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Novel Edge Detection Using Adaptive Neuro-Fuzzy Inference System

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Abstract— This paper proposes the implementation of a very simple but efficient Adaptive Neuro-Fuzzy Inference System (ANFIS)based algorithm to detect the edges of an gray scale image. The proposed approach begins by scanning the images using floating 3x3 pixel window. ANFIS system designed has 8 inputs, which corresponds to 8 pixels of instantaneous scanning matrix, one output that tells whether the pixel under consideration is "edge" pixel or a background pixel. The internal parameters of the proposed ANFIS edge detector are optimized by training using a proposed dataset. The edges are directly determined by ANFIS network. The results of proposed method are compared with the linear Sobel operator and Roberts operator.

Keywords-Adaptive Neuro-Fuzzy Inference System; Edge Detection;Sobel Operator; Roberts Operator.

I. INTRODUCTION

Images have always been very important in human life. Soft Computing is an emerging field that consists of major seminal theories which include fuzzy logic, genetic algorithms, evolutionary computation, and neural networks .In the last few years there is an increasing interest on using soft computing (SC) techniques to solve image processing real-world problems covering a wide range of domains. Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene. Edge detection i is usually done with a first and/or second derivative measurement following by a comparison with threshold which marks the pixel as either belonging to an edge or not. The result is a binary image which contains only the detected edge pixels. Usage of specific linear time-invariant (LTI) filter is the most common procedure applied to the edge detection problem, and the one which results in the least computational effort. In the case of first-order filters, an edge is interpreted as an abrupt variation in gray level between two neighbor pixels. A very important role is played in image analysis by what are termed feature points, pixels that are identified as having a special property. Feature points include edge pixels as determined by the well-known classic edge detectors of PreWitt, Sobel, Marr, and Canny. Recent research has concerned using neural Fuzzy Feature to develop edge detectors, after training on a relatively small set of proto-type edges, in sample images classifiable by Classic edge detectors. This work was pioneered by Bezdek et al, [1] who trained a neural net to give the same fuzzy output as a normalized Sobel Operator.

In the system described in [2, 3], all inputs to the fuzzy inference systems (FIS) system are obtained by applying to the original image a high-pass filter, a first-order edge detector filter (Sobel operator) and a low-pass (mean) filter. The whole structure is then tuned to function as a contrast enhancing filter and, in another problem, to segment images in a specified number of input classes. The adopted fuzzy rules and the fuzzy membership functions are specified according to the kind of filtering to be executed.

In the system described in [4], present a novel adaptive neuro-fuzzy inference system (ANFIS) for edge detection in digital images. The internal parameters of the proposed ANFIS edge detector are optimized by training using very simple artificial images.

In [5] a new edge detection technique is proposed basis on the BP neural network. Here, it is classified the edge patterns of binary images into 16 possible types of visual patterns. In the following, after training the pre-defined edge patterns, the BP neural network is applied to correspond any type of edges with its related visual pattern

In [6, 7] novel method based on fuzzy logic reasoning strategy is proposed for edge detection in digital images without determining the threshold value. The proposed approach begins by segmenting the images into regions using floating 3x3 binary matrix. The edge pixels are mapped to a range of values distinct from each other

In this paper, we present a novel adaptive neuro-fuzzy Inference system (ANFIS) for edge detection of an

image. The key features of our approach which differentiate us from others is the use of image content and adaptive neuro-fuzzy Inference system for edge detection of application-specific image. The result has been compared with the standard algorithms. The proposed technique can be extended for color images as well.

II. ANFIS METHOD

Adaptive neuro fuzzy inference system (ANFIS) combines the advantages of fuzzy logic and neural networks. The ANFIS is a fuzzy rule- based network possessing neural network's learning ability. A major characteristic of the network is that no pre- assignment and design of the rules are required. The rules are constructed automatically during the on-line operation. Two learning phases, the structure identification as well as the parameter learning phases are adopted on-line for the construction task. The structure identification determine the proper number of rules needed i.e., finding how many rules are necessary and sufficient to properly model the available data and the number of membership functions for input and output variables. Fig.1 displays a high level diagram of the proposed ANFIS. Inputs and their membership functions appear to the left of the ANFIS structural characteristics, while outputs and their membership functions appear on the right.

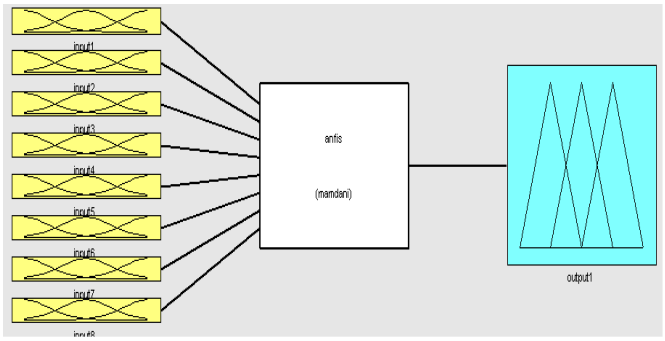

Figure 1. Diagram of the proposed ANFIS

A. Preposed method

The proposed ANFIS detector is a first-order Sugeno type fuzzy inference system with 8-inputs and 1-output. Each input has 2 triangular type membership functions and the output has a constant membership function. The proposed method is shown in Fig. 1 .To detects edges in a grey level image, we firstly binarize the image by Otsu's method threshold value. Researchers have proposed a number of techniques to improve selecting thresholds or to provide some criteria for optimal decisions for threshold selection

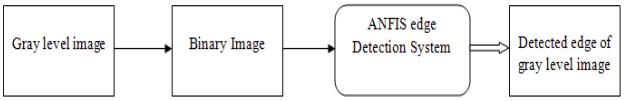

Figure 2. Basic Block Diagram

Binary image disintegrate to 3x3 windows and generate a set of image pattern and then we classified edge patterns in binary images into 32 categories, as shown in Fig. 3, and we train the ANFIS on these patterns. the blank elements in each 3x3window indicate white (pixels va1ue :1s) in binary images, whereas the dark elements indicate black (pixels value: 0s)

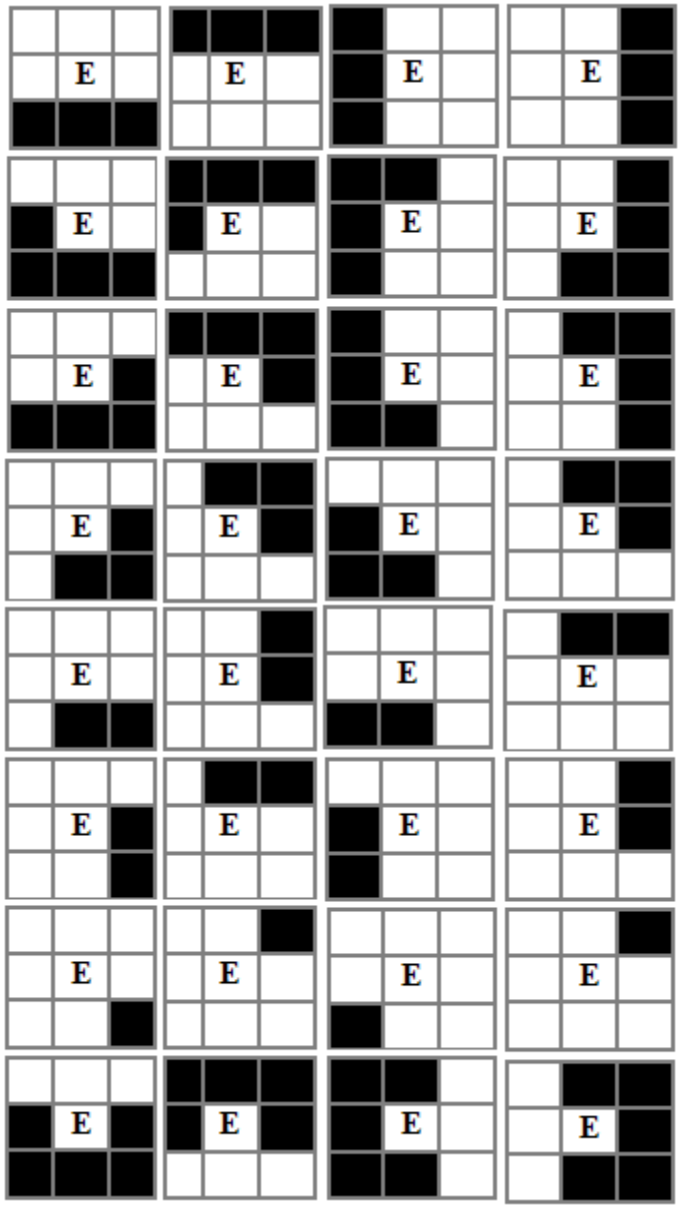

Figure 3.Possible type of input patterns

B. Designed ANFIS

The most difficult part of any ANFIS training problem is defining the proper training set. A simple method is recommended for the edge detection training problem. Training of ANFIS can be accomplished by preparing a dataset in the following manner

Input pattern	Output pattern
1 1 1 1 1 0 0 0	1
0 0 0 1 1 1 1 1	1
0 1 1 0 1 0 1 1	1
1 1 0 1 0 1 1 0	1
0 0 1 0 1 0 1 1	1
1 1 0 1 0 1 0 0	1
0 1 1 0 1 0 0 1	1
1 0 0 1 0 1 1 0	1
0 0 0 0 1 1 1 1	1
1 1 1 0 1 0 0 0	1
0 0 0 1 0 1 1 1	1
1 1 1 1 0 0 0 0	1
1 0 0 1 0 1 1 1	1
1 1 1 1 0 1 0 0	1
0 0 1 0 1 1 1 1	1
1 1 1 0 1 0 0 1	1
0 1 1 0 1 1 1 1	1
1 1 1 0 1 0 1 1	1
1 1 1 1 1 0 0 1	1
0 0 1 1 1 1 1 1	1
1 1 1 1 1 1 0 0	1
1 1 1 1 0 1 1 0	1
1 1 0 1 0 1 1 1	1
1 0 0 1 1 1 1 1	1
0 0 0 0 0 1 1 1	1
0 0 1 0 1 0 0 1	1
1 1 1 0 0 0 0 0	1
1 0 0 1 0 1 0 0	1
0 1 1 1 1 1 1 1	1
1 1 1 1 1 0 1 1	1
1 1 1 1 1 1 1 0	1
1 1 0 1 1 1 1 1	1

TABLE I. PROPOSED TRAINING PATTERN

The designed ANFIS system is given eight inputs and generates one output. The Eight inputs are the eight pixel values (p1, p2, p3, p4, p6, p7, p8, p9) of the window mask used. Take an image object to be learned and slide it from point to point across all locations of a window which will be the input window to the pattern detection network. We also notice that the two margin rows and two margin columns around the image cannot be processed and a kind of padding required. When the whole binary image is scanned by the input pixel window, we obtain the edges.

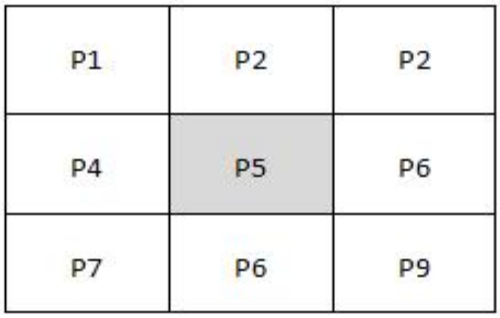

Figure 4. Floating 3x3 pixel window mask

III. RESULTS

The proposed system was tested with different Images, its performance being compared the existing edge detection algorithms such as Sobel and Roberts and it was observed that the outputs of this algorithm provide much more distinct marked edges and thus have better visual appearance than the standard existing It can be observed that the output that has been generated by the ANFIS system has found out the edges of the image more distinctly as compared to that have been found out by the "Sobel" and "Roberts" edge detection algorithm. Thus the ANFIS based System extract the edges with a very high efficiency.

Figure 5(a).Original image

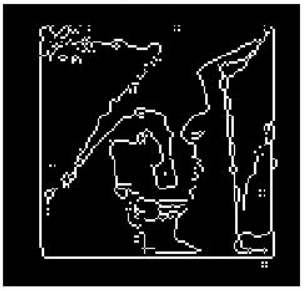

Figure 5(b).Edge detection with proposed method

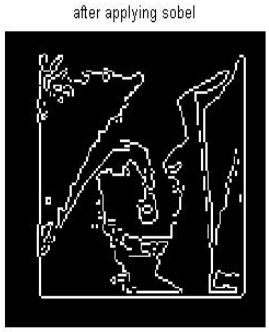

Figure 5(c).Edge detection using the Sobel operator

Figure 5(d).Edge detection using the Roberts operator

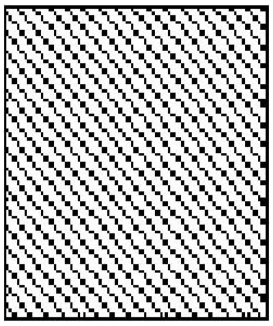

Figure 6(a).Original image

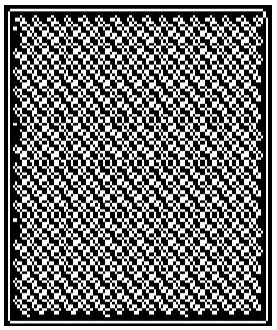

Figure 6(b).Edge detection with proposed method

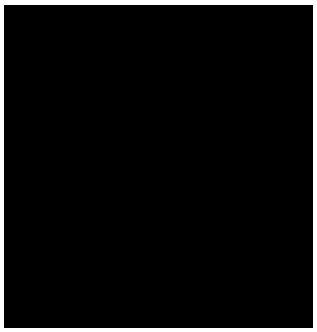

Figure 6(c).Edge detection using the Roberts operator

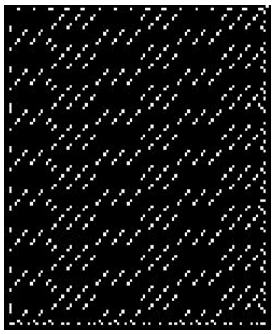

Figure 6(d).Edge detection using the Sobel operator

IV. CONCLUSION

In this paper, a novel ANFIS based edge detection approach is described. We have conducted a number of experiments and the results show that our designed ANFIS simply converging because of small training set and our approach is superior to traditional edge detection operators. It is concluded that the proposed edge detector can be used for efficient extraction of edges in digital images.

V. REFERENCES

[1] Kuo, R. J.: A robotic die polishing system through fuzzy neural networks, Comput. Industry 32(3) (1997), 273–280.
[2] Tizhoosh H.R., "Fast fuzzy edge detection", Proceedings of Fuzzy Information Processing Society, 2002, pp. 239-242.
[3] Lin, C. T. and Lee, S. G.: Reinforcement structure/parameter learning for neural network based fuzzy logic systems, IEEE Trans. Fuzzy Systems
[4] Lei Zhang, Mei Xiao, Jian Ma and Hongxun Song " Edge Detection by Adaptive Neuro-Fuzzy Inference System" 2009 IEEE
[5] Hamed Mehrara , Mohammad Zahedinejad andAli Pourmohammad "Novel Edge Detection Using BP Neural Network Based on Threshold Binarization" 2009 Second International Conference on Computer and Electrical Engineering, pp 408-412
[6] Abdallah A. Alshennawy, And Ayman A. Aly, "EDGE DETECTION IN DIGITAL IMAGES USING FUZZY LOGIC TECHNIQUE" . World Academy of Science Engineering and Technology 51 2009. PP 178-186
[7] Begol, Moslem and Maghooli,Keivan "Improving Digital Image Edge Detection by Fuzzy Systems World Academy of Science, Engineering and Technology 81 2011,pp 76-79

