

# AN EFFICIENT FUZZY LOGIC BASED EDGE DETECTION ALGORITHM

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**Abstract**— Fuzzy techniques allow a new perspective to model uncertainties due to the uncertainty of gray values present in the images. In previous Various Edge detection algorithm has been proposed in the literature for extracting the edges from the image. After emerging the fuzzy logic concept, a lot of Researcher of image processing shifted their attention towards the fuzzy logic concept and its applicability in the field of image processing. This paper presents an efficient fuzzy edge detection technique with parameters such as histogram; threshold and noise removing are carried out by using MATLAB R2015. This approach gives improved results than traditional edge detection techniques. Result of this technique is compared with various standard techniques like Sobel, Prewitt and Canny edge detection.

**Index terms**- Fuzzy Edge Detection, fuzzy rule, digital image processing, fuzzy classification, image segmentation, fuzziness.

## I. INTRODUCTION

The main purpose of edge detection in image processing is to determine the frontiers of all

represented objects, based on automatic processing of color or gray level information contained in each pixel. This edge detection has many applications in image processing computer vision and biological and robotic vision. Edge detection of real world images is a challenging task as there are a number of objects and huge variations between them which makes it difficult to approximate all objects. Most real world images possess a certain amount of ambiguity and hence their segmentation produces fuzzy regions. For such images, fuzzy image segmentation techniques are more adept for processing their uncertainties. Systems have been determined in several application domains.

Edge detection is an image processing technique for finding the boundaries of objects for images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision. Computer vision is concerned with modelling and replicating human vision. It includes methods for acquiring, processing, analysing, and understanding images and, in general, high-

dimensional data from the real world in order to produce numerical or symbolic information [2]. In a color image, individual RGB value difference greater than threshold values. Edge detection may depend on the first derivative or the second derivative of the image intensity values.

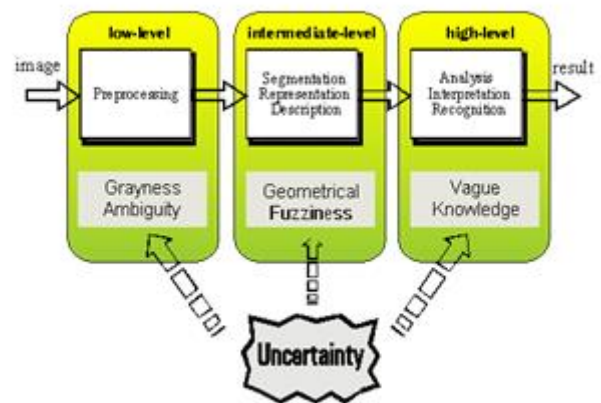


Fig.1: The general structure of fuzzy image processing

Edges and noise both represent a variation in intensity. Usually edge has a large variation between adjacent pixels, compared to additive noise. Use directional gradients to capture variations.

## II. EDGES DETECTION OF IMAGE USING FUZZY APPROACH

Fuzzy techniques can manage the vagueness and ambiguity efficiently and an image can be represented as a fuzzy set. Fuzzy Logic is a powerful tool to represent and process human knowledge in form of fuzzy if-then rules. Edges are extracted from the enhanced image by a two-stage edge detection operator that identifies the edge candidates based on the local characteristics of the image.

The process of classifying and placing sharp discontinuities in an image is called the edge detection. The discontinuities are immediate changes in pixel concentration which distinguish boundaries of objects in a scene. Classical methods of edge detection engage convolving the image through an operator, which is constructed to be perceptive to

large gradients in the image although returning values of zero in uniform regions. There is a very large amount of edge detection techniques available, each technique designed to be perceptible to certain types of edges. Variables concerned in the selection of an edge detection operator consist of Edge orientation, Edge structure and Noise environment.

The major property of the edge detection technique is its ability to extract the exact edge line with good orientation as well as more literature about edge detection has been available in the past three decades. Segmentation based on edge detection mostly consists of two

Steps:

1. Edge detection
2. Edge linking

We can differentiate the target and the background. The basic idea of image detection is to outstand partial edge of the image making use of edge enhancement operator firstly. Then we define the 'edge intensity' of pixels and extract the set of edge points through setting threshold. But the borderline detected may produce interruption as a result of existing noise and image dark. Thus edge detection contains the following two parts:

1) The edge points set are extracted Using edge operators.

2) Some edge points in the edge points set are removed

and a number of edge points are filled in the edge points set. Then the obtained edge points are connected to be a line. The common used operators are the Differential, Log, Canny operators and Binary morphology, etc.

Fuzzy logic includes uncertainties in logical reasoning [5]. It has been applied to image processing in many ways [8]. Segmentation aims at dividing pixels into similar region i.e. crisp sets. Fuzzy segmentation in turn divides pixels into fuzzy sets i.e. each pixel belong partly to many sets and regions of image [6].

There are different possibilities for development of fuzzy logic based edge detections. One method is to define a membership function indicating the degree of edginess in each neighbourhood [6]. This approach can only be regarded as a true fuzzy approach if fuzzy concepts are additionally used to modify the membership values. The membership function is determined heuristically. It is fast but the performance is limited.

The edge detection problem is divided into three stages: filtering, detection, and tracing. Fuzzy reasoning based edge detection has also been popular for edge detection of images affected by noise.

### III. PROPOSED WORK

In this paper we have proposed a new FIS approach over traditional Edge detection Techniques for detecting the edges in digital images with determining the global threshold value. This approach begins by segmenting the images into regions using floating 3x3 binary matrixes. Image thresholding is another method which is used for image segmentation. Fuzzy

techniques are applied for this method. A direct fuzzy inference system mapped a range of values distinct from each other in the floating matrix to detect the edge. For this fuzzy image processing is superimposed over most of the traditional edge-detection algorithms in image processing.

Edge detection algorithm based on fuzzy logic .The instructions of the image edge detection algorithm based on fuzzy logic are as the following.

First acquire the image then convert color image to gray scale, count number of pixels in the image, Generate the histogram. Based on the histogram identify the threshold value. This divides the image into two parts: target and background. Process the images in the fuzzy domain. The purpose is to increase the gap between different gray levels. This can be achieved by both the attenuation processing for pixels with small changes in gray level and the enhancement processing for the ones with large changes. As a result, the contrast of gray level in the edge regions will be enhanced. Finally, detect the edges using conventional algorithms. To get better results before the edge extracting operation, the use of a median filter or an averaging filter for smoothing is suggested.

Fuzzy image processing is the collection of all approaches that understand, represent and process the images, their segments and features as fuzzy sets. The representation and processing depend on the selected fuzzy technique and on the problem to be solved. Fuzzy image processing has three main stages: image fuzzification, modification of membership values, and, image defuzzification.

#### Procedure:

Step 1. Read the image and convert it into gray scale image.

Step 2. Computing the Threshold

The first step before fuzzification is image thresholding. Here thresholding is done by

Global thresholding method.

- Select initial estimate for threshold T.
- Segment the image into two groups  $g_1$  and  $g_2$ . Where  $g_1$  is intensity values greater
  - than or equal T and  $g_2$  is intensity values less than T.
- Compute a new threshold based on  $g_1$  and  $g_2$

Step 3. Computing the Fuzzy Membership value

Step 4. Fuzzy Enhancement

Step 5. Inverse transform of step 2.

The edge detections aim is to determine pixels which are probable edge candidates.

For any one pixel  $(i,j)$  with its gray value equal to  $f_{ij}$ , the 3x3 window centered around

$(i,j)$  is chosen. The mean value  $M_{ij}$  of the gray values of all the pixels in the window is

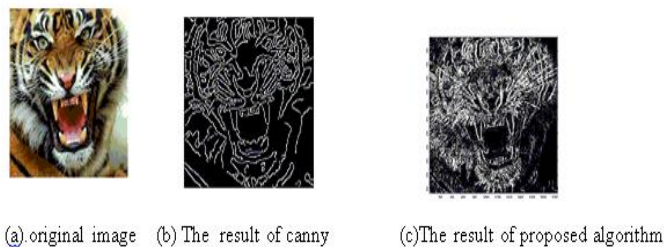
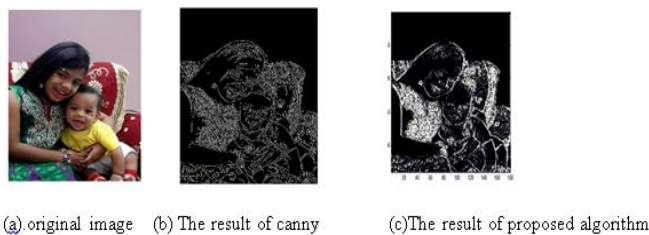
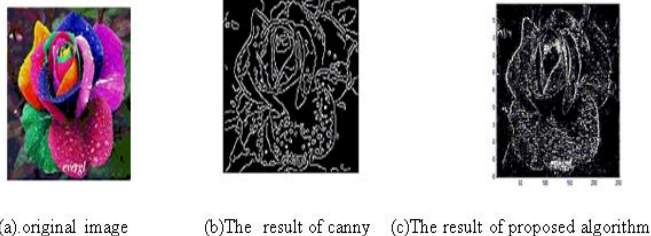
computed. The edge sign is determined according to relationship between  $M_{ij}$  and  $f_{ij}$ .

#### IV. EXPERIMENTAL RESULTS

The accuracy of the proposed algorithm is tested by various images like flower and image. A modified Fuzzy edge detection method was simulated using MATLAB on different images its performance are compared to that of using MATLAB on different images, Otsu's segmentation, watershed segmentation, Canny's edge detector. The entire procedure was implemented and tested using MATLAB7.x [12]

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#### V. CONCLUSION

Some segmentation techniques are studied and implemented in this paper.

Fuzzy image processing is a powerful tool as the fuzzy sets provide a framework for incorporating human knowledge in the solution of problems whose formulation is based on imprecise concepts. in this paper, using the fuzzy logic a very simple and modified fuzzy edge detection method is efficient. The proposed edge detection algorithm based on fuzzy logic defines a new membership function and enhanced operator, applying the fuzzy logic to the threshold value calculation and