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Comparative Analysis of Image Quality Assessment Using HVS Model

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ABSTRACT: This paper describes the image quality assessment techniques i.e used for assessing the qualities of the images sending over the different mediums. In this paper full reference model of objective quality assessment is used. Full reference model is a method, in which we have access to a 'perfect version' of the image against which we compare it with a 'distorted version' of that image. Paper describing how the quality of the image is affected after introduction of noise or other interference parameters. The effects are calculated in terms of some mathematical metrics PSNR, SNR and MSSIM. In this paper the concept of degradation in quality can be understand by comparison between the above metrics of original image with the distorted image. Finally results are drawn using the image processing toolbox in MATLAB.

KEYWORDS: Image quality assessment (IQA),full reference method, Original image, Distorted image PSNR, SNR, MSSIM, Matlab.

I.INTRODUCTION

In this technological era of imaging and multimedia technologies, visual information, recorded by images has become the main source for knowledge acquisition. In the process of visual information acquisition, processing, transmission, and storage, some artifacts or noise maybe introduced to images which degrade the visual quality. The rapid growth in the research of IQA is motivated by the area of applications below:

- IQA can be used to benchmark image and video processing system and algorithm, such as compression, restoration, denoising and deblurring techniques.
- IQA can be used to monitor image quality in the quality control systems.
- IQA can be embedded into image and video processing system to optimize the algorithm and parameter settings.

II. ASSESSMENT TECHNIQUES

The evaluation of quality may be divided into two classes, subjective and objective methods. In the subjective method, human judges the quality by themselves and in the objective method the mathematical metrics are used. The objective IQA can be classified into full-reference, reduced-reference and no-reference IQA based on the availability of the reference image.

Full reference method:

In this method QA algorithm have access to a 'perfect version' of the image or video against which it can compare a 'distorted version'. The 'perfect version' generally comes from a high-quality acquisition device, before it is distorted by, say, compression artifacts and transmission errors. However, the reference image or video generally requires much more resources than the distorted version, and hence FR QA is generally only used as a tool for designing image and video

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processing algorithms for in-lab testing, and cannot be deployed as an application**.** To evaluate the quality of a distorted image, FR metrics, which have access to both whole original and reconstructed information, provide the most precise evaluation results compared with NR and RR.

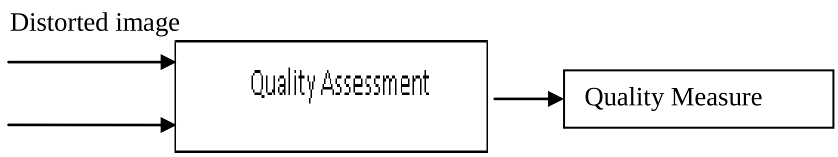

Fig 1. Full reference model

III. DESIGNING FORMULAS

Simple statistics error metrics and Human Visual System(HVS) feature based metrics defined as :

A) Simple statistics error metrics:

i) MSE: It stands for the mean squared difference between the original image and distorted image. MSE (mean square error) is the Euclidian distance between the original and the degraded images. The mathematical definition for MSE [1] is:

$$MSE = (1/M \times N)\sum_{i=1}^{M}\sum_{j=1}^{N}(a_{ij} - b_{ij})^2$$

In Equation ,a_{ij}means the pixel value at

Position (i, j) in the original image and b_{ij} means the pixel value at the same position in the corresponding distorted image.

ii) PSNR: PSNR is a classical index defined as the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation [2]. It is given by:

$$PSNR = 10\log_{10} 255^2 / MSE$$

Where 255 is the maximal possible value the image pixels when pixels are represented using 8 bits per sample. There are also some other metrics like: Average Difference (AD), Maximum Difference (MD),Mean Absolute Error (MAE) ,Peak Mean Square Error (PMSE)

B) Human Visual System (HVS) feature based metric:

SSIM: The structural similarity index is a method for measuring the similarity between two images [3].

$$SSIM(x,y) = \frac{\{(2\mu_x\mu_y + C_1)(2\sigma_{xy} + C_2)\}}{\{(\mu_x^{\,2} + \mu_y^{\,2} + C_1)(\sigma_x^{\,2} + \sigma_y^{\,2} + C_2)\}}$$

Where μ_x*is* average of x, $\mu_y$is average of y, σ_x, $\sigma_y$arestandard deviation between the original and processed images pixels, respectively.C_1, C_2 are positive constant chosen empirically to avoid the instability of measure. The mean of SSIM is known **as mean structural similarity index metric (MSSIM)** and it is given as:

$$MSSIM(X,Y) = \frac{1}{M}\sum_{l=1}^{M} SSIM(xl,yl)$$

IV. METHODOLOGY USED

Image quality assessment consists in modeling the metric between an original (ideal) image and a distorted version of it. The goal is to evaluate and compare the performance of image processing algorithms. For Quality Analysis of Images, step by step operations performed as shown in flow chart.

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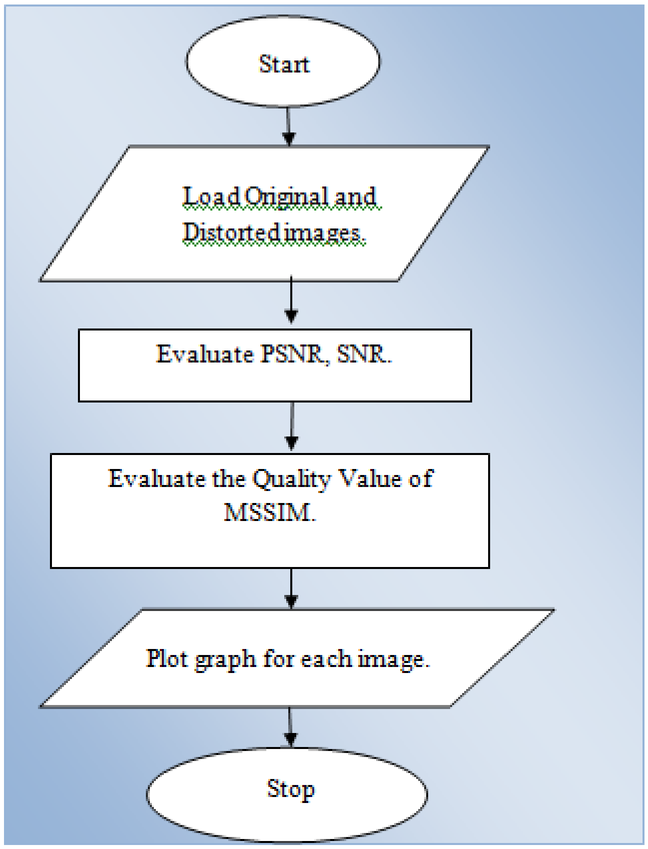

Fig.2 Flowchart of the Methodology Adopted

Fig.3 Original images used for analysis of redwood

Fig.4 (noise density 0.1)

Fig.5 (noise density 0.2)

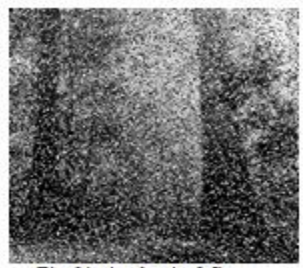

Fig.6 (noise density 0.3)

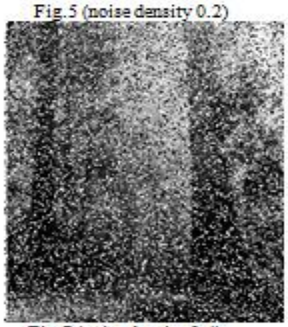

Fig.7 (noise density 0.4)

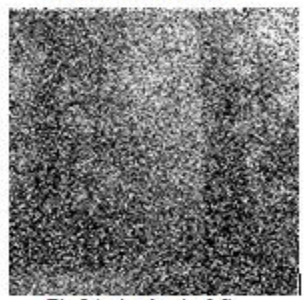

Fig.8 (noise density 0.5)

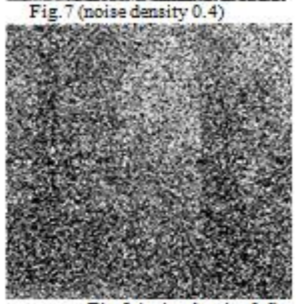

Fig.9 (noise density 0.6)

Fig.10 (noise density 0.7)

V. SIMULATION AND ANALYSIS

In this section, we compare the performance of MSSIM with the statistical methods that are PSNR, SNR. The specific contents of the type of noise we have used is salt & pepper noise. The algorithms were implemented on MATLAB Software. Each Simulation was run on an Intel core i3-330M processor at 2.13 GHz.

Simulation Results

Noise	SNR	PSNR	MSSIM
0.1	-2.069	5.095	0.179
0.2	-2.090	5.074	0.155
0.3	-2.124	5.041	0.142
0.4	-2.153	5.012	0.135
0.5	-2.210	4.954	0.130
0.6	-2.254	4.919	0.126
0.7	-2.312	4.852	0.124

Table 1: Results for redwood image

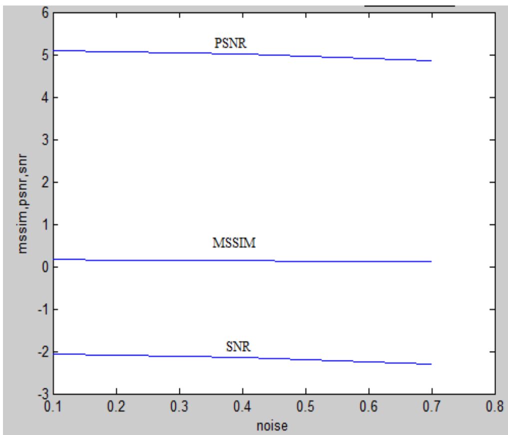

Fig.11: Plot for red wood image

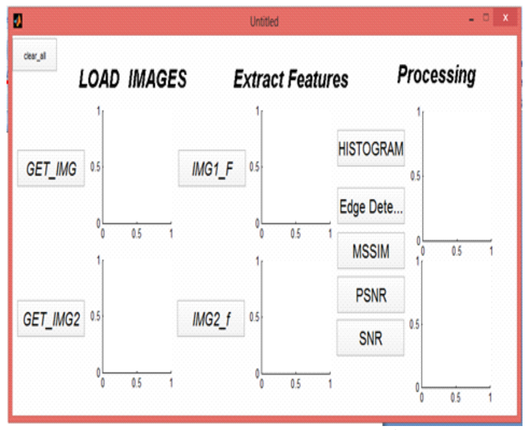

Fig.12: Simulation with MATLAB before loading images

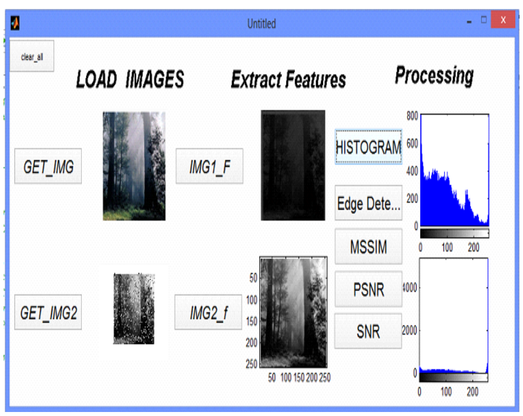

Fig.13: Feature Extraction and Histogram

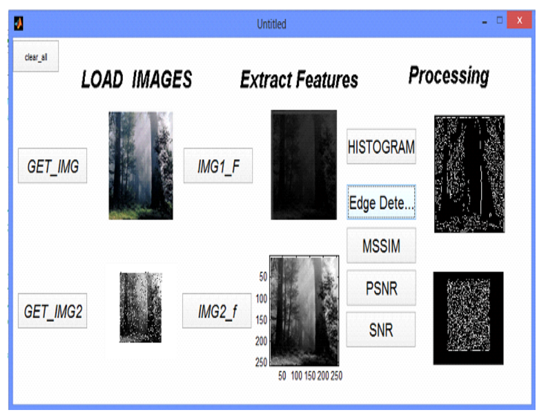

Fig.14: Edge detection

VI. CONCLUSION AND FUTURE SCOPE

A. Conclusion

In the field of image processing, image quality assessment is a fundamental and challenging problem with many interests in a variety of applications, such as dynamic monitoring and adjusting image quality, optimizing algorithms and parameter settings of image processing systems, and benchmarking image processing system and algorithms. Earlier techniques were based on mathematical metrics like PSNR, MSE but they do not correlate well with subjective perception values. MSSIM is a human visual system based metric which uses the luminance, structural and contrast information present in the given image as like in HVS model. These validation results show the robustness, feasibility of the MSSIM and it can perform better than PSNR and SNR.

Plot for redwood image in fig 10 is drawn according to the table1 this shows the variation of the various assessing parameters with respect to noise density variation. The plot clearly shows that curve for MSSIM is almost a straight line parallel to the axis which is used to show the noise density variations. And the variation of this (MSSIM) parameter with respect to noise density is greater than the other two parameters i.e. SNR and PSNR. So the image quality can be calculated more precisely by HVS based metric.

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B. Future Scope

Although this HVS based metric has good consistency with subjective perception values, there are still some issues to be investigated in the future. For example, we can investigate the new image representation method to reduce the number of feature parameters needed for IQA metrics. Also we can introduce the methods which can estimate the quality of the image without any reference.

REFERENCES

[1]. Vikrant Bhateja, AseemKalsi ,Aastha Srivastava," Reduced Reference IQA based on Strucatural Dissimilarity" International Conference on signal and Integrated Networks(SPIN) ,2014

[2]. KeGu,GuangtaoZhai,XiaokangYang,Wenjun Zhang, and Min Liu, "Subjective and Obective Quality Assessment For images with Contrast Change 978-1-4799-2341-0\13\$31.00@2013 IEEE

[3]. YinghuaShen,ChaohuiLu,Hui Ren ,"Obejctive Quality Assessment of JPEG Distorted Stereoscopic image"2nd International Conference on Computer Science and Network Technology(2012).

[4]. Min Zhang, XuanqinMou, Lei Zhang, " Non-Shift Edge Based Ratio (NSER): An Image Quality Assessment Metric Based on Early Vision Features", IEEE Signal Processing Letters, Vol. 18, No. 5, pp. 315-18 ,May June 2011

[5]. Dan Lv, Du-Yan Bi, Yuan Wang, " Image Quality Assessment Using DCT and Structural Similarity", IEEE conference on wireless communication networking and mobile computing, pp.1-4, 2010.

[6]. Gonzalez , R.C.,Woods, R.E., and Eddins, S.L "Digital Image Processing Using Matlab", Gatesmark Publishing ,Knoxville,TN,2nd edition,2009

[7]. Yaohua Yi, Xiaoqing Yu, Leiguang Wang , Zhigao Yang, " Image Quality Assessment Based on Structural Distortion and Image Definition", International Conference on Computer Science and Software Engineering,pp.253-56,2008.

[8]. Engelke U., Zepernick H.J., "Perceptual-based Quality Metrics for Image andVideo Services:" 3rdEuroNGI conference on next generation internet networks, pp.190-97, 2007

[9]. SheikhH.R.,SabirM.F., BovikA.C., "A statisticalevaluation of recent full reference image quality assessmentalgorithms", *IEEE Trans. IP*, vol. 15, pp. 3440-3451, 2006.

[10]. WangZ.,Bovik A. C.,SimoncelliE. P., "Structural Approaches to Image Quality Assessment," Handbook of Image and Video Processing, 2nded, New York, USA: Academic Press, 2005, pp. 1-33

[11]. CadikM.,Slavik P., "Evaluation of two principal approaches to objective image quality assessment", 8th International Conference on Information Visualisation, IEEE Computer Society Press, pp. 513-551, 2004.

[12]. M. Carnec, P. Le Callet and D. Barba, "An image quality assessment method based on perception of structural information," 2003 International Conference on Image Processing, Barcelona, Spain, September 14-17, 2003.

[13]. Avcibas I., Sankur B., Sayood K., "Statistical evaluationof image quality measures", Journal of Electronic Imaging,vol. 11, no. 2, pp. 206-223, 2002.

BIOGRAPHY

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