www.ijecs.in
*International Journal Of Engineering And Computer Science ISSN:2319-7242*
*Volume 2 Issue 6 June, 2013 Page No. 1855-1860*

# EDGE DETECTION THROUGH FUZZY INFERENCE SYSTEM

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***Abstract***

*In this paper fuzzy inference system (FIS) used to detect edges. FIS is very simple and efficient method; identify the edge without determining a threshold value. This paper is concerned with the change of fuzzy logic rules recognized method which will be capable to detect the edges of image. FIS gives single output value corresponding to multiple input values and identifying the pixel, it is an edge pixel. Fuzzy inference system in MATLAB environment has been developed which gives the output result of the input values used as membership functions*

## 1. INTRODUCTION

Edge detection is one of the basic and most significant operations in image processing because edge detection have a lot of application in image processing**.** The edge detection algorithm is based on segmentation, registration, identification and recognition to detect edges. As volume of awareness, research, and growth of computer vision systems has increased tremendously [1]. An image is defined as a boundary or shape and the gray level value of an image such as an immediate change occurs in some physical aspect. The image components of an edge are of high frequency. The edge detection algorithm identified points in a digital image in which image brightness changes sharply or more formally has discontinuities [2]. Edge detection is typically done with a first and/or second order derivative measurement, its comparison based on threshold, marks the pixel as either belongs to an edge or not. The greatest common procedure applied to edge detection problem is based on linear time-invariant.

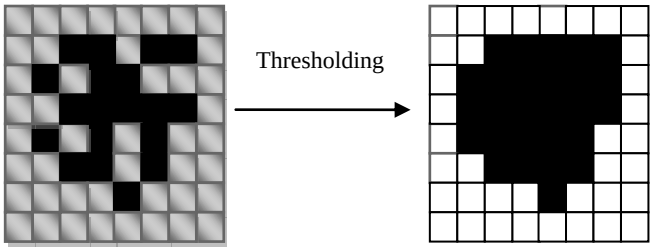


Fig.1 Gray to binary

By carrying out some series of operations within a window centered on the pixel under analysis, traditional operators identify the pixel as a particular class of feature point. When the area of the image, which is under study, is of high contrast, in such circumstances the traditional operators work well. In fact, traditional operators work very well that can be simply converted by simple thresholding into a binary image as shown in Fig1. When an edge, although definite, represents only a small grayscale jump, to be defined as to the failings of traditional operators, traditional edge detector tends to give poor results for labeling edge pixels. Often the human eye can clearly see such edges [3].

Edge Detection is an important task of an image processing. There are different edge detection techniques available, but here we have used fuzzy inference system to detect edges. Fuzzy inference system includes obtaining, processing, analysing, and considerate images, symbolic and numerical information is real world produced by high dimension data [4]. Fuzzy logic model by rotating cell state into a fuzzy cell state, evolution rules of the Fuzzy logic and knowledge-based techniques used for edge detection based on classical techniques some of them are based on training. The recommended techniques objective uses pure fuzzy IF-THEN rules and has simple measures to implement edge detection algorithm.

The fuzzy logic approach doesn't have this restricts, if fixing some parameter changes result of processing. Fuzzy logic simple deal with black and white but it's not satisfying degree of membership. A degree of membership became a new way of solving the problems. A fuzzy set is a set whose elements have degrees of membership. That is, the membership value assigned to an element is no longer restricted to just two values, but can be 0, 1 or any value in-between. A mathematical function which defines the degree of an element's membership in a fuzzy set is called membership function.

In this paper FIS process created on fuzzy logic intellectual approach is recommended for edge detection in digital images without determining the threshold value or need training algorithm. The image divided into floating 3x3 binary matrixes and fuzzy inference system represents a range of values individual from each other in the floating matrix to detect the edge.

## 3. IMAGE CLASSIFICATION

As show in fig. 2 neighbours of central pixel P5 can be computed by absolute intensity difference between neighbour pixels, its neighbour pixel are P1,P2…..P8.

$D1=|P_5-P_1| +|P_9-P_5|$

$D2=|P_5-P_2| +|P_8-P_5|$

$D3=|P_5-P_3| +|P_7-P_5|$

$D4=|P_5-P_4|+ |P_6-P_5|$

D1+D2+D3+D4

| | | |
|---|---|---|
| P1 | P2 | P3 |
| P4 | P5 | P6 |
| P7 | P8 | P8 |

s multi values

| | | |
|---|---|---|
| P1 | P2 | P3 |
| P4 | 0 | P6 |
| P7 | P8 | P8 |

vectors zy set

Fig.2 3*3 Neighbouring pixel

membership function known as fuzzy classification. It provides output feature vector either black or white. In decision making system fuzzy truths are mainly used [5].

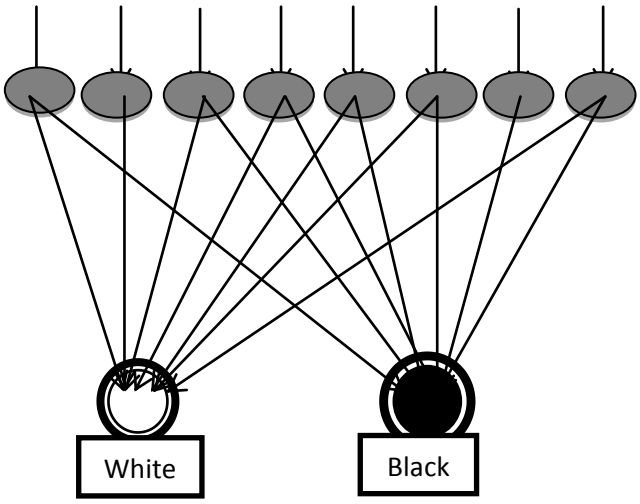


Fig.3 Fuzzy classification modal

## 4. EDGE DETECTION THROUGH FUZZY INFERENCE SYSTEM

Edge detection is a middle step in the pattern recognition of digital images and has the conflicting effects of noise elimination; it consists of highlighting pixels with gray tones that are different than their neighbors. Fuzzy inference is the procedure of transmitting a given input value to an output using fuzzy logic. A fuzzy inference system is given for four inputs and one output. The four inputs are the four pixel values of the window mask used.

The process of fuzzy inference involves: fuzzification, membership functions, fuzzy logic. [1] The fuzzification and defuzzification does not need hardware. Therefore, the fuzzification and defuzzificaion (coding of data and decoding of data) are phases that construct possible to procedure images with fuzzy systems.

Variation in membership values are the core step of fuzzy image processing system, when image values are transformed from gray level values to membership values. (fuzzification), appropriate fuzzy techniques modify the membership values. This can be a fuzzy clustering, a fuzzy rule-based approach, and a fuzzy integration approach and so on. [6]

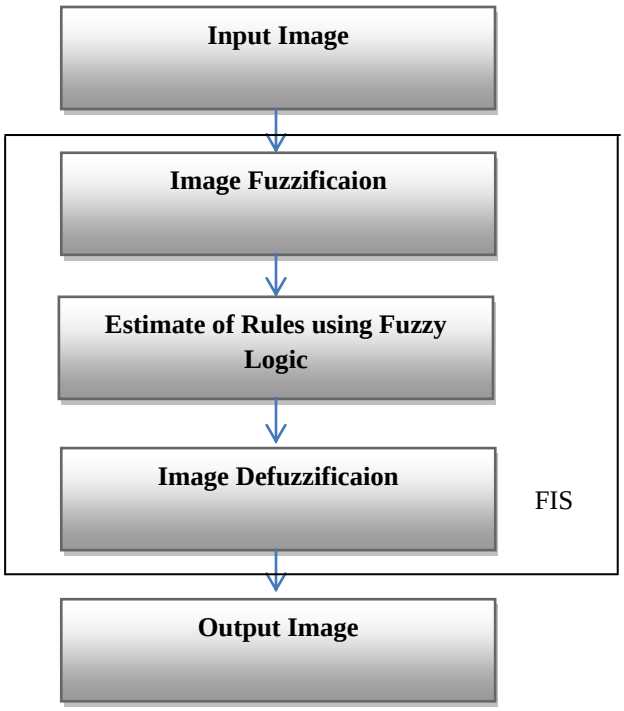


Fig.4 Simple block diagram

The fuzzification of input is achieved by two essential trapezoidal membership functions called Black and White. An evaluation of these two functions, all the image pixels (crisp set) is classified into Black or White fuzzy sets. The pixels are fuzzified in the fuzzy inference system,

and rule base of FIS, have been defined to apply implication on the inputs. The inference rules depend on the weights of neighbours i.e. P1, P2… $P_n$ and itself, i.e. the weights are degree of Black or degree of White. These weights are combined using AND operator as defined in the rule base. The output of applying implication is again fuzzy. These fuzzy outputs of all rules are combined into a single fuzzy set by aggregating them with the OR (max) operation.

There are two kinds of defuzzification that can be applied in the Fuzzy Logic Toolbox:

- Mamdani-type and
- Sugeno-type.

Mamdani's fuzzy inference scheme is a more compact and computationally efficient representation, fuzzy approach and it expects the output membership functions to be fuzzy sets [7]. After the aggregation process, there is a fuzzy set for each output variable that needs defuzzification. The output membership functions are either linear or constant in which any inference system can be used to Sugeno-type systems. This fuzzy inference system was introduced in 1985 and also is called Takagi-Sugeno-Kang.

## 4. ALGORITHM

a) Read the input gray scale image AxB.
b) Fixed the initial masks window pixel P1, P2, P3, P4……P8.
c) Fuzzy set with membership functions white and black map to input pixels.
d) Fuzzy t-norms operator (MIN or PRODUCT) on MFs firing strength computing.
e) Fuzzy rules are fired for each crisp input.
f) Aggregate resultant output FS for all fired rules are achieved by using a MAX operator.
g) Defuzzification is achieved using the centroid method.
h) Crisp output is the pixel value of the output image, i.e. one containing the edge , black White regions.
i) Slide the mask window to the next pixel and repeat until last pixel is checked.

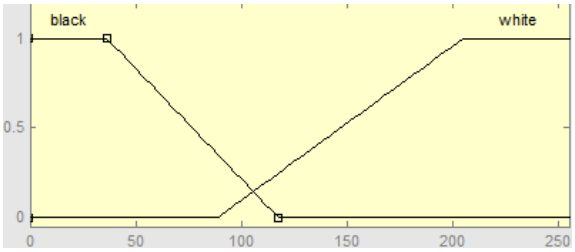


Fig.5 Membership functions of the fuzzy sets associated to the input

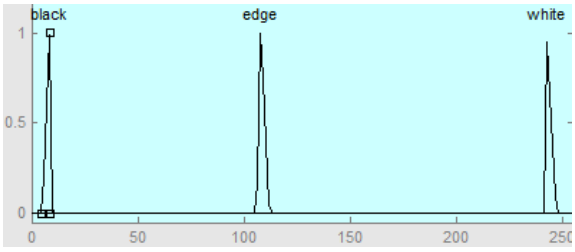


Fig.6 Membership functions of the fuzzy Sets associated to the output

## 5. RULES BASED SYSTEM

1) If P1 is black and P2 is black and P3 is black and P4 is black then P4 is black

2) If P1 is black and P2 is black and P3 is black and P4 is white then P4 is edge
3) If P1 is black and P2 is black and P3 is white and P4 is black then P4 is edge
4) If P1 is black and P2 is black and P3 is white and P4 is white then P4 is edge
5) If P1 is black and P2 is white and P3 is black and P4 is white P4 then p4 is edge
6) If P1 is black and P2 is white and P3 is white and P4 is black then P4 is edge
7) If P1 is black and P2 is white and P3 is white and P4 is white then P4 is edge
8) If P1 is white and P2 is black and P3 is black and P4 is black then P4 is edge
9) If P1 is white and P2 is black and P3 is black and P4 is white then P4 is edge
10) If P1 is white and P2 is black and P3 is white and P4 is black then P4 is edge
11) If P1 is white and P2 is black and P3 is white and P4 is white then P4 is black
12) If P1 is white and P2 is white and P3 is black and P4 is black then P4 is black
13) If P1 is white and P2 is white and P3 is black and P4 is white then P4 is edge
14) If P1 is white and P2 is white and P3 is white and P4 is white then P4 is white

## 5. CONCLUSION

Fuzzy Image processing is an important tool of an edge detection and formulation of expert knowledge edge and the combination of imprecise information from different sources. FIS is an attractive solution to improve the quality of edge as much as possible. These algorithms provide a better compare to the other edge detection algorithm .This work may extend for bright and dark images because this algorithm is only detect edges of a gray image. Further optimization of FIS can be done by using other soft computing techniques.

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