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Analysis of Complete Image Processing System and Design of Improved Image Compression System

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Abstract--- Nowadays image processing is one of the promising & developing areas in information technology. Image processing is backbone of multiple critical applications like medical, automobile, aerospace etc. Each image processing application includes acquiring multiple images with camera. The complete image processing system is comprised of three important aspects as Image capturing, image transmission & image security. This paper includes the comparative analysis of different image filtering, image compression along with image security techniques & also gives efficient technique to have compression & decompression of image with better compression ratio along with PSNR

Keywords--- Image Filtering, Image Compression, Image cryptography**.**

1 INTRODUCTION

The image processing system is now a day's indispensable aspect of human life. The image processing system has multiple applications in the field like medical, automotive and aero-space. In case of medical applications, most of the doctor uses computerized medical imaging for second opinion to draw final conclusion. Various important phenomena of earth including environmental affairs are studied with the help of image taken from satellite. Also due to advancement in technology, the image with higher resolution are captured, these high resolution images helps to detect the object at longer distance that too at very faster rate, this is essential aspect of driverless vehicle which is the future of automotive industry. All such image processing systems are comprised of three important phases as: Image filtering, Image compression and Image security

1.1 IMAGE FILTERING

Often the images captured with the help of camera are corrupted by various types of noise. In addition to this the images also get corrupted more during the process of transmission. These corrupted images may seriously affect the performance of image processing system and may leads to the faulty conclusion. The different types of noises includes: Gaussians noise, poisons noise, salt & pepper noise, speckle noise etc. The different types of filters are used to over-come these noises. These filters includes linear filter, minimum filter, maximum filter, median filter, Gaussian smoothening filter, guided filter, adaptive filter, block matching and 3D filter etc.

ISSN:0971-1260
Vol-22-Issue-16-August-2019

1.2 IMAGE COMPRESSION

The next phase unprocessed images requires larger space rather we can compressed the image to reduce the memory captured from camera can be directly stored on memory devices but these requirement and also to save bandwidth during the process of image transmission. Basically compression means compression of data in digital image. In general image compression techniques are of two types as Lossy image compression and lossless image compression technique. In lossless image compression technique, the available images before compression and obtained image after s in reconstructed image in comparison to that of original image. But the decompressed image is quite closed to original image of image processing system is image compression after image filtering.

1.3 IMAGE SECURITY

The transmitted image data over the communication channel may get stole due to the in-secured communication channel. Hence image security is also one of the very essential and important aspects of image processing system. The image security technique is of two types as, image cryptography and image stenography. In case of image cryptography image content is kept secret while in case of image stenography, image existence in kept secret

2 LITERATURE REVIEW

In this section a brief review of image filtering, image compression & image security is done.

2.1 IMAGE FILTERING

In [1] Hossein Khani et al. proposed an algorithm to remove impulse noise from medical image with real time accuracy. The basic operation of this algorithm involves classification of whole image in to three different parts as smooth, edges and disordered, here each category of part uses the different technique of reconstruction to eliminate the noise. Here the author has tested and verified proposed method for MR Image.

Bouhrara et al. [2] introduces a filter in order to minimize the noise in MR images. This new filter is non-local and high performance one. Also author numerically demonstrated that, this filtering scheme have low blurring & less image details loss as compared to earlier evaluated filters. Overall author presented well efficient methods to estimate the noise and its minimization in MR images. Also author mathematically and experimentally proves that, presented methods have much improved performance over the conventional methods.

Hosseini et al.[3] utilizes the foundation of human vision system (HVS) response to present, NR-ISA (no-reference image sharpness assessment) metric so that the input image can be processed precisely and more efficiently in addition to this author also introduces natural blur assessment datasets in digital pathology called “Focus path”. These datasets plays a vital role in order to validate NR-ISA.

ISSN:0971-1260
Vol-22-Issue-16-August-2019

2.2 IMAGE COMPRESSION

Son et al.[4] Proposed FIC that is Fractal Image Compression which is lossy image compression technique. The development of a whole system on a single chip is possible due to advancement in VLSI system, resulting reduction in number of operations to be performed causes, data transmission and storage becomes more effective and efficient. This work uses, Xilinx Virtex 5 (XUPV5-LX110T) FPGA board for the implementation of fractal image compression by using speed-up Fisher's method.

Mert et al. [5] proposes JPEG-LS encoder which gives lossless image compression. Encoder architecture includes both run mode and regular mode along with run interruption sample encoding procedures for full compliance with the standard like ISO/ITU. Differently from earlier implantations, prediction error calculation is optimized by using pipeline data forwarding approach for small delay and less complexity.

Parikh et al. [6] uses HEVC for compression so as to have diagnostically acceptable medical image. Here the author instantiate acceptable compression range of HEVC for medical image application also from experimental analysis it is proved that, HEVC improves the performance by 5% over JPEG 20000. In addition to this an alternate method is proposed so as to minimize HEVC encoding computational complexity by 55% with a very small increase in file size.

Lucas et al.[7] proposes 3D-MRP compression method this is an efficient lossless compression method, the basic principle of this technique is MRP i.e. minimum rate predictors. From the experimental results, it is cleared that 3D-MRP have 40% and 12 % coding gain over 8-bit and 16-bit depth HEVC standard respectively. Hence this method gives state-of-the-art results for volumetric medical data compression.

2.3 IMAGE SECURITY

Ramirez-Torres et al. [8] presents cryptographic algorithm hardware implementation using matrix approach known as ESCA i.e. encryption by synchronization of cellular automata this is an algorithm which uses systematic key. The soft processor core Microblaze in a Virtex-5 VC5VLX110T FPGA Is used for hardware implementation of this algorithm.

Priyanka et al. [9] uses AES-128 bit core for the implementation of image encryption and decryption algorithm. Here the image information is translated in to the text form using the mat-lab code. Then UART is used to translate this hexadecimal text in to the FPGA for the encryption purpose then same process is reputed for decryption too.

Yan at el. [10] proposes Abs (Analysis by synthesis) framework so as reconstruction error will be push to high frequency band. The flexibility of this framework permits it’s used in threshold visual cryptography (VC) hence visual quality improves without hampering the security. Here author has developed Abs based vector VC & Abs based probabilistic algorithm. Out of these algorithm, the Abs based threshold VC algorithm is selected over several competing algorithms

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due to the advantages like low residual variance, better fidelity performance and zero DC component.

Gupta et al. [11] proposes NSS (Natural Scene statistics) based model for both distorted & natural X-ray images. This NSS-based model captures consistencies of X-ray images and also provides efficient and effective tool to calculate the image degradation effect. Here author proposed that there is a great scope in determining the image degradation geometrically performance in multi-view X-ray images on visual task.

3 SYSTEM DEVELOPMENT

This paper focused on achieving objective where the main focus is to develop an improved low power compression & decompression technique[12-16]. This complete process is divided in the following steps.

3.1 Step 1: Read Image in MATLAB and convert it into text format so that it can be processed in Xilinx tool

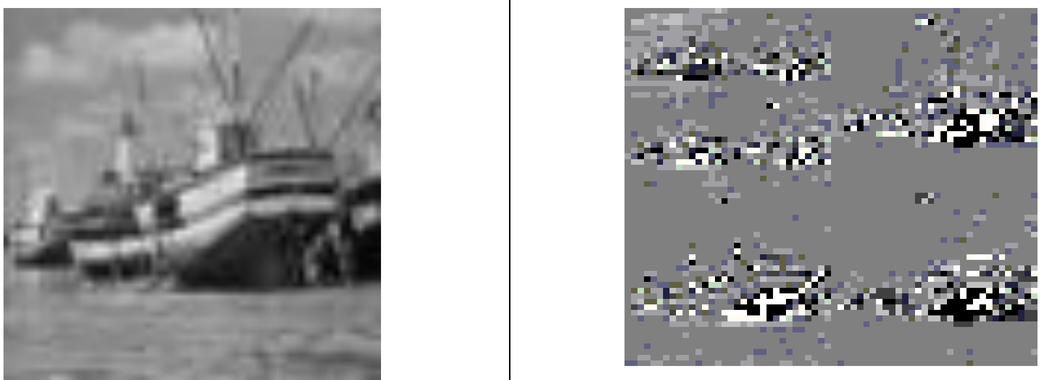
For this purpose, 512x512 Boat image is taken and hexadecimal text file is generated using Matlab file as: 7E 81 81 84 84 85 86 87 86 86 86 85 85 86 87 88 89 89 89 8A 8A 8B 89 8B 8C 8C 8B 8C 8C 8C 8B 88 82 85 8E 91 90 93 9B 83 98 9D 9E 9E 9D 9C 9C 9F A4 A9 AC B0 B1 B1…………………… continued. The obtained text file is stored.

3.2 Step 2: Text image file processing in Xilinx and perform the compression

To achieve the compression, we read the “InImgBitFile.txt” file in Xilinx platform. Here the image text sequence is decomposed in to two sequence using wavelets latter these decomposed sequences are processed using poly-phase matrices, so as to have better compression ratio and PSNR.

From this phase, the compressed output image file is obtained in the text format which is stored with the name “CompressedOutImgBitFile.txt" which contains the compressed pixel value in hexadecimal form as 80 85 87 83 81 85 85 85 84 88 9A 9C A6 AC B7 AD 81 80 7D 82 7E 7F 8C 8F 8A 90 84 7C 8F 8A 80 7D 83 82 80 81 80 80 80 7F 80 82 81 81 81 82 83 86 7C 83 7E 6E 82 82 81 80 81 84 7F 82 80 82 82 7D………………………………… continued. The original and compressed images are depicted in below given figure 1.

ISSN:0971-1260
Vol-22-Issue-16-August-2019



(a)Boat Original Image (b)Boat Compressed Image

Fig.1: Image before & after compression

3.3 Step 3 : Text image file processing in Xilinx and perform the decompression

In this phase, the reconstruction of compressed image is done by applying image decompression technique. This is exactly opposite process to that of compression method the reconstructed image obtained is shown in figure 2.

Fig.2: Image before & after compression

The size of these images is shown in below given table 1.

Table. 1: Image size before & After compression

File Name	Size

ISSN:0971-1260
Vol-22-Issue-16-August-2019

Boat64.bmp	13kb
OutcmprdimgFPGA.bmp	6kb

Above results are shown in a graph given in figure 3.

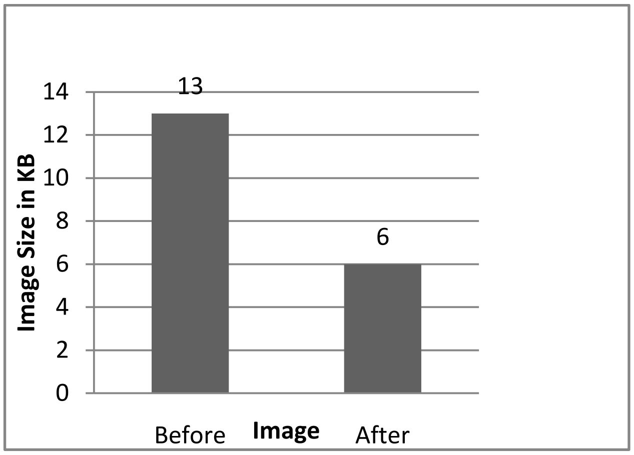


Fig.3: Imagesize Before & after compression

From above table 1 the compression ratio= 46.15%.
Along with compression ratio, the PSNR is compared with earlier results as given in table 2.

Table. 2: Comparative analysis

	Platform	Image Size	PSNR of Lena image(dB)	Compression Ratio
Vidya et. Al. [12]	FPGA	128x128	28.1	4
Erra [13]	GPU	256x256	NA	5
Jackson et al [14]	FPGA	512x256x 256512	33.1	12.8
Samvi et al [15]	FPGA	1024x1024	25.3	26
Saad et al [16]	FPGA	512x512	30.3	34.1
Proposed	FPGA	512x512	34.59	46.15

results for PSNR, in comparison with earlier results obtained from other authors, is plotted as shown in figure 4.

ISSN:0971-1260
Vol-22-Issue-16-August-2019

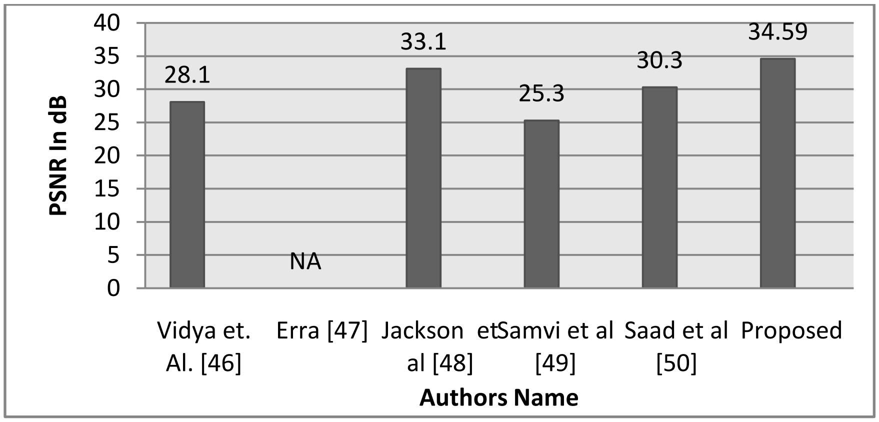


Fig.4: PSNR Comparison with Earlier results

Similarly results for compression ratio, in comparison with earlier results obtained from other authors, are plotted as shown in figure 5. .

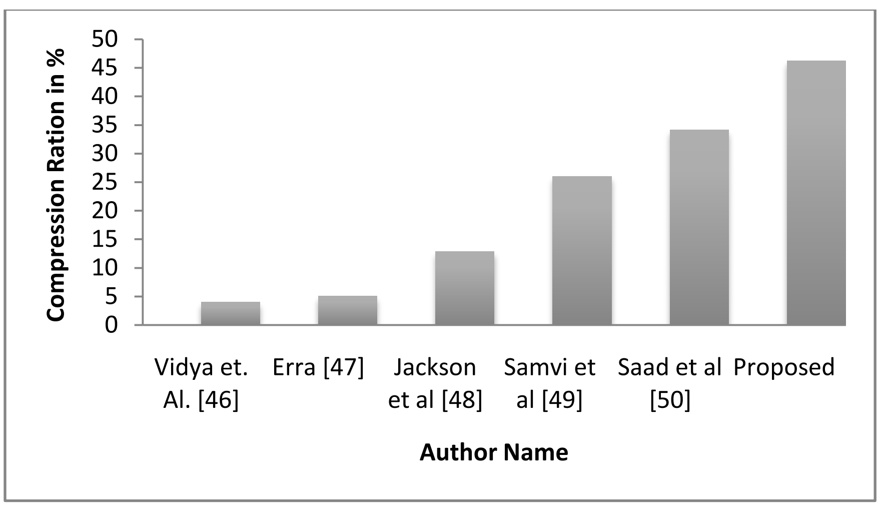


Fig.5: Compression Ratio Comparison with Earlier results

4 CONCLUSION

The use of poly-phase matrices exclusively improves the compression and decompression of an image. The use of wavelet enhances the compression, and combine use of wavelet transform and

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processing of decomposed text sequence using poly-phase matrices gives 4.5% improvement in PSNR and 34.33% improvements in compression ratio.

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