An Efficient Decision Tree Based Denoising Algorithm for Removal of Impulse Noise

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Abstract--- *Noise filtering and image enhancement are two active areas of research in signal processing. For the time ofsignal acquisition and transmission, impulse noise may corruptthe digital data. To overcome this, switching median filters aregenerally used which consist of impulse detection and noisefiltering. In this paper, an efficient decision tree based denoisingtechnique is presented for removal of random valued impulsenoise. The design uses a 3x3 mask on each and every pixel inthe image to verify whether it is corrupted by noise. To identifynoise pixels, we propose a new tree based impulse noise detector.The noisy pixels are then reconstructed by an algorithm whichpreserves edges in the image. This method achieves excellentimage quality as shown by the simulation results.*

Keywords--- *Improved Decision Tree, Impulse Noise, Image Denoising*

I. INTRODUCTION

THERE are many applications in image processing for areas such as face recognition, remote sensing, techniques for scanning and medical imaging. The images may get corrupted by impulse noise. This could happen during acquisition and transmission. So, efficient denoising technique plays an important role in the world of image processing. The distributions of noisy pixel intensities are different in many cases. They are broadlyclassified into the following, fixed valued impulse noise (saltand-pepper noise) and random valued impulse noise. In the case of random valued impulse noise, the distribution is uniform and because of the random nature, it is difficult to remove them. The focus of this work is to eliminate random valued impulse noise from the corrupted images. There are different methods available for this purpose [5], [6], [7],[8],[9]. Some methods make use of standard median filter [5] or its alterations [6], [7]. The approach here is to introduce a modification of both noisy and noise-free pixels, which blurs the image. The methods in [8], [9] use an efficient switching strategy so as to avoid the damage on the pixels that are noise free. The method of switching median filters work in two steps. First, impulse noise is detected and then noise is filtered. The detection is done by an impulse detector, and only the pixels which are detected are further processed. The decision tree is a powerful form of multivariable analysis [10]. A complex decision is divided into smaller simpler steps. There have been several decision tree based methods [4],[12]. A novel adaptive decision tree based noise detector is presented in [2]. Here, a decision tree based noise detector isfollowed by an edge preserving filter.

In this paper, we propose an improved decision tree baseddenoising method (IDTBDM) based on decision-trees forelimination of random-valued impulse noise. This methodconsists of an impulse noise detector based on improveddecision tree. The experimental outcome ensures the betterperformance of the proposed technique, if we analyse theimages with respect to the visual quality and quantitativeevaluation when compared with the other denoising methods[5], [6],[7], [8], [9].

The rest of the paper is systematized as follows: SectionII describes the proposed IDTBDM. Section III describes theimplementation results. We conclude the paper in section IV.

II. PROPOSED IDTBDM

In this paper, random valued impulse noise which is uniformlydistributed is considered as in [5],[9] and [10]. Weaccept a 3x3 mask for image denoising. Let pixel which is to be denoised is at coordinate *(i, j).*The pixel is denoted as$p_{i,j}$and its luminance value is noted as$f_{i,j}$as shown in Fig. 1. In an image input sequence, we divide eight other adjacent pixels values into two groups: W_{T_Half} andW_{B_Half}. Theyare given as in equation (1) and (2).

$$W_{T\_Half} = \{a, b, c, d\} \quad (1)$$

$$W_{B\_Half} = \{e, f, g, h\} \quad (2)$$

	j-1	j	j+1
i-1	a	b	c
i	d	$f_{(i,j)}$	e
i+1	f	g	h

Fig. 1: A 3 x 3 Mask Centered on $p_{i,j}$

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IV. CONCLUSION

In this paper we introduced an efficient decision tree based algorithm for the removal of impulse noise. The main advantageof this method is that it is of very low complexity. The simulation results show that the PSNR values of our algorithm are better than the existing ones. There is approximately 2dB improvement across different images. The visual quality is also observed to be better.Currently we are working on VLSI implementation of thisalgorithm.

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