a) Lena image corrupted with 5% noise

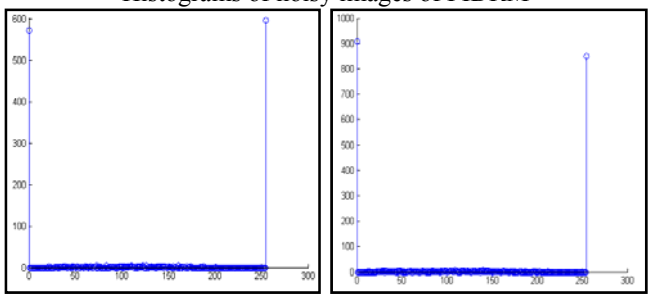
b) Lena image corrupted with 7% noise

c) Lena image corrupted with 9% noise

d) Lena image corrupted with 11% noise

Fig 3 Lena image corrupted with different impulse noise intensities

Histograms of noisy images of FIDRM



a) Histogram of 5% noisy image

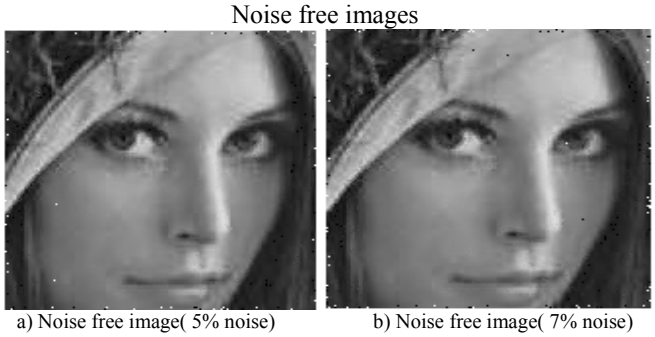
b) Histogram of 7% noisy image

c) Histogram of 9% noisy image

d) Histogram of 11% noisy image

Fig.4 Histograms of four noisy images of Lena describe in Fig.3 respectively

Noise free images



a) Noise free image(5% noise)

b) Noise free image(7% noise)

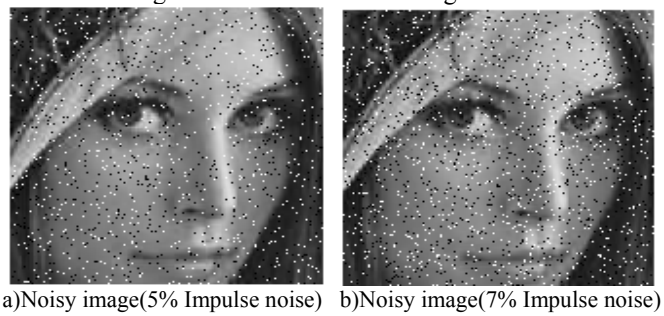
c) Noise free image(9% noise)

d) Noise free image(11% noise)

Fig. 5 Images of Lena after filtered through one step FIDRM

B. Results of Two step FIDRM

Reference image is same as described in fig. 2



a)Noisy image(5% Impulse noise)

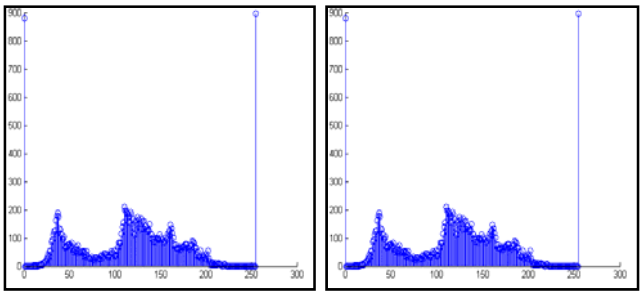
b)Noisy image(7% Impulse noise)

c)Noisy image(9% Impulse noise)

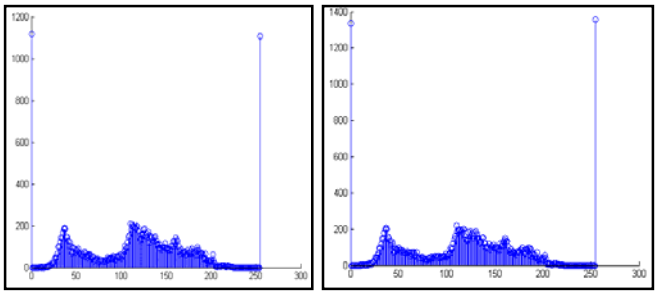
d)Noisy image(11% Impulse noise)

Fig. 6 Images corrupted by impulse noise of different intensites

Histograms of Two step FIDRM



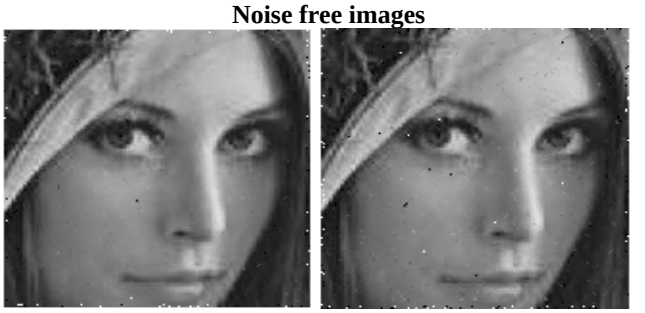
a) Histogram of noisy(5%) image b) Histogram of noisy(7%) image



c) Histogram of noisy(9%) image d) Histogram of noisy(11%) image

Fig. 7 Histogram of impulse noise corrupted images in fig. 6

Noise free images



a) Noise free image(5% noise) **b) Noise free image(7% noise)**

c) Noise free image(9% noise) **d) Noise free image(11% noise)**

Fig. 8 Two step filtered images corrupted by impulse noise

Table 2. Comparison of one step and Two step FIDRM (PSNR)

Noise	1 Step	2 Step
5%	37.97	38.89
7%	35.66	35.48
9%	33.88	33.13
11%	31.90	31.79

Table 3. Comparison of one step and Two step FIDRM (MSE)

Noise	1 Step	2 Step
5%	10.44	8.45
7%	17.76	18.52
9%	26.79	31.84
11%	42.24	43.38

Table 4. Comparison of one step and Two step FIDRM (Time taken)

Noise	1 Step	2 Step
5%	15.9	21.71
7%	17.0	23.23
9%	17.42	24.80
11%	16.78	24.87

From these results it is proved that Two step FIDRM is better than One step FIDRM in terms of picture quality, edge noise removal, PSNR ratio.These filters are also compared with conventional filters which are described in section 2.2. Their results in terms of PSNR(db) is compared with One step FIDRM and Two step FIDRM in Table 5.

Table 5. Comparison with other conventional fillters

Filters	PSNR(db)
Rank order mean filter	31.01
Progressive switching median filter	31.28
AWCM	34.77
Differential ranked impulse detector	36.01
Enhance ranked impulse detector	36.06
Tristate median filter	36.06
Two output filter	24.92
One step FIDRM	37.97
Two step FIDRM	38.89

IV. CONSLUSION & FUTURE WORK

Four parameters of a test window are supplied to a fuzzy membership function. Upon constructing the consequent membership function and subsequent defuzzification a decision is made on the noise status of the center pixel of the window. The restored images of these two schemes exhibit the desirable properties of edge and detail preservation. The inherent correlation among the pixels is exploited in these two schemes. However, it has a drawback of not making the threshold as adaptive.

Various test images of different extensions are fed to the system. The images are corrupted with salt and pepper noise. The filter is seen to preserve intricate features of the image while removing heavy impulse noise where as the conventional mean and median filters fail in this context even at low corruption levels. The learning of fuzzy rules in a fuzzy image filter with a true hierarchical fuzzy logic structure where the output of the first layer is fed in to the second layer to obtain an 'improved' final output. The evaluation parameters PSNR and Evaluation time taken are evaluated. The program generates positive PSNR and is above 20dB which is considered to be the best ratio. The overall execution time which the program takes is approximately 15 seconds. In future, modification of fuzzy rules can produce better result.

V. REFERENCES

[1] Gonzalez, R.C., Woods, R.E., Book on "Digital Image Processing", 2nd Ed, Prentice-Hall of India Pvt. Ltd.

[2] Carl Steven Rapp, "Image Processing and Image Enhancement", Texas, 1996.

[3] R. Vorobel, "Contrast Enhancement of Remotely-Sensed Images," *in 6th Int. Conf. Math. Methods in Electromagnetic Theory,* Lviv, Ukraine, Sept 1996, pp. 472-475.

[4] Tizhoosh, "Fuzzy Image Processing", © Copyright Springer, 1997.

[5] Farzam Farbiz, Mohammad Bager Menhaj, Seyed A. Motamedi, and Martin T. Hagan, "A new Fuzzy Logic Filter for image Enhancement" IEEE Transactions on Systems, Man, And Cybernetics—Part B: Cybernetics, Vol. 30, No. 1, February 2000

[6] P. Fridman, "Radio Astronomy Image Enhancement in the Presence of Phase Errors using Genetic Algorithms," *in Int. Conf. on Image Process.,* Thessaloniki, Greece, Oct 2001, pp. 612- 615.

Jyoti Chauhan received B.Tech degree in Information Technology from M.D.U in 2009 and is persuing M.Tech. in CSE. Her areas of interest are Image Processing, Mobile Ad hoc Networks.

Dr. S. S. Tyagi received B.Tech in Computer Science and Engineering from Nagpur University and M.E from BITS, Pilani and Ph.D in Computer Science from Kurukshetra University, Kururkshetra. Presently, he is working as Professor in Computer Engineering department in Manav Rachna International University, Faridabad. His areas of interests are Wireless Security, Mobile Ad hoc Networks and Wireless Mesh Networks