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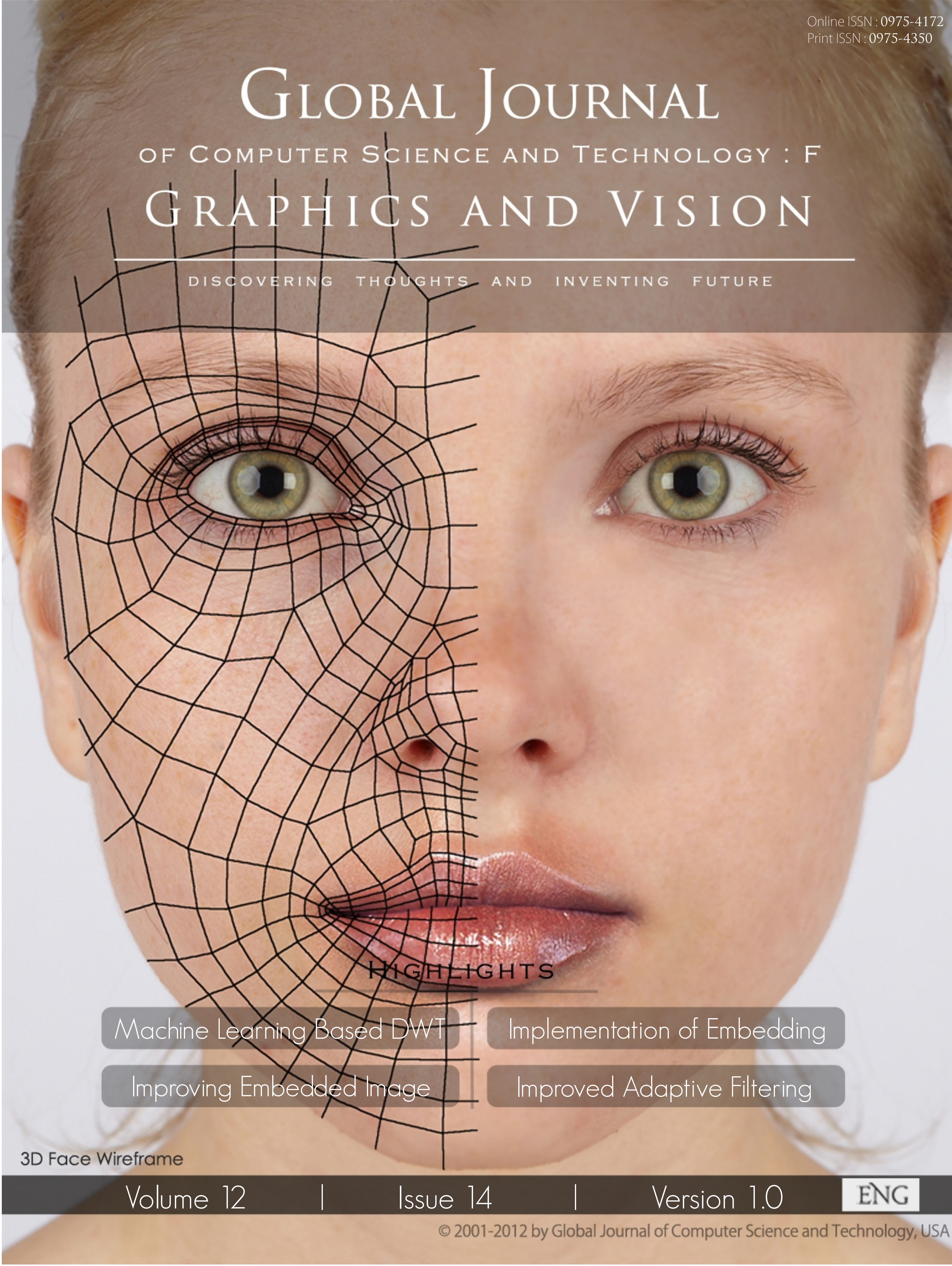

3D Face Wireframe

HIGHLIGHTS

- Machine Learning Based DWT
- Implementation of Embedding
- Improving Embedded Image
- Improved Adaptive Filtering

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Image Outlier Filtering (IOF): A Machine Learning Based DWT Optimization Approach

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IMAGE OUTLIERFILTERINGIOFAMACHINELEARNINGBASEDDWTOPTIMIZATIONAPPROACH

Strictly as per the compliance and regulations of:

Image Outlier Filtering (IOF): A Machine Learning Based DWT Optimization Approach

R.Sunitha α & Yugandhar Dasari σ

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I. Introduction

Outlier filtering from a specific type of data entails changeover and organizing the data in a way which is easily represented. Images are in wide use today, improving the visual clarity, decreasing the resource required to transmit and store of a given image is a benefit. With images, lossy compression, outlier reduction is generally allowed as long as the losses and outliers are subjectively unnoticeable to the human eye.

Depending on training given the use of machine learning techniques in wide areas helps in choosing of contextual limits. So the use of machine learning techniques in the process of signal and image encoding and decoding has been promoted. The images can be compressed by training LS-SVM a machine learning approach for regression to assign set of values, which can be further approximated using hyper parameters.

The paper further describes (i) use of machine learning techniques to related work in image processing. (ii) Use of knowledge in proposed outlier filtering approach. (iii) Optimization of Optimal-HAAR Wavelet Changeover using mathematical design. (iv) Optimization of QPSO based parameter search. (v) Design for LS-SVM Regression under QPSO. (VI) Proposed outlier filtering approach. (vii) Comparative analysis of the proposed model and existing DBA[6A] standard results.

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II. Related Work

Noise reductions are basically classified into two types 1) linear techniques and 2) Nonlinear techniques. In linear techniques noise reduction formula is applied to all pixels of image linearly without classifying pixel into noisy and non noisy pixels. The drawback of linear algorithms is it damages the non noisy pixels because the algorithm is applied for both noise and non noisy pixels. Examples of linear filters are average, mean, median filters etc. Nonlinear Noise reduction is a two step process 1) noise detection and 2) noise replacement [20-33]. In the first step, location of noise is detected and in a second step, detected noisy pixels are replaced by estimating value. In literature so many algorithms are proposed but with the low noise condition (up to 50% noise ratio), such algorithms works well but in high noise conditions performance of these algorithms is poor. To improve the range of noise reduction non linear techniques, MMF (Min-Max Median Filter) [20], CWMF (Center Weighted Media Filter)[21], AMF (Adaptive Median Filter) [22], PSMF (Progressive Switching Median Filter) [23], TMF(Tri-state Median Filter)[24] and DBA (Decision Based Algorithm) [25] algorithms are proposed.

The drawback of these algorithms is that as soon as the noise ratio increases the time required to process noise also increases and takes too much time that is not suitable for actual world purpose. To progression real time videos very high speed algorithms are required.

The use of Machine learning algorithms in image dispensation has seen growth in recent times. A procedure using back-propagation algorithm of neural network in a feed-forward network has been introduced by M H Hassan et al [1]. By using this algorithm, compression ratio of 8:1 could be achieved. Another method of image coding using Vector Quantization (VQ) on Discrete Cosine Transform (DCT) coefficients using Coonan map was introduced by Amerijckx et al [2], was

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considered to be better than other noise removal standards because its ratios were more than 30:1. An outlier filtering method that executes SVM regression on DCT coefficients was introduced by Robinson et al [3]. An SVM regression model with different parameters from [3] was introduced by Kecman et al [4].

Outlier Filtering practices are on the whole classified into two forms 1) linear practices and 2) Nonlinear practices. In linear practices noise lessening formula is applied to all pixels of image linearly without classifying pixel into noisy and non noisy pixels. The drawback of linear algorithms is it damages the non noisy pixels as the algorithm is applied for both noise and non noisy pixels. Examples of linear filters are average, mean, median filters etc. Nonlinear Noise lessening is a two step process 1) noise exposure and 2) noise substitution [20-33]. In the first step, location of noise is detected and in a second step, detected noisy pixels are replaced by estimating value. In literature so many algorithms are projected but with the low noise state, such algorithms work well but in high noise conditions act of these algorithms is poor. To improve the range of noise lessening non linear practices, MMF (Min-Max Median Filter) [20], CWMF (Center Weighted Media Filter) [21], AMF (Adaptive Median Filter) [22], PSMF (Progressive Switching Median Filter) [23], TMF (Tri-state Median Filter)[24] and DBA (Decision Based Algorithm) [25] algorithms are proposed.

The drawback of these algorithms is that as soon as the noise ratio increases the time required to process noise also increases and takes too much time that is not suitable for real world application. To process real time videos very high speed algorithms are required.

In this regard a machine learning based DWT optimization approach for outlier filtering is proposed. The aim of the work is to describe the usage of novel mathematical models to optimize DWT model such as FHT, QPSO, which is an optimal model for selecting hyper parameters for SVM. The result of outlier filtering is the considerable and comparative studies with linear and nonlinear standards concluding the significance of the proposed model.

III. Standards used in Proposed Oulier Filtering Approach (OFA)

a) HAAR and Optimal-HAAR Wavelet Changeover

In the linear and nonlinear outlier filtering process DWT is considered as important [5]. For images we require two-dimensional (2D) DWT separating the image into four parts i.e. into approximation coefficients and three detailed coefficients including horizontal, vertical, and diagonal coefficients. There is no loss of the lower frequency position of the image whereas there is a loss in the higher frequency position which does not affect the vision quality. The original image is preserved and we can apply the DWT to the recent image obtained which is known as wavelet packet decomposition which appears like inverted tree structure. The chattels of the HAAR and FHT as follows:

- HAAR changeover is optimal orthogonal. Therefore

$Hr = Hr^*$ (1) & $Hr^{-1} = Hr^T$ (2)

- HAAR Changeover is quick and has a deprived energy compaction for images
- HAAR matrix vectors are sequential.
- Linear and Orthogonal progression: This enables splitting the signal into high and low frequencies without any duplication and symmetric filters have to be used to achieve linearity.
- Condensed sustain: In cases of frequency where the magnitude is zero the changeover is said to be energy invariant.
- Perfect restoration: If the inversely changeover signal is similar to the input signal which was earlier changeovers and also if it avoid redundancy than the reconstruction is perfect.

Daubechies, bi-orthogonal and HAAR wavelets are optimal Selectives of the changeover [1]. These wavelets satisfy all needs of their application. The advantages of HAAR Wavelet changeover as follows:

- Scalable in terms of calculation is the best and also its speed is miles ahead of other models.
- HAAR changeover is a simple and efficient attribute elimination method for compression and outlier removal.
- As there is no replication, the memory space required is less.

i. *Optimal-HAAR Changeover*

HAAR procedure as a step method be able to present as:

$$f(t) = [[t]];$$

$$H(t) = 1 \qquad 0 <= t < 1;$$

$= 0$ Elsewhere.

The HAAR changeover of an array of n samples:

The average of each pair of samples is determined. ($n/2$ averages). Next the difference between the average and the samples from which it was calculated. ($n/2$ differences). The array is designed as: the first half of the array with averages and the second half of the array with differences. Repeat the process on the first half of the array. (The array length should be a power of two)

Average / Difference

Let 'l' and 'r' be two samples with difference'd' and average 'a'

$$a = (l + r) / 2, \ d = a - l = r - a$$

Can be written as : $l = a - d, r = a + d$

Thus we generate for the process:

$$a_n = \bigcup_{n=1}^{N/2} \frac{\sum_{m=n-1}^{n} fm}{\sqrt{2}} \quad d_n = \bigcup_{n=1}^{N/2} \frac{\sum_{m=n-1}^{n} k.fm}{\sqrt{2}}$$

Where k is -1 for $m = n-2 \ldots n$

b) Quantitative Particle Swarm Optimization

When physicists like Heinsenberg, Schrodinger, Neils Bhor started contributing to the quantum mechanics[6],the subject of particle kinematics became more confusing .How ever according to the classical PSO the position (xi) and velocity (vi) of the particle are enough to decide the particle trajectory but this wasn't satisfying the Uncertainty principle of Heinsenberg.But if the quantum behavior of the particles is considered than it would be diverting from the classical PSO [7].The quantum mechanics states $\psi(x,t)$ as a wave function and $|\psi(x,t)|^2$ as a density function, the form of which depends on the potential field the particle lies in [10].

The iterative equations [8], [9] shown below describe the motion of the particle:

$$x(t+1) = p + \beta * | mbest - x(t) | * \ln(1/u) ifk \geq o.5$$

$$x(t+1) = p - \beta * | mbest - x(t) | * \ln(1/u) ifk < o.5$$

Where,

$p = (c_1 p_{id} + c_1 p_{gd})/(c_1 + c_2)$

mbest = $\bigcup_{k=1}^{d} 1/M \sum_{i=1}^{M} Pik$

Mean-Best (mbest) of the population is the mean of the best location of every particle. 'u', 'k', 'c1' and 'c2' are uniformly distributed random numbers over the interval $[0, 1]$. 'b' Is contraction-extension coefficient. The subsequent procedure used to solve QPSO explained below:

(i) Instigate the swarm.
(ii) Evaluation of best mean and particles position is optimized.
(iii) 'P_{best}'and 'P_{gbest}' are rearranged till the specified iterations are obtained.

c) LS-SVM

The tribulations like pattern identification, categorization and deterioration can be solved by using a valuable tool called Support vector machine (SVM) projected by Vapnik [12, 13]. SVM scales in minimizing structural risk and because of its recompenses when matching up to other methods it has got a lot of gratitude [9, 12]. Both linear and nonlinear regression is performed and solutions are obtained from the formulas. The nonlinear equations solutions are used to compute the least SVM model. A modified version of SVM called least-squares SVM was introduced for simple achievement of results by Suykens and Vandewalle[14]. The clear introduction of SVM [15, 16], theory of LS-SVM by Suykens et al [14, 15] and application of LS-SVM in quantification and classification [17, 18] is described.

A linear relation $(y = w_x + b)$ between regression (x) and a reliant variable (y) is fit by LS-SVM and is considered to be optimum if the cost method (Q) containing a penalized regression error is minimized:

$$Q = \frac{1}{2} w^T w + \frac{1}{2} \gamma \sum_{i=1}^{N} e_i^2 \qquad (1)$$

Subject to: $y_i = w^T \phi(x_i) + b + e_i \quad i = 1, \ldots\ldots, N \qquad (2)$

Firstly the regularization of weight sizes is done using cost function as a weight decay because of which there are no changes in the values of weight. Secondly for the training data cost function is the regression error. The user optimizes the comparison between the current and first part which is represented by 'g'.

The combination of parameters indicates the performance of LS-SVMs. To attain support vector the kernel function is used as the radial basis function (RBF) and the degree of the Gaussian and polynomial functions are used for optimization. To obtain a good generalized model for the RBF kernel and the polynomial kernel a proper selection of parameters and regularization constant g is to be done.

IV. Image Oulier Filtering Approach(OFA)

a) Optimal-HAAR Changeover- OHC

There is no requirement of coefficients leaving the level 0 during the reconstruction process in multi-resolution wavelet and are ignored to reduce the storage space. 2^N data are applied in FHT.

For approximation instead of $\frac{(x+y)}{2}$ we use $\frac{(w+x+y+z)}{4}$ and for the differentiating process instead of $\frac{(x-y)}{2}$ we use $\frac{(w+x-y-z)}{4}$. On calculating '$\frac{(w+x-y-z)}{4}$', '$n-2$' level detailed coefficients are obtained and for further detail coefficients differentiating process $\frac{(x-y)}{2}$ is to be calculated, which is done using matrix formulation.

The following procedure represents the computation of decomposition for the OHC for 2^N data:

$q = \frac{N}{4}$;

Coefficients:

$$N = 2^n$$

$$q = 2^n / 4$$

$$a_m = \bigcup_{m=0}^{2^n/q-1} \frac{\sum_{p=0}^{2^n/q-1} f((2^n/q)m + p)}{N/q}$$

If N is divisible by 4 detailed coefficients are given by

$$d_m = \bigcup_{m=0}^{2^n/q-1} \frac{\sum_{p=0}^{x/2} f((2^n/q)m + p) + \sum_{p=x/2}^{x} -f((2^n/q)m + p)}{2^n/q}$$

If N is divisible by 2 detailed coefficients are given by

$$d_y = \bigcup_{y=1}^{N/2} \frac{\sum_{m=y-1}^{y} k.fm}{\sqrt{2}} \text{ Where k is } -1 \text{ for } m = n-2\ldots n$$;

In any other situations the detailed coefficients are given by

$$d_m = \bigcup_{m=2^n/2}^{2^n} \partial$$ Where ∂ is considered to be zero

b) *Optimized Least Significant Particle based QPSO [OLSP-QPSO]*

A new Swarm particle is used instead of least good swarm particle so as to obtain optimized QPSO. By putting a quadratic polynomial technique on best fit swarm particles a new equation is obtained, depending on which new particle is recognized. Replacement is possible if the new swarm particle obtained is better than the least good swarm particle and after each search lap the same procedure is followed.

The optimized QPSO is obtained using the following procedure:

Step 1: Instigate the horde.

Step 2: Compute 'mbest'

Step 3: elements spaces ought to be restructured.

Step 4: The vigor significance of every element is measured.

Step 5: On matching up to the current vigor significance and the best vigor significance (Pbest), either is best is taken into account.

Step 6: Update 'Pgbest'

Step 7: A fresh element is to be traced.

Step 8: On matching up to the fresh element with most awful element either is better is taken into account.

Step 9: Go over step 2 till utmost iterations are attained.

On by means of the following table the swarm particle can be obtained. The swarm particle can be found using the following.

$t_i = \sum_{k=1}^{3} (p_i^2 - q_i^2) * f(r)$	$p = a, q = b, r = cfork = 1;$ $p = b, q = c, r = afork = 2;$ $p = c, q = a, r = bfork = 3$
$t1_i = \sum_{k=1}^{3} (p_i - q_i) * f(r)$	$p = a, q = b, r = cfork = 1;$ $p = b, q = c, r = afork = 2;$ $p = c, q = a, r = bfork = 3$

$$\overset{o}{x}_i = 0.5 * (\frac{t_i}{t1_i})$$

Where 'a' is considered as a best fit swarm particle, 'b' and 'c' are considered as randomly selected swarm particles $\overset{o}{x}_i$ are considered as a new swarm particle.

Regression by '$LS-SVM$' and agitated parameter selection by '$QPSO$'

Considering the training set of *N* data points $\{x_t, y_t\}_{t=1}^{N}$ where $x_t \in R^d$ input data is and $y_t \in R$ is output data. Further LS-SVM regression technique can be written as $y(x) = w^T \phi(x) + b$ ………….……… (1)

Where the input data is mapped $\phi(.)$.

The below set of linear equations provides results to LS-SVM for function estimation:

$$\begin{bmatrix} 0 & 1 & \cdots & 1 \\ 1 & K(x_1, x1) + 1/C & \cdots & K(x_1, x_1) \\ . & . & . & . \\ . & . & & . \\ 1 & K(x_1, x_1) & & K(x_1, x_1) + 1/C \end{bmatrix} \begin{bmatrix} b \\ \alpha_1 \\ . \\ . \\ \alpha_1 \end{bmatrix}$$

$$= \begin{bmatrix} 0 \\ y_1 \\ . \\ . \\ y_1 \end{bmatrix} \ldots\ldots.(2)$$

$K(x_i, x_j) = \phi(x_i)^T \phi(x_j)^T \ fori, j = 1....L$ And on applying the Mercer's condition the following LS-SVM model for function estimation is obtained:

$$f(x) = \sum_{i=1}^{L} \alpha_i K(x, x_i) + b \text{ ....(3)}$$

α , b represents solution of the linear system, K(.,.) indicates nonlinear mapping of high dimensional feature spaces from the input space x. Using Eq. (3) function is approximated by LS-SVM. Here we consider the radial basis function (RBF) as the kernel faction:

$$k(x_i, x_j) = \exp(-\| x - x_t \|^2 / \sigma^2)$$

The generalization error can be reduced by proper use of hyper-parameters like kernel width parameter σ and regularization parameter C which are used during the training LS-SVM problem.

c) Outlier Filtering: Optimizing Transformation by Machine learning

i. *Hyper-Parameters Selection Based on OLSP-QPSO*

The optimization of hyper-parameter is done to get better L2 loss result in least-square SVR. The optimized hyper-parameters using QPSO can be obtained using two key elements: (i) representation of hyper-parameters as the particle's position i.e. [10, 11] are too encoded. (ii) Obtaining the goodness of a particle by defining the fitness function. The following will give the two key factors.

ii. *Training Hyper-parameters:*

The parameters kernel and regularization are used to optimize hyper-parameters for LS-SVM. A hyper-parameters combination of dimension 'm' is represented in a vector of dimension 'm', such as $x_i = (\sigma, C)$ where each particle represents a potential solution which can be solved using the model OLSP-QPSO (Optimized Least Significant Particle based QPSO), which is represented in the graph 5.1

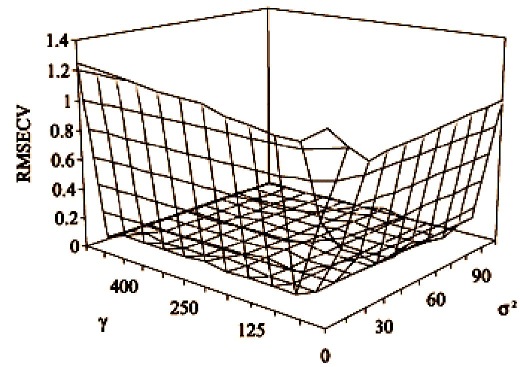
iii. *Vigor method :*

There are different descriptions for generalization performance which is measured using vogor Method and is represented as given below:

$$vigor = \frac{1}{RMSE(\sigma, \gamma)} \text{ .... (12)}$$

'$RMSE(\sigma, \gamma)$' Represents the root-mean-square error of obtaining values and it differs as the LS-SVM parameters σ, γ) vary. The biggest fitness is equivalent to the optimal values of LS-SVM when the end results are achieved.

The approaches to stop criterion are: (i) if the threshold value ε is more than the objective function (ii) if the mentioned iterations are obtained. OLSP-QPSO-Trained LS-SVM algorithm is as below:



Graph 5.1: Hyper-Parameter optimization response surface under OLSP-QPSO for LS-SVM

1) Randomly each particle is positioned with a vector ix and iP = iX. Hyper-parameters act as a part of each element position vector used to arrange LS-SVM.
2) LS-SVM is to be trained.
3) Using Eq.(12) vigor significance of each particle, personal 'iP' and global gP best position is obtained.
4) On achieving termination proceed with step (6) else step (5).
5) Using Eq.(7) each particle position vector is rearranged and then proceed to step (2).
6) Optimized parameters is a part of the gP.

iv. *Outlier Filtering :*

Using LS-SVM regression and OLSP-QPSO coefficients are achieved and further process for outlier filtering is explained.

- The image can be used as both in blocks and multitude blocks of custom size.
- Considering OHC each block is assigned with 2D-DWT images and its detailed coefficients and result is obtained.
- To generalize the data by minimum support vectors on independent coefficient matrices using LS-SVM regression under OLSP-QPSO, obtaining the appropriate coefficient values.
- Using the Huffman - coding principle to filter the coefficients that are distinct.

V. Results Discussion

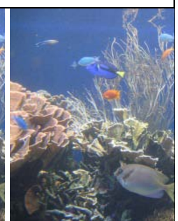
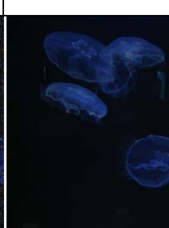
Original Image	Image with outliers	Resultant of DBA	Resulatant of OFA
			
Original Image	outliers by guassian model with intensity of 0.12	Ouliers filtered by DBA	Outliers filtered by OFA
			
Original image	Outliers by poisson model with intensity of 0.25	Ouliers filtered by DBA	Outliers filtered by OFA
			
Orginal Image	Ouliers of speckle with intensity of 0.40	Ouliers filtered by DBA	Outliers filtered by OFA

Table 1: Images and results of outlier filtering by DBA and OFA

Selection of images which have accuracy and are photographic is done carefully for the purpose of outlier filtering. These images are obtained from past data or from other sources and are minute in size with accuracy 8-bit, 16-bit, 16-bit linear variations, RGB and gray. The images can be copied without any limit for experiment's purpose from [19]. The pictorial representation of the original, noise added, DBA [25] noise removal standard and oulier filtering approach that proposed is shown in table 1.

VI. Results Analysis

For Outlier filtering of RGB images comparison between proposed model and DBA was made. The influence of the oulier filtering ratio on existing DBA[25] and proposed OFA model has been compared in the form of PSNR and RMSE percentage.

Fig 1 : The Image considered for Comparative study.

Table 1 : The results obtained from existing DBA standard:

Quality	Oulier filtering ratio (R)	Size compressed ratio	PSNR	RMSE
1	388	3.107804	28.606872	10.33527
2	211	5.546348	33.788950	6.702779
3	161	7.298222	34.898287	4.903699
4	117	9.497002	36.347839	4.661059
5	98	11.80054	39.279044	2.967337
6	83	13.77292	36.833082	4.893237
7	76	16.12473	39.239933	3.429187
8	61	18.90566	41.435035	2.674366
9	59	20.62013	42.706003	1.971018
10	55	23.19557	39.396384	3.355773
11	47	25.61548	43.675025	2.638899
12	46	27.66886	43.713415	1.755872
13	44	29.82042	46.295324	1.335152
14	40	32.07001	46.063484	1.514999
15	34	34.93525	47.350056	1.891448
16	33	36.06998	45.465762	1.894038
17	35	38.50481	46.568662	2.09902
18	28	40.70558	45.391035	1.861799
19	26	43.87018	44.324986	2.312027
20	24	45.23771	44.099152	2.666287

Table 2 : Results Obtained from OFA

QUALITY	Oulier filtering ratio (R)	Size compressed ratio	PSNR	RMSE
1	569.00	2.744253	28.77016	10.48553
2	249.00	5.022253	34.10943	6.152693
3	184.00	6.183361	36.21566	4.619115
4	133.00	9.212381	36.50637	4.813236
5	103.00	11.40636	39.52442	3.307031
6	96.00	11.62107	36.69631	4.523026
7	73.00	15.66123	39.69439	3.205598
8	67.00	18.16065	41.6445	3.209784
9	57.00	19.91655	43.71898	2.229024
10	54.00	21.33654	39.62734	2.993972
11	46.00	24.14933	43.73133	2.309553
12	44.00	26.34806	45.09799	2.074782
13	41.00	28.83657	46.99521	1.49826
14	39.00	32.14516	46.86183	1.578477
15	37.00	33.84327	47.41084	1.485134
16	34.00	35.31944	45.60309	1.861443
17	31.00	38.29239	46.46973	1.6009
18	29.00	40.00721	45.8981	2.119537
19	28.00	42.6345	44.74294	2.448485
20	26.00	43.49564	43.87592	2.273431

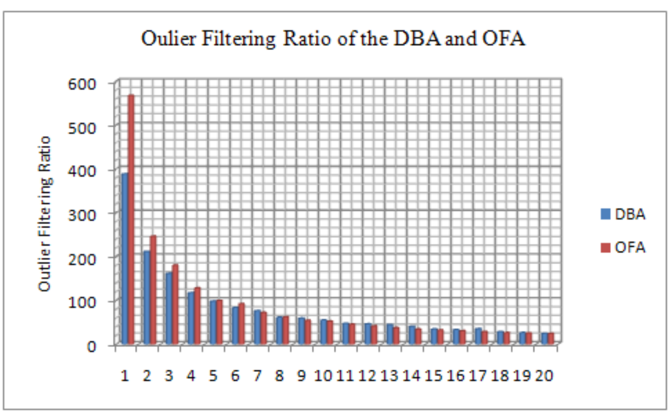


Fig 2 : The 20 different outlier filtering ratios applied under DBA and OFA models

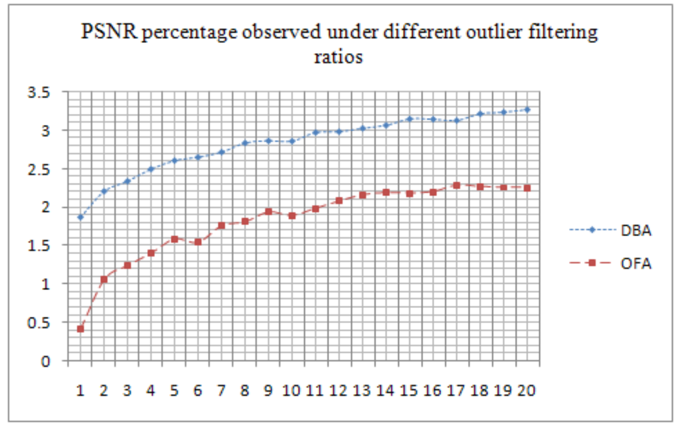


Fig 3 : A comparison chart that indicating the PSNR percentage at different outlier filtering ratios for DBA and OFA models

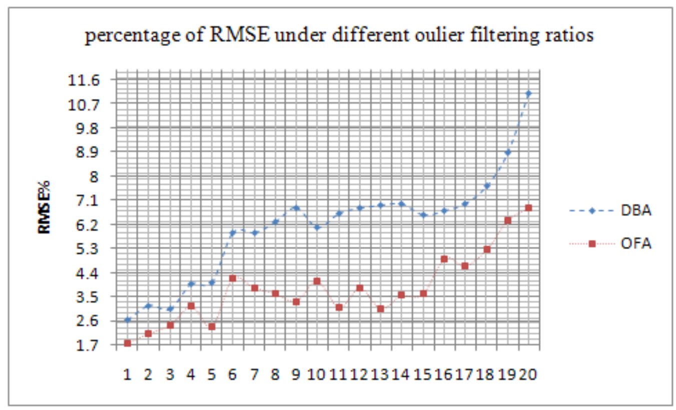


Fig 4 : A comparison chart that indicating the RMSE percentage at different outlier filtering ratios for DBA and OFA models.

VII. Conclusion and future Work

In this paper we have explored a new machine learning model for outlier filtering from RGB images. To apply on coefficients collected from DWT, LS-SVM regression model was introduced and the model selected hyper coefficient using QPSO. Two mathematical models were proposed to optimize the process of outlier filtering: (i) to optimize the Fast HAAR, which results in better performance and reduces the complexity which results in new Wavelet changeover i.e. Optimal-HAAR Changeover (OHC). (ii) To optimize the QPSO by replacing the least good particle with the new best obtained particle which results in OLSP-QPSO (Optimized Least Significant Particle based QPSO). Finally we can conclude that an optimized LS-SVM regression model for outlier filtering from RGB images has been proposed using models for OHC and OLSP-QPSO. On comparing the proposed model with existing linear and nonlinear standards we conclude that proposed model is better. In future this work can be extended to outlier filtering from multimedia standards.

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Implementation of Embedding and Extracting Watermarking

By Kareem Mohammed Jubor
Thiqar university-Iraq

Abstract - In this paper, we used an image with a gray scale (256 bits) and bmp type. An image can be converted into binary file by using one of filters (Sober, Prewitt, and Robert) to find edges of the original image. Then we input the watermark to prove the authentic and password that used as a key for ciphering the information. This information will embed by using the Vigenere system that will store the cipher information in the edge of the image. As a result invisible watermark is not noticeable to viewer and without any degrade the quality of the content. The product invisible watermark is robust against distortions processes and resistant to intentional tampering solely intended to remove the watermark. Only the person who know the password and watermark and the cipher system, can read the information, we use a visual basic 6.0 program to implement this work.

Keywords : image processing, filters, edge detection, information hiding, cryptography.

GJCST-F Classification: I.4.0

EVALUATING PERFORMANCE OF WEB SERVICES IN CLOUD COMPUTING ENVIRONMENT WITH HIGH AVAILABILITY

Strictly as per the compliance and regulations of:

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Keywords : image processing, filters, edge detection, information hiding, cryptography.

I. Introduction

There has been a rapid growth in digital imagery and digital watermark technology recently. Especially, the recent growth of network multimedia system has caused problems regarding the protection of intellectual property right such as the true image, the audio and video data [1]. Digital watermark technology has been developed quickly during the recent few years and widely applied to protect the copyright. The watermark is a digital code irremovable robustly and imperceptibly embedded in the host data and typically contains information about origin, status, and destination data [2].Given the motivation to protect intellectual property, Digital Watermarking has been suggested as a form of copyright protection and a deterrant to those wishing to obtain images illegally [3].

While the cryptographic techniques provide secrecy for the communication by scrambling a message which cannot be understood a cryptographic message can be intercepted by an eavesdropper because the encrypted message brings suspicion especially in military communications [4]. So, there is need for embedding data in a way that should be invisible to a human observer and doesn't make any suspicion. Then we encrypt the information by using Vigenere system, to prevent any unauthorized persons from getting the information [5].

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II. Edge Detection

The edge and line detection operators presented here represent the various types of operators in use today. Many are implemented with convolution masks, and most are based on discrete approximations to differential operators. Differential operations measure the rate of change as a function of (in this case) the image brightness function. A large change in image brightness over a short spatial distance indicates the presence of an edge [6]. Some edge detection operators return orientation information (information about the direction of the edge), whereas others only return information about the existence of an edge at each point. Also included in this section is a special transform, the Hough Transform, which is specifically defined to find lines [7].

Edges detection methods are used as a first step in the line detection process. Edge detection is also used to find complex object boundaries by marking potential edge points corresponding to places in an image where rapid changes in brightness occur. After these edges points have been marked, they can be merged to form lines and object outlines [8].

With many of these operators, noise in the image can create problems. That is why it is best to preprocess the image to eliminate, or at least minimize, noise effects. To deal with noise effects, we must make tradeoffs between the sensitivity and the accuracy of an edge detector [9].

Edge detection operators are based on the idea that edge information in an image is found by looking at the relationship a pixel has with its neighbors. If a pixel's gray-level value is similar to those around it, there is probably not an edge at that point. However, if a pixel has neighbors with widely varying gray levels, it may represent an edge point. In other words, an edge is defined by a discontinuity in gray-level values. Ideally, an edge separates two distinct objects. In practice, apparent edges are caused by changes in color or texture or by the specific lighting conditions present during the image acquisition process [8, 9].

a) Roberts Operator

The Roberts operator marks edge points only; it does not return any information about the edge orientation. It is the simplest of the edge detection operators and will work best with binary images (gray-level images can be made binary by a threshold

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operation). There are two forms of the Roberts operator. The first consists of the square root of the sum of the differences of the diagonal neighbors squared, as follows

$$\sqrt{[I(r,c)-I(r-l,c-l)]^2+[(I(r,c-l)-I(r-l,c)]^2} \qquad (1)$$

The second form of the Roberts operator is the sum of the magnitude of the differences of the diagonal neighbors, as follows:

$$|I(r,c) - I(r-l,c-l)| + |I(r,c -l) - I(r-l,c)| \qquad (2)$$

The second form of the equation is often used in practice due to its computational efficiency- it is typically faster for a computer to find an absolute value than to find square roots.

b) Sobel Operator

The Sobel edge detection masks look for edges in both the horizontal and vertical directions and then combine this information into a single metric.

At each pixel location we now have two numbers: s1, corresponding to the result from the row mask, and s2, from the column mask. We use these numbers to compute two metrics, the edge magnitude and the edge direction, which are defined as follows

$$\text{EDGE MAGNITUDE} = \sqrt{s_1^2 - s_2^2} \qquad (3)$$

$$\text{EDGE DIRECTION} = \tan^{1}\left[\frac{s_1}{s_2}\right] \qquad (4)$$

The edge direction is perpendicular to the edge itself because the direction specified is the direction of the gradient, along which the gray levels are changing.

c) Prewitt Operator

The Prewitt is similar to the Sobel, but with different mask coefficients.

These masks are each convolved with the image. At each pixel location we find two numbers: p1, corresponding to the result from the row mask, and p2, from the column mask. We use these results to determine two metrics, the edge magnitude and the edge direction, which are defined as follows

$$\text{EDGE MAGNITUDE} = \sqrt{p_1^2 + p_2^2} \qquad (5)$$

$$\text{EDGE DIRECTION} = \tan^{-1}\left[\frac{p_1}{p_2}\right] \qquad (6)$$

As with the Sobel edge detector, the direction lies 90o from the apparent direction of the edge.

III. Digital Watermarking

Digital watermarking technology is an emerging field in computer science, cryptography, signal processing and communications. Digital Watermarking is intended by its developers as the solution to the need to provide value added protection on top of data encryption and scrambling for content protection [5].

Watermarking technique is to hide secret information into the digital signals so as to discourage unauthorized copying or attest the origin of the media. The watermark is a digital code embedded in the image data and is invisible. A digital watermark is permanently embedded in the data, that is, it remains present within the original data after any distortion process. A watermark could be used to provide proof of authorship of a signal [10].

IV. Vigenere System Cipher

A popular form of periodic substitution cipher based on shifting alphabets is the Vigenere cipher. As noticed this cipher has been falsely attributed to the 16th century Fench cryptologist Blaise de Vigenere. The key K is specified by a sequence of letters K=k1, k2,…….kd, Where ki (i=1,……..d) gives the amount of shift in the ith alphabet ; that is [5]

$$f_i(a) = (a+k_i) \bmod n \qquad (7)$$

Where a is the location of alphabet, where n is the number of the letters in the alphabet.

V. Result

The implementation of watermark and information embedding process and extracting process. Data storage process is performed in original image in edge points corresponding to the same place in a binary image. These edges are specified based on location of the edge that depend on the threshold (we take it 128, if the value => 128, then there is edge so we store the cipher information in this edge) Fig.(1) shows the block diagram for watermark and information embedding process.

a) Algorithm of Watermark & Information Embedding

1. Input the password text (5byte), as a letters
2. Input the marker (4 byte), as a numbers.
3. Input text of information hiding, as a letters
4. Convert the letters in steps (1&3) to ASCII Code then to decimal number
5. Convert the color image into grayscale (256 bits).
6. Find edges detection of the original image by selecting one of filters (Sobel, Prewitt, Robert), and then obtain binary file depending on a specified threshold.
7. Compare the value of threshold (128) with the values of file that obtain the image, if TH>128 then input the information sequence (Watermark, Password, Information) step 14 (that mean every 14 edges put one value, depend on sum of value of watermark "2+0+3+9=14")
8. Return the image in gray scale that obtain the information, as shown in Fig (2).

b) Algorithm of Watermark & Information Extracting

1. Read the image was produced from embedding algorithm
2. Compare the value of threshold with the value of file that obtain the image, if TH>128 then read the information sequence (Watermark, Password, Information)
3. Input the marker (4 byte), as a numbers, and compare it by the first (4-byte) extract from 56 edge (each 14 edges one value) if they equaled, then the water marker is authentic and continue, else massage box “you in un authentication person.
4. Convert the (5 bye) in 70 edges start form edge 56, to ASCII code then to letters and make it as key
5. Convert(22 byte) the in 308 edges start form edge 126, to ASCII code then to letters
6. Decipher the information by using Vigenere system with key from step 4, as shown in Fig (3).

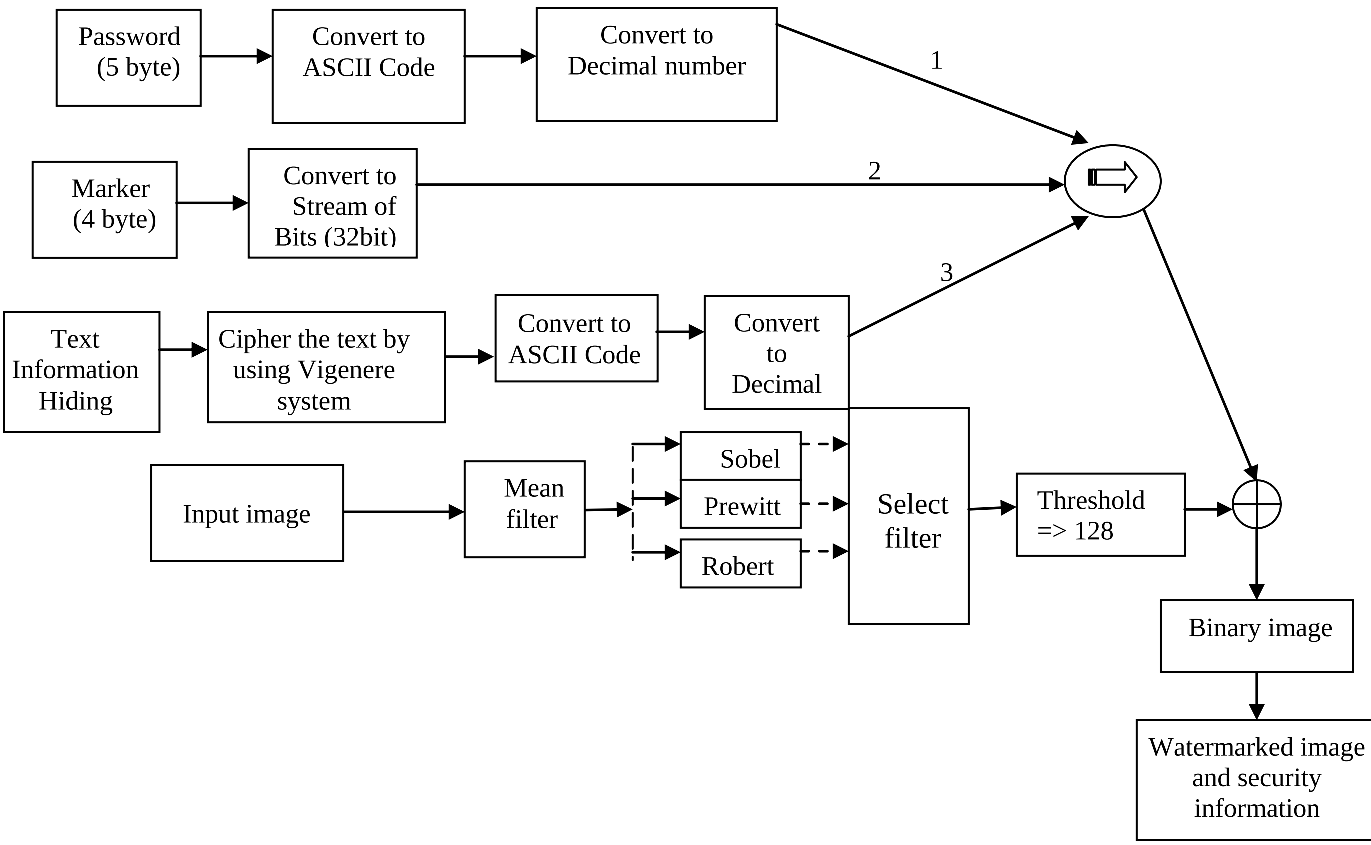

Fig. 1 : Block diagram for watermark and information embedding process

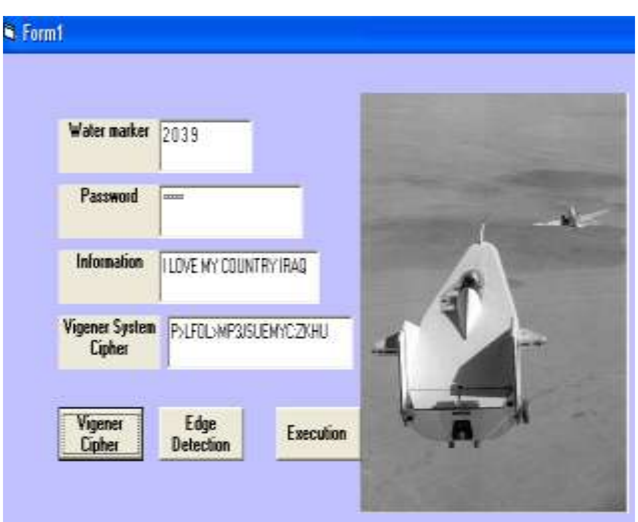

Fig. (2-a) : Illustrated the input of PW.,WM. , INF., and ciphering

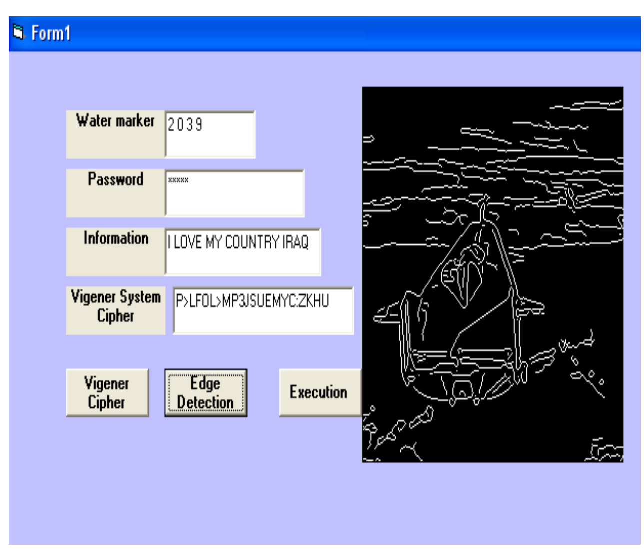

Fig. (2-b) : Illustrated the edge detection for the image

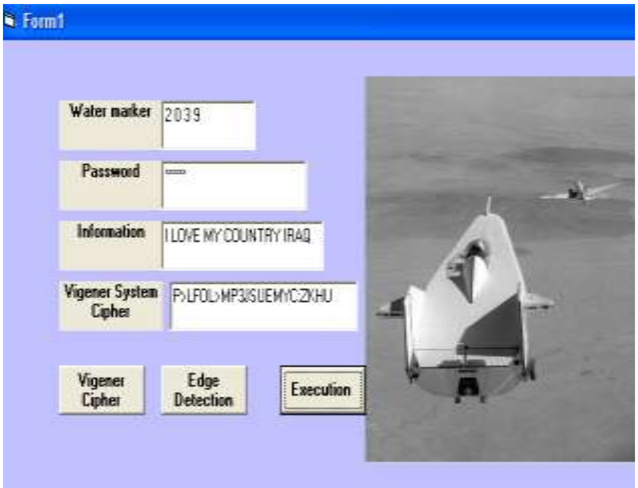

Fig. (2-c) : Illustrated the embedding

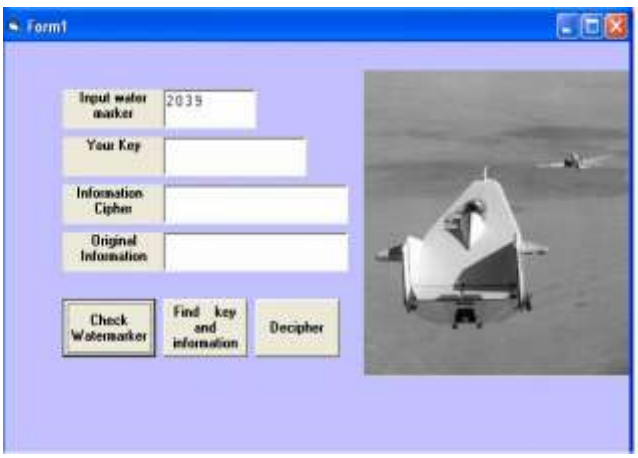

Fig. (3-a) : Illustrated the checking for water marker

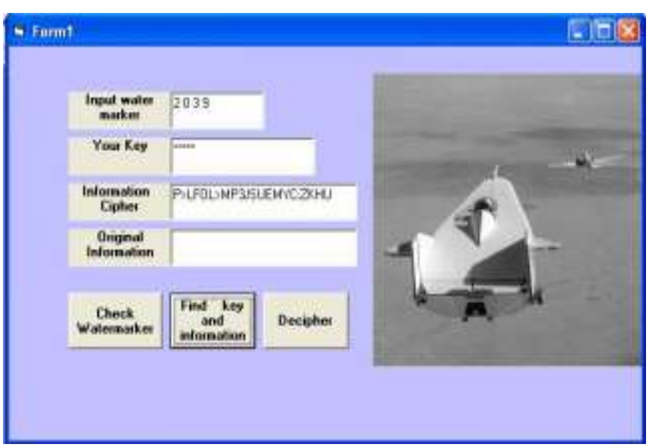

Fig. (3-b) : Illustrated the extracting the original information

VI. Conclusions

1. In this paper the invisible watermark is not noticeable to viewer and without any degrades the quality of the content.
2. Data storage process is based on the existence of the edges in the image. These edges or the storage location in the image is not specified but depends on characteristic of image
3. The product invisible watermark is robust against distortions processes and resistant to intentional tampering solely intended to remove the watermark.
4. Returning information is impossible except when we know the type of used filter and used threshold value in case of converting image into binary image. In addition, we must know the password, watermarked image and the system cipher.
5. Watermarking provides the capability to specify the original image and ownership to this image and prevent counterfeits processes to this watermarking.

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Improving Embedded Image Coding Using Zero Block - Quad Tree

By S.China Venkateswarlu, Ms.Daggumati Rajani & V.Sridhar

ECE VJIT, Hyderabad

Abstract - The traditional multi-bitstream approach to the heterogeneity issue is very constrained and inefficient under multi bit rate applications. The multi bitstream coding techniques allow partial decoding at a various resolution and quality levels. Several scalable coding algorithms have been proposed in the international standards over the past decade, but these former methods can only accommodate relatively limited decoding properties. To achieve efficient coding during image coding the multi resolution compression technique is been used. To exploit the multi resolution effect of image, wavelet transformations are devolved. Wavelet transformation decompose the image coefficients into their fundamental resolution, but the transformed coefficients are observed to be non-integer values resulting in variable bit stream. This transformation result in constraint bit rate application with slower operation. To overcome stated limitation, hierarchical tree based coding were implemented which exploit the relation between the wavelet scale levels and generate the code stream for transmission.

Keywords : *bit level scalable codecs, ezbc, image, wavelet transformations, wavelet scale.*

GJCST-F Classification: *I.4.2*

IMPROVING EMBEDDED IMAGE CODING USING ZERO BLOCK - QUAD TREE

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S.China Venkateswarlu [α], Ms.Daggumati Rajani [σ] & V.Sridhar [ρ]

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Keywords : bit level scalable codecs, ezbc, image, wavelet transformations, wavelet scale.

I. Introduction

The rapid growth of digital imaging technology in conjunction with the ever-expanding array of access technologies has lead to a new set of requirements for image compression algorithms. Not only are high quality reconstructed images required at medium-low bitrates, but as the bitrate decreases, the quality of the reconstructed image should degrade gracefully. The traditional multi-bitstream solution to the issue of widely varying user resources is both inefficient and rapidly becoming impractical. The bitlevel scalable codecs developed for this dissertation allow optimum reconstruction of an image from an arbitrary truncation point within a single bitstream. That is, the encoder is effectively isolated from the decoder and the target decode rate need not be known at encode time. The discrete wavelet transform is utilized to provide a multi-resolution decomposition of an image. A wavelet coefficient's magnitude is then directly proportional to the fidelity of the reconstructed image. To exploit this in a scalable manner, a progressive bitplane transmission scheme is utilized. Each bitplane is represented by means of a significance map. It is the efficiency of representation of the significance map that this dissertation explores.An important characteristic underlying the design of image processing systems is the significant level of testing and experimentation that normally is required before arriving at an acceptable solution. This characteristic implies that the ability to formulate approaches and quickly Prototype candidate solutions generally plays a major role in reducing the cost and time required to arrive at available system implementation.

An image may be defined as a two-dimensional function, $f(x, y)$, where x and y are spatial coordinates, and the amplitude of f at any pair of coordinates (x,y) is called the intensity or gray level of the image at that point. When x, y, and the amplitude values of f are all finite, discrete quantities, we call the image a digital image. The field of digital image processing refers to processing digital images by means of a digital computer. A digital image is composed of a finite number of elements, each of which has a particular location and value. These elements are referred to as picture elements, image elements, pels, and pixels. Pixel is the term most widely used to denote the elements of a digital image Vision is the most advanced of our sense, so it is not surprising that images play the single most important role in human perception. However, unlike humans, who are limited to the visual band of the electromagnetic (EM) spectrum, imaging machines cover almost the entire EM spectrum, ranging from gamma to radio waves. They can operate also on images generated by sources that humans are not accustomed to associating with images. These include ultrasound, electron microscopy, and computer-generated images. Thus digital image processing encompasses a wide and varied field of applications.

Digital imagery has had an enormous impact on industrial, scientific and computer applications. It is no surprise that image coding has been a subject of great commercial interest in today's world. Uncompressed

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digital images require considerable storage capacity and transmission bandwidth. Efficient image compression solutions are becoming more critical with the recent growth of data intensive, multimedia-based web applications.

II. Image Coding Algorithm

In the previous two chapters it has been established that the building blocks required to achieve the stated research targets include the discreet wavelet transform, bitplane progressive scalar quantization and adaptive arithmetic entropy coding. Each bitplane is represented by means of a significance map. It is the efficiency of representation of this map that determines the compression performance. Sets composing the significance maps can be classified as "Tree", "Block" or "Hybrid" based. This chapter reviews the most influential literature in each classification that has helped shape the current state-of-the-art of bitplane progressive image compression

Efficient image compression solutions Image Coding Algorithm : In the section and previous it has been established that the building blocks required to achieve the stated research targets include the discreet wavelet transform, bitplane progressive scalar quantization and adaptive arithmetic entropy coding. Each bitplane is represented by means of a significance map. It is the efficiency of representation of this map that determines the compression performance. Sets composing the significance maps can be classified as "Tree", "Block" or "Hybrid" based. This chapter reviews the most influential literature in each classification that has helped shape the current state-of-the-art of bitplane progressive image compression The algorithm maintains three lists: LIP List of Insignificant Pixels.LSP List of Significant Pixels.LIS List of Insignificant Sets.The LIP and LSP contain nodes (2D matrix coordinates) of single coefficients, while the LIS contains nodes that are the roots of spatial orientation trees. The Offspring set, O (i, j), contains the direct offspring of the node at coordinates (i, j), that is the four coefficients at the same spatial location in the next level of the pyramid. Except at the highest and lowest pyramid levels, the offspring set is defined as:O(i, j) = {(2i, 2j), (2i, 2j + 1), (2i + 1, 2j), (2i + 1, 2j + 1)} (3.1)Nodes at the lowest level have no offspring and nodes at the highest level are grouped into 2x2 blocks whereby the upper left coefficient has no offspring. Figure 3.3 shows the parent-offspring relationship and the set definitions for a three level decomposition. It is essentially the same as EZW except in the way that the offspring of trees in the root subband are defined. The algorithm consists of four stages, the last three of which are repeated; initialization, sorting pass, refinement pass and quantization step update. The algorithm is initialized by adding all coe ficients in the lowest frequency subband to the LIP, and all those with offspring. EBCOT. The EBCOT algorithm introduces a number of new developments to the wavelet bitplane coding family. Compression to a specific rate is achieved as a two-tier process. The image is first compressed using a coding engine which does not consider the target bitrate, the second tier post processes the bitstream to produce a rate-distortion optimized bitstream for a specific rate. In EBCOT, each subband is partitioned into relatively small blocks of samples, called code-blocks. Each code-block is coded independently to produce an embedded bitstream for that block. Truncation points are marked in the embedded bitstream for each block and its contributions to overall distortion reduction is noted. The tier two algorithms select various truncation points from each block to construct the optimum bitstream for a given bitrate. The downside of the scheme is that for each desired embedded rate, truncation points have to be marked in each code block. EBCOT can approximate a true embedded scheme by selecting a large number, e.g. 50, truncation points for each code-block but the overhead associated with signaling the location and contributions from each truncation point has a negative effect on performance. EBCOT is essentially a bitplane coder. Code-blocks that contain significance relative to the current threshold are identified using a conventional quadtree coding approach. The size of the code-block is decided at compile time but is typically 16 × 16. Thereafter, individual coefficients in a code-block are identified as significant/ insignificant using a combination of coding primitives and context models. A context is chosen for each coefficient considering eight neighbors. Both sign bits and refinement bits are also arithmetically coded. Fractional bitplane coding is achieved using four passes for each bitplane. This increases computation but if the target bit rate is reached mid bitplane the advantage of fractional bitplane coding is that a better performance is achieved. Image compression systems are composed of two distinct structural blocks: an encoder and a decoder. Image $f(x,y)$ is fed into the encoder, which creates a set of symbols from the input data and uses them to represent the image. If we let n_1 and n_2 denote the number of information carrying units (usually bits) in the original and encoded images, respectively, the compression that is achieved can be quantified numerically via the compression ratio

III. Embedded Coding

The performance of an embedded image coding system significantly relies upon the efficiency of the entropy coder used for compression of bitplane data. The various bitplane compression algorithms in the literature can be loosely categorized into two classes: hierarchical set-partitioning coding and context-dependent sequential bitplane coding.

The hierarchical set partitioning is block *entropy coding* scheme .The energy clustering nature of subband coefficients is exploited by joint coding of bitplane data in blocks. With large numbers of samples tested and coded in groups, this class of coders has excellent speed and compression performance. Nevertheless, ever since publication of the benchmark work SPIHT by Said and Pearlman, we have not seen any significant and consistent advancement of this technique in *compression* presented in the literature, to author's knowledge, despite numerous research attempts. The context-based sequential bitplane coding is a *conditional entropy coding* scheme. The strong statistical dependencies of subband coefficients are effectively captured by the modeling contexts. With the elaborate high-order modeling scheme, the wavelet bitplane coder proposed by Wu reports the significant PSNR improvement over the best existing set-partitioning coders in the literature. Nevertheless, unlike the set-partitioning coder, the sequential bitplane coder processes and encodes the individual bitplane data sample by sample. Every pixel typically has to be visited at least once to finish a full bitplane coding pass, hence with an implied higher computational cost. Given the distinctive features of the two embedded coding schemes, it is certainly desirable to have an image coding system which combines these two powerful techniques and takes advantage of their respective strength at the same time. The proposed EZBC algorithm was developed to answer this challenge. It also adopts the set partitioning approach in the bitplane coding framework. However, instead of the classical zerotree coding scheme, it utilizes the more recent zeroblock coding scheme for hierarchical coding of wavelet coefficients. The development of EZBC is motivated by the experimental observation that strong dependency exists not only among subbands coefficients but also among quadtree nodes from quadtree representations of the subbands. Fig. 3.1 displays the *MSB maps* (indicating the bit indexes of the MSB's of individual quadtree nodes) of the quadtrees built up from the individual subbands of the decomposed Lena image. Each quadtree node $Q(i, j)$ is a basic *zero set* for grouping of *insignificant coefficients* and contains all coefficients from a block region as members. The value of the quadtree node is defined to be the maximal magnitude of its members. Interestingly enough, another pyramidal image description is thus provided by the individual quadtree levels, as shown in Fig. 3.1, in addition to the original subband pyramid generated by the wavelet transform. Self-similarity is clearly exhibited in such a multiresolution data representation across both resolution and quadtree levels. The image features, e.g., edges and contours can be easily identified in different hierarchies of the wavelet transform domain. The proposed EZBC algorithm is the first attempt to explore such rich dependency existent in quadtree representation of a decomposed image. With special care given to the design of the context modeling strategy, it is demonstrated in our experimental results that the compression performance of the set partitioning coder can be substantially improved. As it will become clear, EZBC can be thought of as a hybrid coding algorithm which aims at attaining the theoretical bound of coding bitrate (entropy rate) by joining block entropy coding and conditional entropy coding approaches.

The development of the EZBC image coding system is built upon several prior research works in the field of embedded wavelet image coding. The following advanced coding techniques are efficiently combined in the EZBC coding system: quadtree-based set partitioning for compact and flexible data representation,• context modeling for exploitation of statistical dependency between subband coefficients • bitplane de-interleaving to improve rate-distortion (R-D) performance, and context-dependent de-quantization to further utilize the source statistics accumulated during the bitplane decoding phase. Although many algorithms in the literature also attempted to join some of these coding tools, they either substantially increased the implementation complexity or just made limited improvement. For example, most set partitioning coders, also employ context-based arithmetic coding to further compression efficiency. However, the simple context modeling schemes utilized in these former algorithms are insufficient to accurately predict the status of a given quadtree node. The bitplane de-interleaving utilized in the conventional sequential bitplane coders is effective in improving the R-D efficiency of the embedded codestream. However, such improvement is accomplished at a cost of additional bitplane scans/passes. In EBCOT proposed by Taubman, the quadtree decomposition, run-length coding and conventional context-based bitplane coding work together for significance coding of subband coefficient. The quadtree decomposition therein only proceeds up to a pre-selected minimum sub-block size, 16×16 by default. The quadtree

IV. Codestreab Embedding

In order to have efficiently embedded codestreams, it is essential that the code data in the compressed file are ordered according to their relative efficiencies for distortion reduction. This basic concept is commonly called embedding principle. In the proposed algorithm, a fixed path for encoding of wavelet coefficient bitplane data is chosen as follows: The coding process advances in a bitplane-wise fashion from the most significant bit toward the least. In a given bitplane, the arrays of LINs are processed in an increasing order of quadtree level, as suggested by Islam and Pearlman in SPECK. That is, all the *pixels* in LIN[0] are processed first and all the *nodes* in LIN[1] are then processed next, followed by the processings of LIN[2], LIN[3], and so on. In this way, the busy areas in the transformed image are updated earlier via a few quadtree splitting and coding steps, resulting in a good rate-distortion performance. The refinement of the previous significant coefficients from LSP is executed at last. In a significance test pass of a given quadtree level or a coefficient refinement pass, the subbands are visited from coarse to high resolution (as indicated in

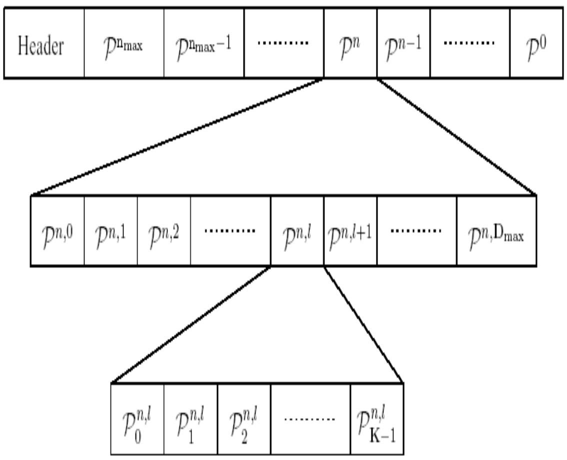

Figure 4.1 : Illustration of the hierarchical layout of a EZBC codestream

A hierarchical layout of a EZBC codestream is depicted in Fig. 4.1, where p^n denotes the bitplane pass n, $p_k^{n,l}$ the sub-bitplane pass for processing the insignificant nodes in $LIN_k[l]$ (routine CodeLIN(k, l)), and $p_k^{n,D_{max}}$ the sub-bitplane pass for the refinement of the significant coefficients in LSP_k (routine CodeLSP(k)). Similar to the bitplane de-interleaving scheme widely adopted in the sequential bitplane coders, EZBC effectively partitions each bitplane into multiple sub-bitplane passes $\{p_k^{n,l}\}_{n,l,k}$ for providing an embedded codestream of fine granularity. However, unlike the multi-pass approach proposed in, EZBC does not need to scan the individual pixels more than once in each bitplane pass because all the involved pixels for the individual sub-pass were already organized in separate lists. Although our pre-defined data embedding order is not optimized for the best R-D performance (as compared to the algorithms), our empirical data show the resulting relative performance loss is mostly insignificant. The effectiveness of the proposed data embedding strategy is further evidenced by the smooth R-D curves shown in our actual coding simulation results. It is worth mentioning that each bitplane pass could have been divided into even more sub-bitplane passes in our data embedding scheme to further improve the R-D performance of the resulting codestream. It is simply accomplished by partitioning of the existing lists into smaller sub-lists and then processing each sub-lists via separate sub-bitplane coding passes. The resulting computational and storage costs are still the same because the total number of the nodes to be stored and processed in all the maintained lists is unchanged. For example, our empirical data show that the refinement of the significant coefficients from the previous bitplane coding pass reduces distortion more efficiently than the refinement of the significant coefficients from the other earlier bitplane coding passes (if exist). The PSNR performance can thus be slightly improved by partitioning the existing refinement pass into multiple sub-passes, each for the refinement of the significant coefficients from particular bitplane level(s). Nevertheless, it is observed that the granularity of the resulting codestream by the current algorithm is already fine enough in practical image coding applications.

V. Result Analysis Observation

Original Image

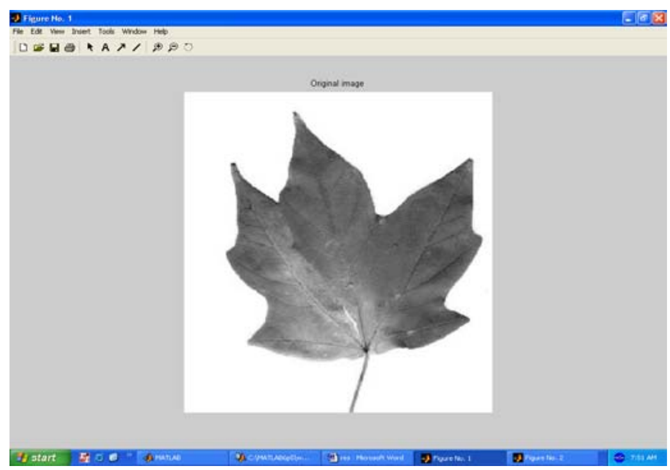

Figure 5.1 : Original leaf image sample

Recovered Image

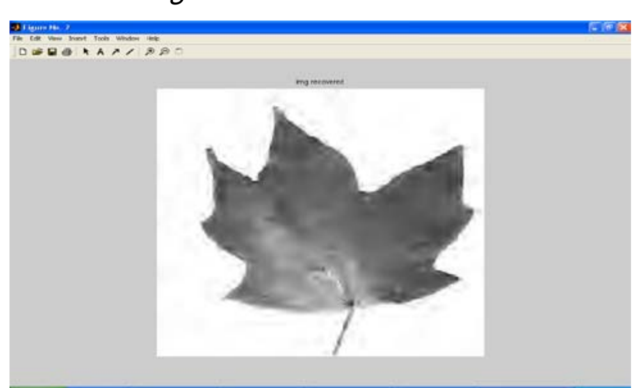

Figure 5.2 : Recovered image at 0.1 bpp

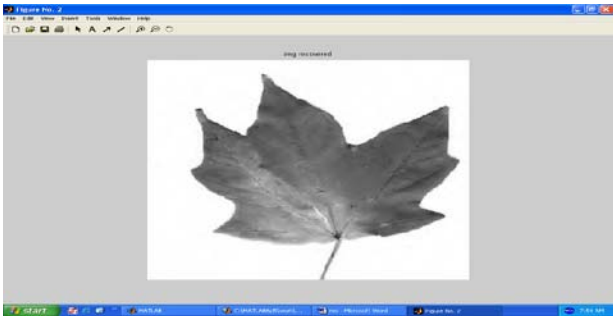

Figure 5.3 : Recovered image at 0.5 bpp

Figure 5.4 : Recovered image at 0.9 bpp

Bpp-PSNR plot

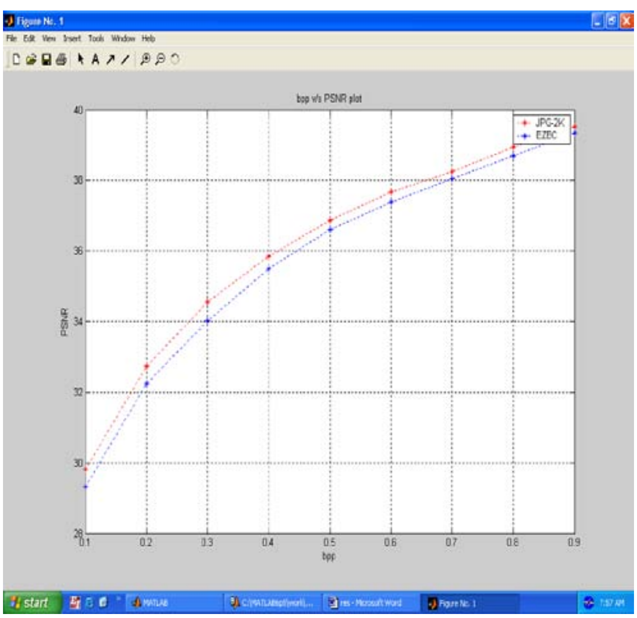

Figure 5.5 : PSNR v/s bpp plot for the given leaf imageSample-2

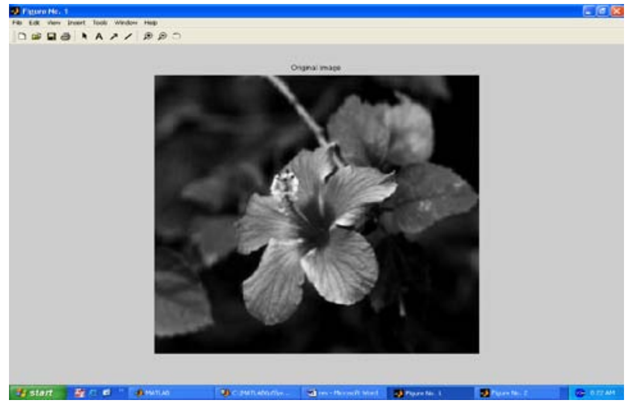

Figure 5.6 : Original flower image sample

Recovered Samples

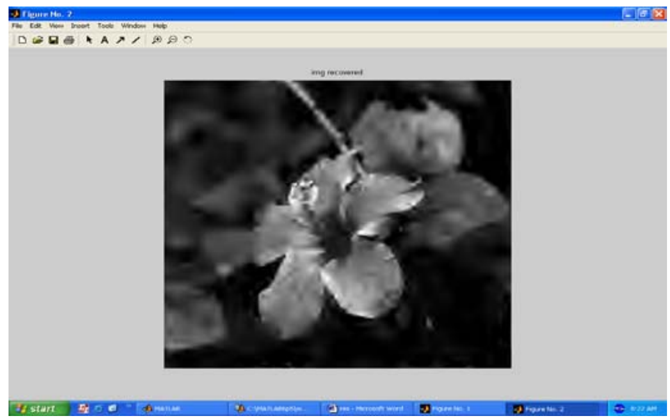

Figure 5.7 : Recovered flower image ample at 0.1 bpp

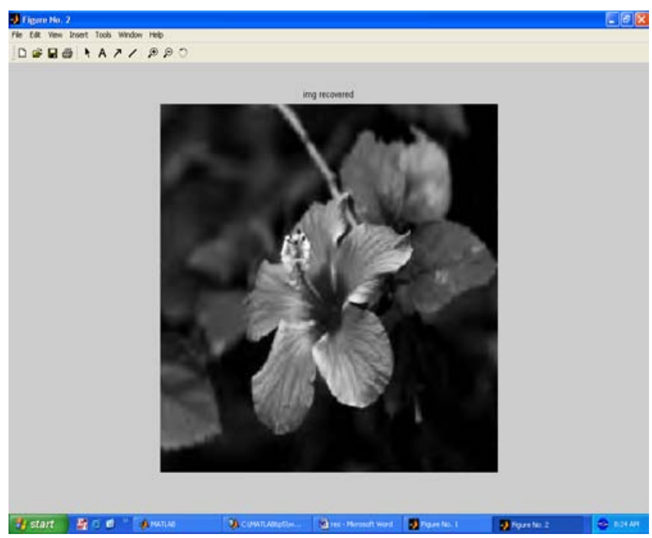

Figure 5.8 : Recovered flower image sample at 0.5 bpp

VI. Future Scope

This paper implements the coding algorithm on less noisy images. The work can be further extending for different kind of images having different properties. The project realizes EZW coding algorithm that can be further applied for image coding systems where embedded coding is used.techniques—set partitioning and context modeling—for efficient entropy coding of coefficient bitplane symbols. Unlike traditional zerotree-based set partition coders, we utilized the emerging quadtree-based zeroblock-coding scheme for hierarchical set-partition coding of wavelet coefficients. Exploitation of the strong statistical dependency in quadtree representation of the decomposed image is attempted in this work. Our coder has some attractive features of the traditional embedded bitplane coders such as precise rate control and multi -rate/-precision decoding. Without a zerotree spanning across different resolutions, this algorithm is ideal for resolution scalable coding. A substantial PSNR improvement over the state-of-the art algorithms in the literature is exhibited in extensive simulation results. A new algorithm for reconstruction of decoded wavelet coefficients. This technique features a context-dependent de-quantization strategy utilizing probability models dynamically accumulated in the decoding phase. Although the related PSNR improvement is not significant, it yields visually more pleasing coding results, as experimentally demonstrated the proposed-quantization algorithm is quite general and is expected to able to applied in other context-based wavelet bitplane coders, e.g., EBCOT, and ECECOW.

A reversible image coding system derived from the classical EZBC algorithm. The proposed coder exhibits excellent compression performance for both lossy and lossless image coding, as compared to competing a highly scalable and perceptually tuned image coding system was presented in related chapter, built upon the EZBC framework. Special care is given to modeling and coding of subbands so that the information related to desired resolution and precision levels can be efficiently retrieved from a single compressed .le. A variety of code stream formats can be easily composed from the hierarchically structured bit streams. As such, the encoding and decoding stages is allowed be effectively decoupled. Perceptual image coding is jointly addressed in a scalable coding system in this work. Unlike former research approaches adopted in the literature, the decoder or the stream parser exclusively performs "perceptual tuning" at the decoding/transmission times. Significant PSNR and visual improvements by the proposed scheme are presented in experimental results. A new embedded image coding algorithm EZBC using zeroblock coding of the subband/wavelet coefficients and context modeling was presented. With effective exploitation of context information at the individual levels of the quadtree representation of subband/wavelet coefficients, EZBC outperformed the well-known zerotree coder SPIHT and a more recent zeroblock coder SPECK in compression efficiency.

Our experimental results also indicate that the PSNR performance of the proposed algorithm is comparable to that of the JPEG 2000 test coder, a state-of-art image coder using context modeling and also a hybrid of pixel- and block- wise zero coding schemes. Nevertheless, EZBC adopts unified zeroblock coding framework and thus possesses the desirable low-complexity feature of this class of coders.

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An Improved Adaptive Filtering Technique to Remove High Density Salt-and-Pepper Noise Using Multiple Last Processed Pixels

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Abstract - This paper presents an efficient algorithm which can remove high density salt-and-pepper noise from corrupted digital image. This technique differentiates between corrupted and uncorrupted pixels and performs the filtering process only on the corrupted ones. The proposed algorithm calculates median only among the noise-free neighborhoods in the processing window and replaces the centre corrupted pixel with that median value. The adaptive behavior is enabled here by expanding the processing window based on neighbourhood noise-free pixels. In case of high density noise corruption where no noise-free neighborhood is found within the maximum size of window, this algorithm takes last processed pixels into the account. While most of the existing filtering techniques use only one last processed pixel after reaching maximum window, the proposed algorithm considers multiple last processed pixels rather than considering a single one so that more accurate decision can be taken in order to replace the corrupted pixel.

Keywords : salt-and-pepper noise, noise removal, adaptive median filter, last processed pixels.

GJCST-F Classification: *I.4.m*

AN IMPROVED ADAPTIVE FILTERING TECHNIQUE TO REMOVE HIGH DENSITY SALT-AND-PEPPER NOISE USING MULTIPLE LAST PROCESSED PIXELS

Strictly as per the compliance and regulations of:

An Improved Adaptive Filtering Technique to Remove High Density Salt-and-Pepper Noise Using Multiple Last Processed Pixels

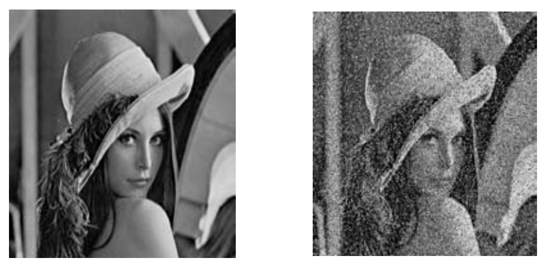
Mohammad Imrul Jubair [α], Imtiaz Masud Ziko [σ], Syed Ashfaqueuddin [ρ] & Md. Helal Uddin [Ѡ]

Abstract - This paper presents an efficient algorithm which can remove high density salt-and-pepper noise from corrupted digital image. This technique differentiates between corrupted and uncorrupted pixels and performs the filtering process only on the corrupted ones. The proposed algorithm calculates median only among the noise-free neighborhoods in the processing window and replaces the centre corrupted pixel with that median value. The adaptive behavior is enabled here by expanding the processing window based on neighborhood noise-free pixels. In case of high density noise corruption where no noise-free neighborhood is found within the maximum size of window, this algorithm takes last processed pixels into the account. While most of the existing filtering techniques use only one last processed pixel after reaching maximum window, the proposed algorithm considers multiple last processed pixels rather than considering a single one so that more accurate decision can be taken in order to replace the corrupted pixel. Simulations on various images corrupted with different levels of noise density shows the result that, the proposed technique can perform significantly better than other existing techniques while preserving fine details and the image quality.

Keywords : salt-and-pepper noise, noise removal, adaptive median filter, last processed pixels.

I. Introduction

Impulse noise is a special type of noise where the intensity of the corrupted pixels has the tendency of being either relatively high or low [1]. The principal sources of impulse noise in digital images arise due to transmission errors, faulty memory locations or timing errors in analog-to-digital conversion [2]. Salt-and-pepper noise, a special case of impulse noise is the phenomenon where a certain percentage of individual pixels of an image are randomly digitized into the two extreme (maximum and minimum) intensities in the here dynamic range [3]. It is named 'salt-and-pepper' because of its appearance as white and black dots superimposed on the corrupted image [4].The presence of salt-and-pepper noise in digital image can severely damage image details and information. Therefore, removal of this type of noise is an important is an important issue in order to perform further processing on an image and it is critical for the extraction of reliable and accurate information from a digital image [5]. Non-linear filtering techniques are implemented widely because of their superior performance in removing salt-and-pepper and also preserving fine details of image while linear filters perform weakly and create blurring effect. Several researches on this area have been done to modify non-linear filters and to develop more efficient algorithm in removing this kind of noise from a digital image.



(a) (b)

Fig.1 : a) Shows an original image and b) Is the image corrupted by salt-and-pepper noise

In this paper, a developed algorithm has been proposed which exhibits better result than some recent techniques. In the next few sections of this paper, a study on the recently developed works will be discussed including some traditional adaptive filtering techniques as well. After that the proposed technique will be illustrated in details with the performance analysis followed by that.

II. Some Existing Noise Removal Techniques

Standard Median Filtering is the simplest non-linear technique where the value of each pixel is replaced by the median of the gray levels in the neighborhood of the corresponding pixel [4] regardless of whether it is corrupted or not. SMF is ineffective in presence of high density noise and exhibits blurring of the filtered image if the window size is large [2]. For noise level over 50% it fails to preserve the edge details of the original image [6]. Different techniques have been proposed to improve the performance of median

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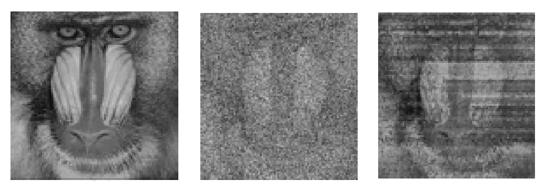
filtering, such as the Weighted Median Filter (WMF) [7], the Center Weighted Median Filter (CWMF) [8], and the Recursive Weighted Median Filter (RWMF) [9]. In these methods weights are assigned to the pixels covered by the processing window. Regardless of considering corrupted or uncorrupted pixels, these methods apply modification on the centre pixels of the window and the local features are not considered. Therefore, when the noise level is high, these filters fail to recover the details and edges satisfactorily [10]. Some research works deal with distinguishing between corrupted and uncorrupted pixels in order to further process such as Adaptive Median Filter (AMF) [11]. The basic difference between the AMF and the SMF is that, the AMF changes the window size during the filtering operation, depending on the noise density of the image. The variation of this window size depends on the median value of the gray-levels in the local neighborhood. The AMF starts with a 3×3 window and checks the value of the median in the corresponding neighborhood. If the median value is found to be an impulse, then the window size is increased and the process is repeated until a noise-free median value is found or the size of the filtering window reaches a threshold [5]. The other such techniques are the Tri-State Median Filter (TSMF) [12], the Progressive Switching Median Filter [13], the Multi-State Median Filter (MSMF) [14], and the Noise Adaptive Soft Switching Median Filter (NASSMF) [15] where corrupted pixels are selected for processing and uncorrupted ones are left unchanged. These techniques are effective for removing salt-and-pepper noises up to medium range of density. Furthermore, a two-stage Noise Adaptive Fuzzy Switching Median filter (NAFSM) has been proposed in [3], where the noise detection stage utilizes the histogram of the corrupted image to identify the noise pixels first. Then, the second stage of filtering process employs fuzzy reasoning to process the noise pixels only. Thus, this method handles the uncertainty present in the extracted local information, which was introduced by noise [5]. Besides, another kind of techniques have been developed where the sum of the distances between each vector pixel and the other vector pixels in the window is calculated for further processing such as Vector Median Filter (VMF) [16], Improved Vector Median Filter [17] and Enhanced Adaptive Vector Median Filter (EAVMF) [18]. In the EAVMF [18] a single last processed pixel is taken into account in case of extremely high density of salt-and-pepper noise. Besides, the Decision Based Algorithm (DBA) [2] has been proposed where only noisy pixels are replaced by the median value or by the mean of the previously processed neighborhood pixel values. However, at higher noise densities, it is likely that the median value is also a noise. Therefore, this method produces streaking when the noise density is high [5]. In [10], a Non-linear Adaptive Statistics Estimation Filter has been proposed to remove high density Salt-and-pepper noise, which reduces streaking at higher noise densities [5], but the image details is disturbed after the filtering process.

In case of worst case situation, the concept of considering last processed pixel has been adopted by several researches where the centre pixel of the processing window is replaced with the previously processed value of the pixel. EDBAMF [19] has been developed based on the above method of using last processed pixel. Moreover, in this approach an assumed threshold value is used to determine the pixel value in case of extreme situation. Image quality is degraded in the filtered image after applying EDBAMF. Recently, Enhanced Non-Linear Adaptive Filtering Technique (ENLAFT) [5] has been proposed which seeks for uncorrupted median in the processing window and continues to increase window until a noise-free median is found. After reaching the maximum allowable size, the technique does not expands its window and it considers the last processed pixel obtained from previous iteration. Decision is taken using statistical analysis on local features in order to use the last processed pixel. The techniques depending on a single last processed pixel may create streaking on the output image and thus decrease the image quality. Fig. 2 shows an example of streaking on image.



(a) (b) (c)

Fig. 2 : a) Original image and b) Image corrupted by salt-and-pepper noise c) Occurrence of streaking after filtering with considering single last processed

Furthermore, depending on a single last processed pixel leads these algorithms to have a weak decision in case of extreme level of noise density while other previously processed pixels are not taken into account.

In this paper, we present an improved approach to remove high density salt-and-pepper noise which overcomes the problems faced in other existing non-linear filtering methods. Drawbacks of depending on a single last processed pixel have been relaxed in this method where multiple last processed pixels obtained from previous steps are used for further decision making and processing. The proposed technique is able to reduce the occurrence of streaking on output image because the method does not depend on a single last processed pixel. Simulation applied on several input images exhibits satisfactory result and proves that the proposed method performs better than the other non-linear filtering techniques in removing salt-and-pepper up to 95% level of noise density.

III. Multiple Last Processed Pixels

The proposed method deals with multiple last processed pixels. This section of the paper will explain the concept of obtaining multiple last processed pixels and estimating values using them.

As mentioned before, the last processed pixel is obtained from the value that has been estimated from the previous iteration. In this case, the direction of image scanning is an important issue. To get an example, let X be an input grayscale image of size m×n. We know that any filtering procedure is done by sliding the window mask in every iteration on X from pixel to pixel keeping current processing pixel X(i,j) at the centre of the window, where i = 1,2,3…m and j = 1,2,3,….n. By convention, sliding starts from the first pixel of an image which is located at X(1,1) and it will be under processing. Let Y be the output matrix (initialized as an empty matrix) where the processed pixel obtained from all iterations are stored. Suppose X(i,j) is current centre pixel, so its processed value will be stored at Y(i,j), Similarly, after sliding to the next pixel X(i,j) where j=j+1, the processed value will be stored at Y(i,j) where j=j+1 and so on. If any pixel is needed to be left unchanged, then Y(i,j) would be equal to X(i,j) directly. In this manner the whole X will be scanned through X(1,1) to X(m,n) and simultaneously Y will be constructed with processed pixels as well. Here, we can see that if X(i,j) is a current pixel then its last processed pixel is Y(i,j-1). The concept of a single last pixel can be visualized from Fig. 3 where filter scanning direction starts from upper left corner of an image X(1,1) and ends at X(m,n).

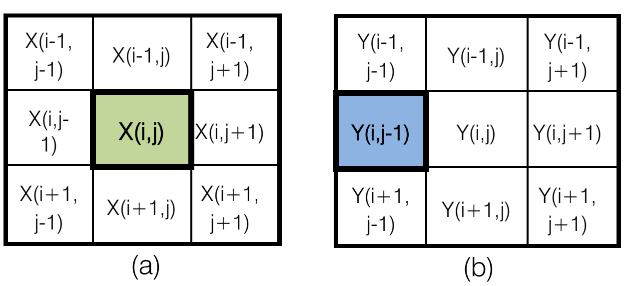


Fig. 3 : a) Shows current centre pixel X(i,j) and b) Shows its last processed pixel Y(i,j-1)

In case of multiple last processed pixel, only Y(i,j-1) is not selected, rather more than one pixels in Y are considered. Assuming that, conventional scanning direction is applied (from upper-left to lower-right) and for a current pixel X(i,j) at any iteration, we can consider four last processed pixel within a 3×3 mask from Y which are Y(i,j-1), Y(i-1,j-1), Y(i-1,j) and Y(i-1,j+1). The other remaining four pixels in Y covered by that window will not be considered because they have not been processed yet. The concept is shown in Fig. 4 (a).

The remaining last four processed pixel can be obtained through a reverse-direction scanning on X. That means the sliding procedure will start from X(m,n) and end at X(1,1). In this manner Y(i,j+1), Y(i+1,j+1), Y(i+1,j) and Y(i+1,j-1) are the last processed pixels for X(i,j) and similarly the other remaining pixels will not be selected. Fig. 4 (b) shows the idea.

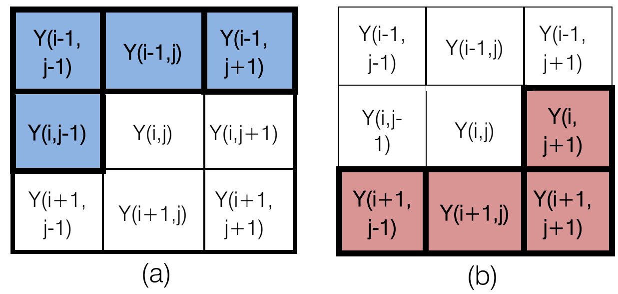


Fig. 4 : Multiple last processed pixel in a 3×3 window for the centre pixel shown in Fig. 3(a). Blue colored pixels are selected as last processed pixel in (a) and in (b) Red colored pixels are selected as last processed pixel for reverse -direction scanning

Overall, we need to filter the image twice (2nd one has the opposite direction of the other) in order to select multiple last processed. For a pixel P, let L_1 be the set of last processed pixels obtained from forward scanning (from upper-left to lower-right) and L_2 be the set of last processed pixels obtained from reverse scanning (lower-right to from upper-left). Then the set of all the selected last processed pixels L_P can be determined by combining both the elements of L_1 and L_2.

IV. Proposed Technique

The proposed method takes X as an input image of size M×N. A sliding window W of size (2a+1) × (2a+1) is defined where X(i,j) at the centre of W. The algorithm starts with a=1 from X(1,1) and checks whether X(i,j) is noisy (0 or 255) or not. If it is noise-free, W slides to next pixel and starts processing again. If X(i,j) is noisy then the neighborhood pixels are checked and among them only the noise-free neighborhoods are selected as the candidates for calculating median. The centre pixel X(i,j) is then replace with the median calculated from noise-free neighbors. If no noise-free neighbors is found in the current window, then W is expanded by incrementing a by 1 and the algorithm again seeks for noise-free pixels within the window area. This expansion process is continued up to a maximum window size W_{MAX}. After reaching W_{MAX}, the proposed technique does not expand its W anymore. This is the worst case scenario where no noise-free pixel exists within a maximum defined window. In this situation, set L_1 for the current pixel X(i,j) is determined and the current centre pixel X(i,j) is marked and its location is stored in order to processing later. In this procedure, the entire image is filtered by scanning once. The set L_2 for a pixel X(i,j) is determined from reverse scanning in similar procedure and as mentioned in previous section the set of selected last processed pixels L_P for a pixel X(i,j) can be determined using L_1 and L_2 . Finally, median is calculated from the values of L_P and the marked pixel X(i,j) is then replaced with that median value.

V. Simulations

The performance of the proposed algorithm is tested with different grayscale and color images using MATLAB. The Peak-Signal-to-Noise Ratio (PSNR), Mean Square Error (MSE), and Image Enhancement Factor (IEF) evaluation schemes are used to quantitatively assess the strength and quality of the restored images, where-

$$PSNR = 10 \times \log_{10}\left(\frac{255^2}{MSE}\right) \quad (1)$$

$$MSE = \frac{1}{MN}\sum_{i,j}\left(y_{i,j} - x_{i,j}\right)^2 \quad (2)$$

$$IEF = \frac{\sum_{i,j}(X(i,j)-Y(i,j))^2}{\sum_{i,j}(Z(i,j)-Y(i,j))^2} \quad (3)$$

$$MAE = \frac{1}{MN}\sum_{i,j}\left|y_{ij} - x_{ij}\right| \quad (4)$$

Here, X denotes the original image, Y denotes the corrupted image, Z is the restored image, and MN is the total number of pixel in the image. In our experiment, a total of 2 standard test images (Lena and Baboon) frequently used in literature are selected and contaminated with salt-and-pepper noise ranging from 10% to 95%. These images contain various characteristics, which are suitable for analyzing filtering performance. The performance of the proposed algorithm (PA) is compared with some state-of-the-art filters, namely AMF [11], DBA [2], NAFSMF [3], EDBAMF [19] and ENLAFT [5] based on the above parameters. Table 1-2 shows performance analysis of different algorithms for removing noise at different noise levels. In Table 1, different values exhibit that proposed algorithm performs better than the others by showing higher PSNR at different noise levels. In comparisons of MAE values among the algorithms, proposed algorithm shows satisfactory result which is shown is Table 2.

Table 1 : Comparisons of PSNR values for different algorithms at different noise levels for Lena image

Noise level (%)	SMF	AMF	DBA	NAFS MF	EDBA MF	ENLA FT	PA
10	33.9	41.8	31.7	42.6	40.1	43.4	44.9
20	29.6	37.2	29.3	38.7	36.5	39.6	40.2
30	24.1	34.3	26.5	36.3	34.3	36.9	37.7
40	19.1	32.1	23.6	34.3	32.6	35.1	36.2
50	15.3	29.9	21.1	32.5	31.0	33.5	34.1
60	12.3	27.4	19.0	30.8	29.6	31.9	33.7
70	9.9	22.2	17.3	29.3	28.3	30.4	31.6
80	8.0	16.3	15.5	27.4	26.7	28.6	30.1
90	6.5	10.5	13.7	23.7	24.4	26.0	27.9

Table 2 : Comparisons of MAE values for different algorithms at different noise levels for Lena image

Noise level (%)	SMF	AMF	DBA	NAFS MF	EDBA MF	ENLA FT	PA
10	2.7	0.4	1.6	0.4	0.5	0.3	0.3
20	3.4	0.9	2.2	0.8	1.1	0.7	0.5
30	4.9	1.5	3.4	1.3	1.7	1.2	0.9
40	8.9	2.2	5.4	1.8	2.4	1.7	1.4
50	16.7	3.0	8.5	2.4	3.2	2.2	1.8
60	29.2	4.1	12.5	3.1	4.0	2.8	2.3
70	47.4	6.8	17.7	4.0	5.1	3.6	2.7
80	70.9	15.1	25.3	5.1	6.4	4.7	3.8
90	98.1	43.3	36.1	7.5	8.6	6.4	5.1

Fig. 5 exhibits the analysis of IEF for the algorithms and the proposed approach is also significant in this case. Fig. 6-7 shows visual inspections performed on the filtered images in order to judge the effectiveness of different algorithms.

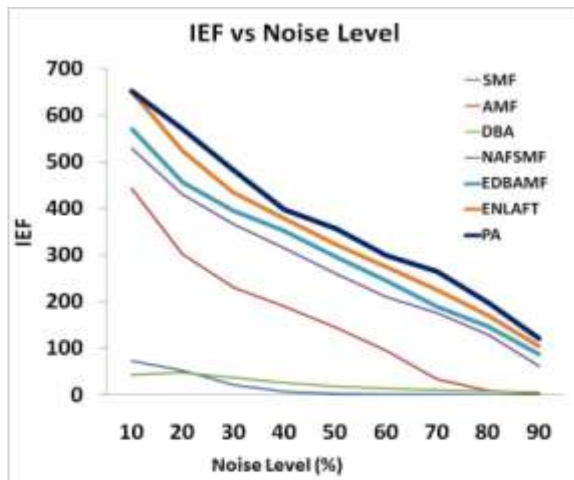


Fig. 5 : IEF values for different algorithms for Baboon image at different noise level

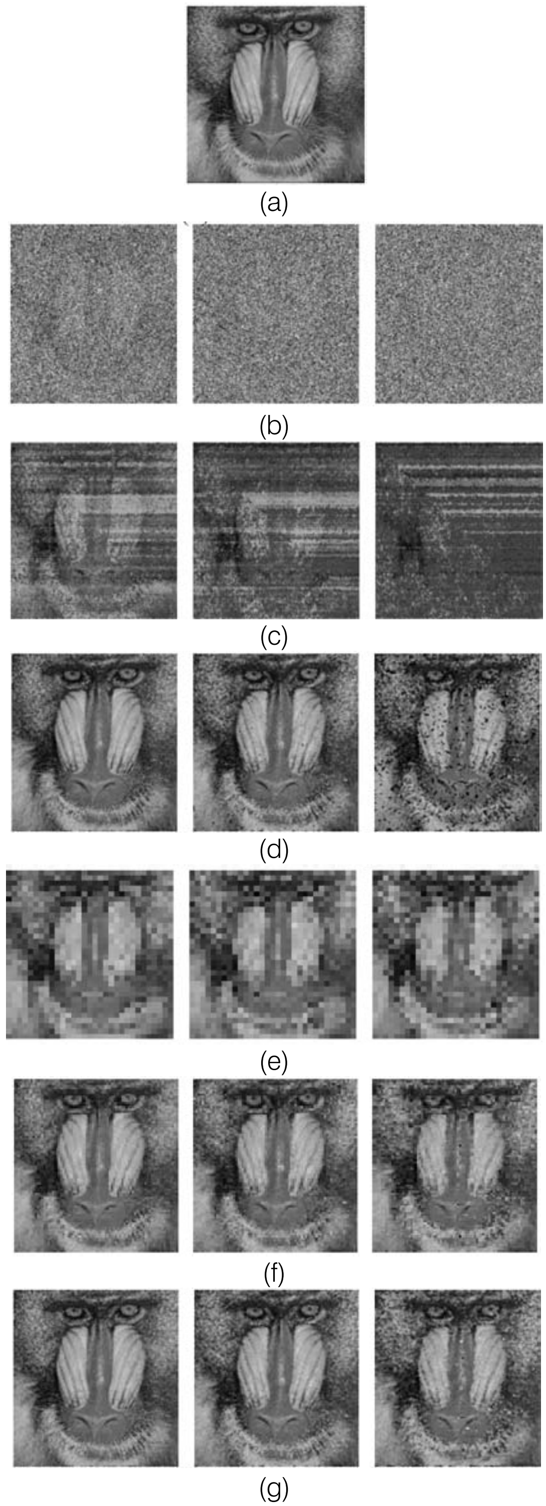


Fig. 5 : Results of applying different filtering methods on Baboon image corrupted with salt-and-pepper noise. Here, (a) is the original image and (b) shows images corrupted with 80%, 90%, and 95% salt-and-pepper noise, respectively from left to right. Row (c), (d), (e), (f) and (g) shows the results obtained by using DBA, NAFSMF, EDBAMF, ENLAFT and PA, respectively on the corrupted images of (b)

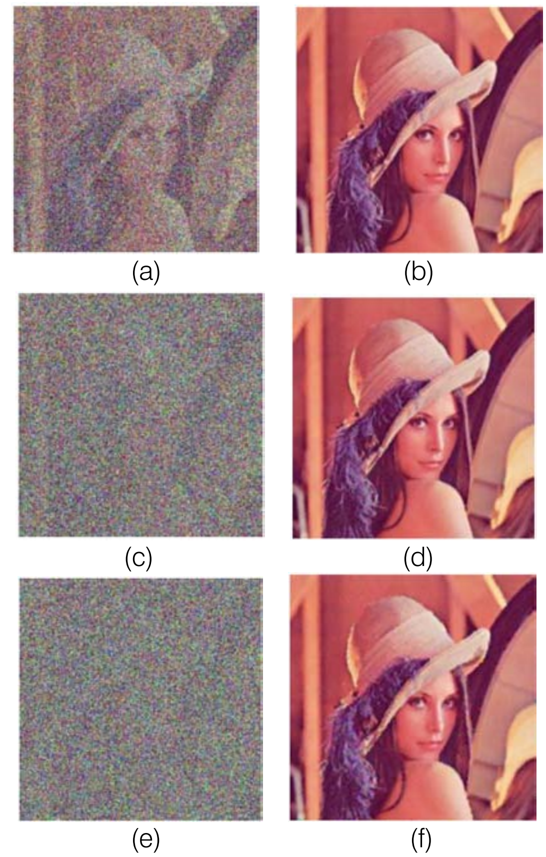


Fig. 6 : Results of applying the proposed filter on a color image corrupted with varying density salt-and-pepper noise, (a), (c) and (e) shows the Lena image corrupted with 70%, 90%, and 95% noise, respectively and (b), (d) and (f) shows the results of applying the proposed filter on images of (a), (c) and (e), respectively

VI. Conclusion

In this paper, an improved technique is presented that performs better than the other state-of-art methods in removing salt-and-pepper noise from digital images. The proposed technique introduces a concept of using multiple last processed pixels in case of extreme situation of high density noise. Several simulations based on different comparison parameters exhibit the superior performance of the proposed technique over some existing filtering techniques such as SMF, AMF, DBA, NAFSMF, EDBAMF and ENLAFT.

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It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

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Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

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the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

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10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

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15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

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21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. **Think technically:** Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page

- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

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The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
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- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
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- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

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- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
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What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
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What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
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Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
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- In spite of position, each table must be titled, numbered one after the other and complete with heading
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- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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