sum a_o$), Entropy (ea_o), and Image Gradient ($\hat{G}a_o$).

Mean of the image is calculated using the formula,

Mean (μa_o) = (1/9) $\sum_{i=0}^{8} ai$ --------- (1)

Standard Deviation is given by,

Standard Deviation ($\sum a_o$) = $\sqrt{}$ [(1/9) $\sum_{i=0}^{8}(ai - \mu a_o)^2$] --------- (2)

Entropy is given by,

Entropy (ea_o) = $\sum_{i=0}^{8} ti(1 - ti)$ ---------- (3)

Where $ti = ai / \sum_{i=0}^{8} ai$ and

Image Gradient is given by,

Image Gradient= $\hat{G}$= $[\delta a_o / \delta_x, \delta a_o / \delta_y]^T$; --------- (4)

Where $\left| \hat{G} \right| = \sqrt{(\delta a_o / \delta_x)^2 + (\delta a_o / \delta_y)^2}$; $\alpha = \beta tan2(\delta a_o / \delta_y, \delta a_o / \delta_x)$;

Hence depending on the calculation of the feature extraction values the formula for edge detection is identified. These features are measures of local homogeneity which assigns the maximum value for 3X 3 matrices and assigns the same gray value in the image.

Finally the Edge Detection Formula is given by,

$eda_o = 255* (((1-\sum a_o) + \hat{G} + (1- ea_o)) / 3$ ---------- (5)

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Output Results and Discussions:

The program is categorized into five subdivisions. First part Main calls other three instructions to perform the specified instructions. Here feature extraction was used to extract the values of features for the input image. Clustering Instruction is used to cluster the image using K means algorithm. Finally the output pixel writing is used to extract the pixel intensity value of the output image and then it calls for the next function [8]. By applying this algorithm any kind of gray scale image of all edges can be determined. Examples of some images along with their Histogram output are represented in figure no.2 and 3.

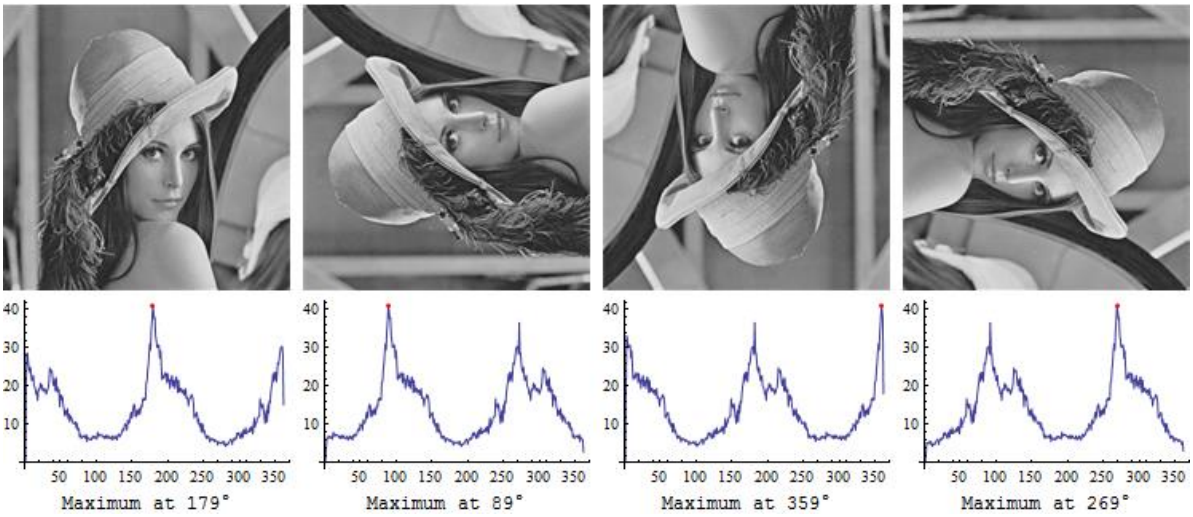

Figure 2: Lena Image with Histogram output at Different angles

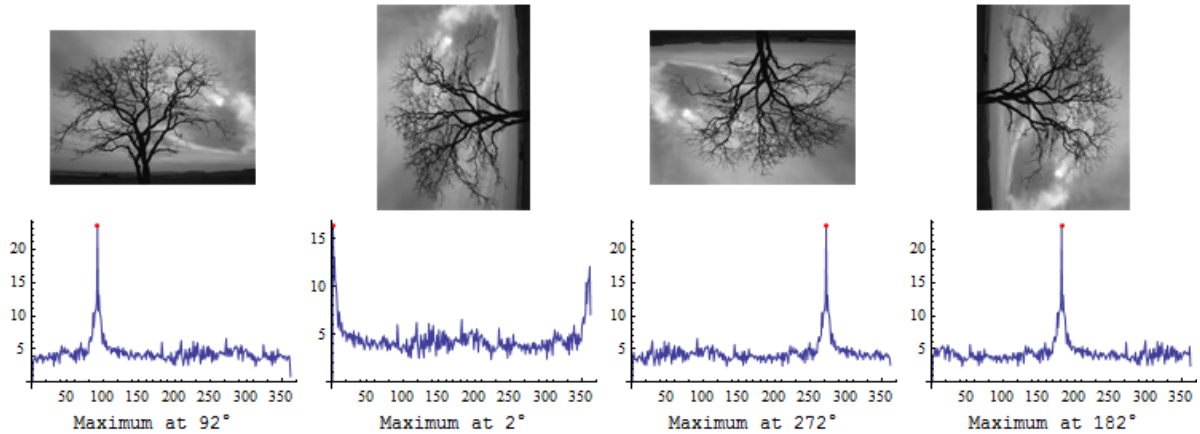

Figure 3: Tree Image with Histogram output at different angles

Conclusion:

All the Edge Detection algorithms were based on threshold based techniques [6]. Hence most of the datas are statistical and execution process becomes complicated. In this work the features Mean, Standard Deviation,

Entropy and image gradient are obtained from pixel intensity levels based on K means clustering algorithm. This algorithm is comparatively providing better and simple performance since there is no requirement of thresholding. By applying this algorithm the number of clusters identification is increased and number of iterations are reduced thereby the speed of execution process is increased.

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