Compare the Performance and Effectiveness of Proposed Edge Detector against Conventional Edge Detection Techniques

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Abstract:- *Edge detection the most important technique of image processing to tackle with the uncertain issues while extracting useful information from images. In this work an edge detection method is proposed with the help of neuro-fuzzy systems, known as Adaptive Neuro-fuzzy Inference System (ANFIS). Sugeno fuzzy Model is used to produce the desired result of images with the help of hybrid algorithm. Experimental results show that ANFIS edge detector method performs better if compared with conventional methods such as robert, sobel's methods*.

Keywords:- Edge detection, neuro-fuzzy system, ANFIS, hybrid algorithm.

I INTRODUCTION

Edge detection is the process of locating and identifying sharp discontinuities in an image. These are the abrupt changes in pixel intensity which represent boundaries of objects in a scene. Detection of edges is a pre-processing step to extract some boundary features which are used for further processing [1][2]. In recent years several methods have been developed for edge detection such as mathematical morphology, wavelet transformation, roberts, prewitt, sobel, Zero-crossing, Canny etc. [3]. Traditional edge detectors were based on a rather small 3x3 neighborhood, which only examined each pixel's nearest neighbor. This may work well but due to the size of the neighborhood that is being examined, there are limitations to the accuracy of the final edge. These local neighborhoods will only detect local discontinuities, and it is possible that this may cause false edges to be extracted. A more powerful approach is to use a set of first or second difference operators based on neighborhoods having a range of sizes (e.g. increasing by factors of 2) and combine their outputs, so that discontinuities can be detected at many different scales [4]. Edge detectors based on gradient concept are the Roberts [6], Prewit and Sobel [5] show the effect of these filters on the sensing images. Now a days a combination of neural networks and fuzzy logic, neuro-fuzzy got so much attention due to its robustness and capability of dealing

with some uncertain conditions during information extraction. NF combines the abilities of both NN and FL and then train the system with the help of parameters [7]. In the proposed method edges are directly determined by the ANFIS edge detector. The proposed edge detector is tested on popular images and a variance in result is seen in comparison of robert and sobels method.

II PROPOSED METHOD

The name of the proposed method is derived from adaptive neuro-fuzzy inference system (ANFIS). With the help of input/output data sets ANFIS creates a fuzzy inference system in which member function are adjusted using backpropagation algorithm in combination with least square method. Fig.1 shows the proposed diagram of ANFIS. ANFIS edge 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. Therefore 256 rules were taken.

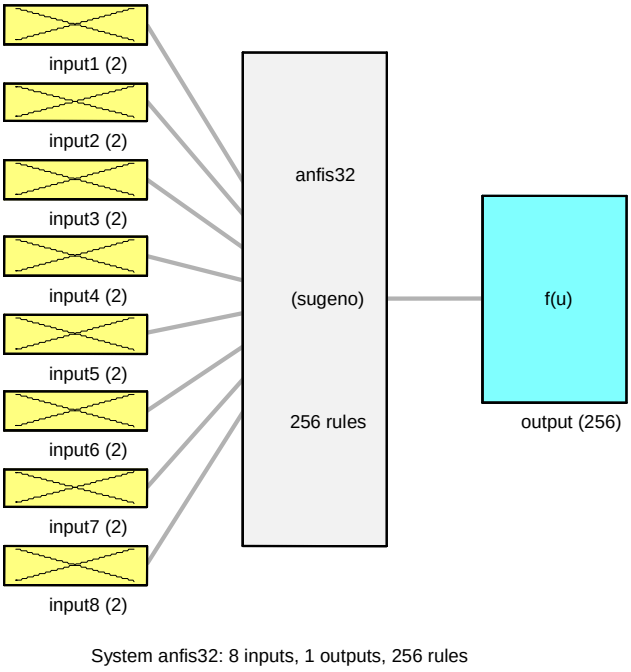

Fig.1 Proposed dig. of ANFIS

III TRAINING OF ANFIS DETECTOR

ANFIS uses a hybrid learning algorithm to identify parameters of Sugeno-type fuzzy inference systems. The internal parameters of the proposed ANFIS edge detector are optimized by training. Here, the parameters of the ANFIS under training are iteratively adjusted so that its output converges to the output of the ideal edge detector which, by definition, can correctly detect the locations of the edge pixels of the image fed to its input. The hybrid algorithm is composed of a forward and a backward pass. The least squares method (forward pass) is used to optimize the consequent parameters with the premise parameters fixed. Once the optimal consequent parameters are found, the backward pass starts immediately. The gradient descent method (backward pass) is used to adjust optimally the premise parameters corresponding to the fuzzy sets in the input domain. The output of the

ANFIS is calculated by employing the consequent parameters found in the forward pass.

Table 1

ANFIS information (triangular membership function)

Learning Algorithm	Hybrid
Number of nodes	555
Number of linear parameters	256
Number of nonlinear parameters	48
Total number of parameters	304
Number of training data pairs	32
Number of checking data pairs	0
Number of fuzzy rules	256
No. of Epoch's	100

The ideal edge detector is conceptual only and does not necessarily exist in reality. It is only the output of the ideal edge detector that is necessary for training, and this is represented by the target training image. With the following ANFIS information given in Table-1, the training error plot is shown in Fig.2

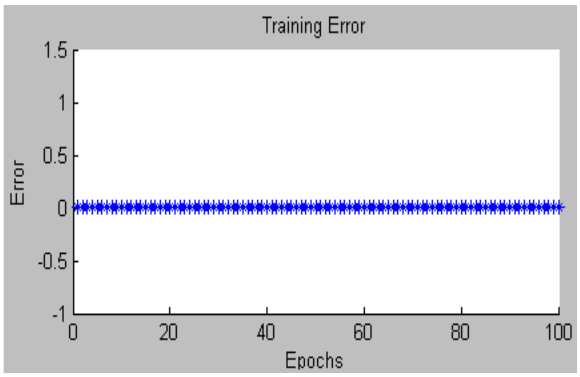

Fig.2: Error plot after Training

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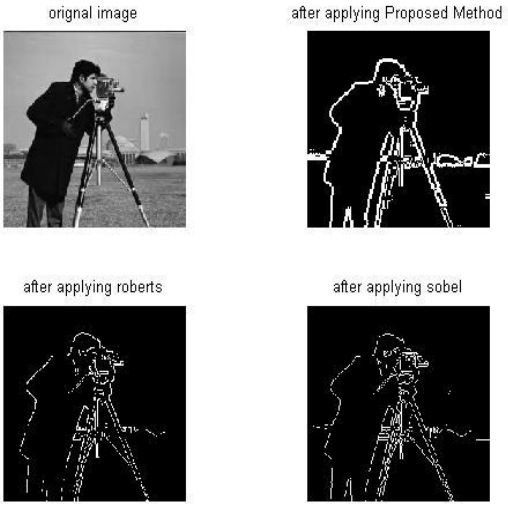
IV RESULTS

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 3X3 window mask used as shown in Fig. 3. The experiment has been performed in MATLAB 2011a.

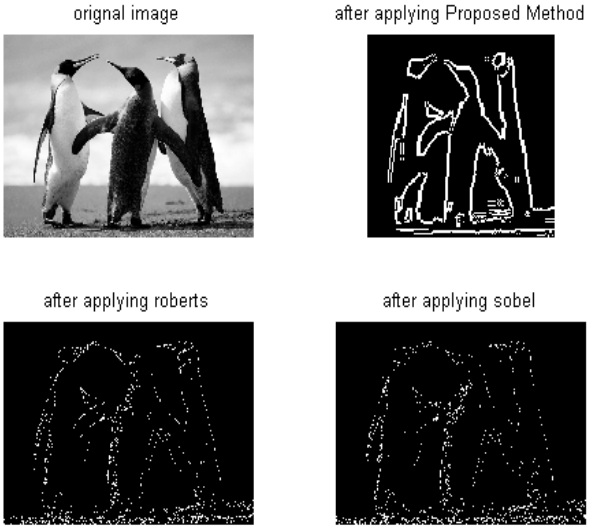
P1	P2	P3
P4	**P5**	P6
P7	P8	P9

We have compared the proposed approach with the roberts and sobels edge detector. We have taken number of edges and peak to signal ratio (psnr) as the performance evaluation criteria and make a comparison

of proposed model with other methods. Experimental studies reveal that the result of the proposed method detects dominant edges clearly and computes the peak signal-to-noise ratio, between two images. This ratio is often used as a quality measurement between the original and edge detected image. The higher the PSNR, the better the quality of the compressed, or reconstructed image. We have taken the image of cameraman and the image of penguins for making the comparison.



Edge Detection Methds	**No. of edges**	**psnr**
Proposed Method	1513	49.6590
Roberts Method	766	49.5102
Sobel Method	753	49.5000



Edge Detection Methds	**No. of edges**	**psnr**
Proposed Method	1943	49.8359
Roberts Method	1	49.5668
Sobel Method	1	49.5725

V CONCLUSION

From the above work, the fuzzy method and applied corrections in rules and digital processing has significantly improved digital edge detection compared with conventional methods. This method performs well in objects where small image details are not so important. This technique performed well in detecting image edges and while eliminating image noise, has successfully maintained edges.

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