Survey on Approaches used for Image Quality Assessment

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Abstract

One of the fundamental segments influencing the general execution of biometric structure is nature of biometric data. Low nature of biometric test generally brings about spurious or missing segments, which extends the enrolment frustration and degenerate the general execution of biometric systems. Finding the way of a photograph is the key issue in picture and video dealing with. For quality assessment of a photo distinctive methods have been evaluated. Nature of biometric test can be described as subjective and target methodologies. In this paper relationship of picture quality assessment techniques which are basic to update the execution of biometric system is displayed.

Keywords: Biometric system, Quality assessment, subject and objective image quality assessment

I. INTRODUCTION

This template, modified in MS Word 2007 and saved as a In the progressed inventive time of imaging and sight and sound advances, visual information, recorded by pictures has ended up being essential asset for learning obtaining. In the strategy of visual data securing, preparing, correspondence, administration and capacity, a few antiques or commotion may even be acquainted with pictures to corrupt the nature of visual data. In an extremely normal computerized photo handle framework, the picture is caught and improved into advanced flag by detecting component. This advanced flag is then handled to limit the commotion and is packed for capacity or transmission. Once the image is sooner or later exhibited to the user, it won't be same because of the real picture since it has been presented to numerous styles of distortions. The bending can be rune from development obscuring, Gaussian noise, and sensor deficiency, and pressure, mistakes at some phase in transmission or the mix of numerous components. Subsequently it's important to evaluate visual characteristics of pictures to improve the execution of visual information recorded by pictures, so it might keep up, oversee and apparently upgrade the acceptable of the photo before transmission or capacity. Quality mensuration is required for few pictures prepare applications that grasp acknowledgment, recovery, arrangement, pressure, recuperation and comparative fields. The target of picture quality assessment is to mechanically break down the famous of photos in settlement with human fine judgments. To judge the standard of pictures and movement photographs, as of late different ways were composed. Image excellent may be measured in two ways subjective and objective [1] [7]. On the bases of subjective experiments subjective assessment of photograph is carried out whereas objective picture quality appraisal strategies were basically in view of some numerical measures.

II. RELATED STUDIES

Zhou Wang, Alan C. Bovik in 2002 showed a novel all inclusive picture quality list and specified that test plays past MSE [1] [5]. Yusra A. Y. Al-Najjar, Dr. Der Chen Soong said that contrasting sorts of Image Quality measurements change in cost in venture with assortments of contortion among the picture and intense to get the equivalent best esteem regardless of the possibility that the equivalent twisting is connected on various photos. The author said that, regardless of SSIM progress toward becoming built from UIQI, the outcome given by UIQI is toward one than SSIM [11]. Hore A., Ziou, D clarified that numerical connection amongst SSIM and PSNR with various types of photo corruptions, such as Gaussian blur, additive Gaussian white noise and discussed that SSIM performs superior to PSNR [5]. X. Zhuand P.Milanfar provided sharpness metric primarily based on the neighborhood gradients of the without any side detection. Its cost drops when the photograph either turns into blurred or corrupted by using random noise. The author provided the experiments to illustrate the usefulness and forcefulness of this metric using synthetic, natural, and compressed photo [10]. H. R. Sheikh and A. C. Bovik stated that the visual information fidelity (VIF) criterion for full-reference image QA. The VIF, derived from statistical model for natural scenes. Author mentioned that VIF to be better than HVS-based strategy [7]. Anu et al. demonstrated that advance techniques had been based totally on scientific measures like PSNR, MSE, however they do not associate nicely with subjective perception values.

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A human visual framework based metric MSSIM utilizes the luminance, basic and difference data introduce in the given picture. The approval onsequences of these demonstrate the heartiness, attainability of the MSSIM and it can perform superior to PSNR and SNR [5].

III. CLASSIFICATION OF IMAGE QUALITY ASSESSMENT METHODS

Quality of a picture may be a feature that measures the perceived picture degradation imaging systems might in addition introduce some quantities of distortion or artifacts within the signal, that the quality analysis is a necessary drawback. The analysis of image quality is classified as shown below Fig. 1.

A. Subjective Method

In the subjective technique human judges the standard of a photo without anyone else's input. In this way these methodologies to be the foremost correct measures of perceptual quality and are the main generally perceived technique for judging saw quality. Nisha and Sunil Kumar Discussed that, to evaluate the extraordinary of ravaged photos; photographs are given to some of onlookers and are requested to examine real pictures with deformed photographs. Subjective methods are again categorized into stimulus and double stimulus methodology [8].

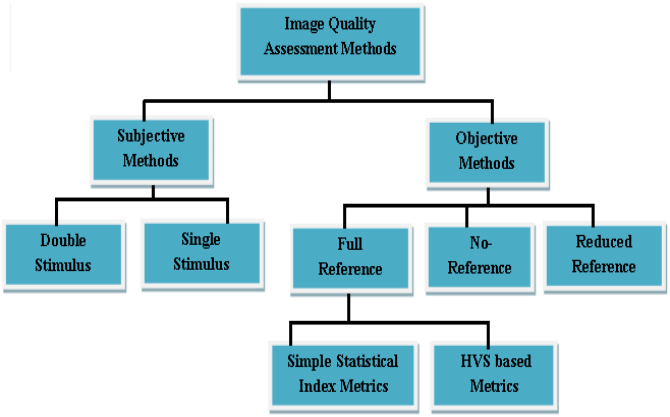

Fig.1 Classification of Image Quality Assessment Methods

In double-stimulus methodology, before looking over their qualities on a straight quality scale, subject is given with the source and test pictures, where as in single-stimulus approach the subject assesses the method for the test pictures on a prompt quality scale without the source as reference. The scores assessed through numerous subjects are arrived at the midpoint of for each check picture to get mean supposition score. Mean opinion score (MOS) is calculated based on their evaluation which is taken as the image quality index. Mean Opinion Score (MOS) scores scales from 1 to 5 shown in below Table I.

TABLE I

MEAN OPINION SCORE

1	2	3	4	5
Very Poor Quality	Poor Quality	Good Quality	Very Good Quality	Excellent Quality

In this technique, it is understood that subjective picture quality changes beginning with one individual then onto the following: generally, the scores given by various persons are not same. The score are depends upon observer's general association, individual appreciation and may differ as per his attitude. To deal with this issue, an ordinary score is figured. This Mean Opinion Score is indicated by MOS or the Difference Mean Opinion Score. Be that as it may, subjective quality evaluation is normally excessively awkward, costly, tedious and furthermore these techniques are when all is said in done not pertinent in situations which require continuous preparing [8].

B. Objective Method

In the objective method quality of an image is evaluated by algorithms. This is a numerical approach in which force of two pictures, allusion and mutilated pictures are used to find a number which indicate the image quality. In light of the accessibility of reference picture, the objective IQA can be ordered into full-reference, reduced-reference and no-reference [3].

No Reference (NR) Models:

In these techniques, as a rule the human visual framework does not need a source test to decide the excellence level of a picture. No reference method is also called “blind models” methods. This technique can be utilized as a part of any application where quality estimation is required with no reference data [9-10].

Reduced Reference (RR) models:

The reduced reference model is an assessment system, which helps to evaluate the quality of the mutilated picture and quantify. In this procedure the reference picture is simply partially open, as a course of action of isolated segments made available as side information to evaluate the way of the contorted picture. However, from the original reference image some set of features are extracted and they are being utilized by the quality [4-5].

Full Reference (FR) model:

In full reference model, the human visual system requires a allusion sample to define the excellence level of an image. In this, quality appraisal algorithms have access to impeccable version of photograph from which it may examine a 'distorted model'. For the most part the 'ideal form' originates from an incredible securing gadget, before it's far misshaped with the guide of pressure antiquities or transmission blunders. In general there are two training of objective excellent evaluation method, simple applied mathematics error metrics and human sensory system feature based mostly metrics.

a) Simple statistical error metrics:

Mean Absolute Error (MAE): is the mediocre contrast between allusion picture and the test picture. MAE is specified as [1]

$$MAE = (1/MN) \sum_{i=1}^{M} \sum_{j=1}^{N} |x(i,j)-y(i,j)| \quad (4)$$

Peak Mean Square Error: is specified as [1]

$$PMSE = 1/MN \sum_{i=1}^{M} \sum_{j=1}^{N} (x(i,j)-y(i,j))^2 / (MAX(x(i,j))2 \quad (5)$$

The least complex and most broadly utilized full reference picture quality measure is MSE and PSNR. The upside of MSE and PSNR is that, they are quick and simple to execute. They rearrange and dispassionately evaluate the blunder flag.

Peak Signal to Noise Ratio: is characterized as the proportion between maximum possible power of a signal and the power of corrupting noise that affect its fidelity of its representation [1][11].

$$PSNR = 10 \log 10\, 2552 / MSE \quad (6)$$

In the above equation 255 is maximum conceivable estimation of the picture pixel when pixels are denoted using 8 bit per sample MSE is the Euclidian separation between the source and mutilated pictures.

b) Human Visual System (HVS) feature based metrics:

It is another approach of measuring picture quality. The technique utilizes human eye as a source of perspective. The principle thought is that people are interested in various qualities of the picture other than taking it as a whole. These properties incorporate brightness, contrast, texture, orientation etc.

Universal Image Quality Index (UIQI)

It breaks the examination amongst source and mutilated pictures into three correlations: luminance, contrast, and structural comparisons. Wang et al. discussed that their experimental results performs better than MSE [1].

$$UIQI\ (x, y) = 4\mu_x \mu_y \mu_{xy} / (\mu^2_{x+} \mu^2_{y)(}\sigma^2_x + \sigma^2_y) \quad (7)$$

Structural Similarity Index Measure (SSIM)

This is a technique for measuring the closeness between two pictures. In SSIM, measuring picture quality depends on an underlying uncompressed or bending free picture as reference. Picture is by means of info about luminous, contrast and structure. This strategy is intended to enhance the earlier methods like PSNR and MSE. SSIM is given by the equation [5]:

$$SSIM(x, y) = (2\mu_x\mu_y+C1)\ (2\sigma_{xy}+C2) / \{(\mu^2_x\mu^2_y+C1)\ (\sigma^2_x\sigma^2_y+C2)\} \quad (8)$$

In above equation μx is average of x, μx is average of y and are the standard deviation between source and processed images pixels. C1, C2 are positive constant.

Mean Structural Similarity Index Measure (MSSIM): is given by [7]

$$MSSIM = 1/M \sum_{i=1}^{M} SSIM\ (xi, yi) \quad (9)$$

Dissimilarity Structural Similarity Index(DSSIM): is structural dissimilarity metric. It is given by the equation [5]:

$$DSSIM\ (x, y) = 1/\ (1-SSIM(x, y)) \quad (10)$$

IV. RESULTS

First, the pictures are chosen from Laboratory of Image and Video Engineering at University of Texas, Austin contains Lossless True Color Image Suite" provided by "LIVE Image Quality Assessment Database". The selected pictures were then changed into gray level pictures by making use of function RGB2gray in MATLAB; afterwards the measurements are actualized upon these pictures. Finally by utilizing MATLAB programming a comparison can be done between four target appraisals: pixel-contrast based estimation Peak Signal-to-Noise Ratio (PSNR), HVS utilizing Fourier Transform, Structural Similarity Index (SSIM), and Universal Image Quality Index (UIQI) measurements. MATLAB is identical software for managing representation since it has picture handling tool box. The original pictures and mutilated pictures are shown in Fig. 2 and Fig. 3. The comparison of six original and mutilated images buildings, caps, toys, butterfly, parrots, airplane, and light house is shown in Table II.

TABLE III

COMPARISON OF IMAGE QUALITY MEASUREMENTS APPLIED ON IMAGES

Image	PSNR	SSIM	UIQI	DSSIM
Buildings	18.22	0.62	0.99	2.65
Caps	28.38	0.82	0.99	5.58
Airplane	25.10	0.84	0.99	6.07
Lighthouse	22.22	0.69	0.99	3.22
Toys	21.48	0.77	0.99	4.26
Parrots	28.09	0.87	0.99	7.59

Fig. 2 Original images a) to f) used in the test

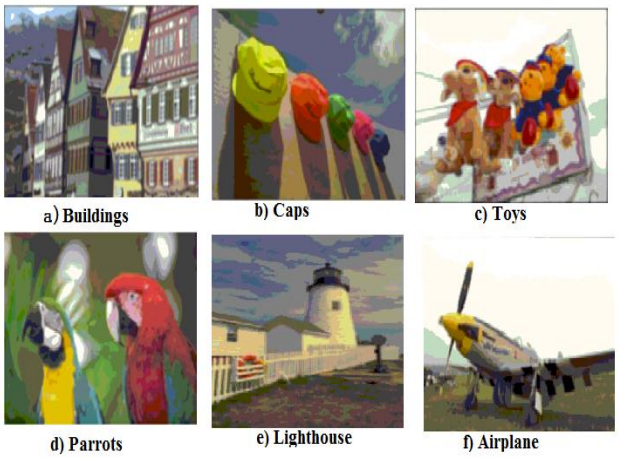

Fig. 3 Mutilated images from a) to f) used in the test

Table-III shows the comparison of UIQI with other statistical methods such as PSNR, SSIM and DSSIM. The particular substance of the kind of noise we have utilized here is salt & pepper noise. Graph for building pictures in Fig. 4 is drawn according to the TABLE II. This demonstrates the different accessing parameters with respect to noise density variations. Fig. 4 clearly demonstrates that arc for UIQI is nearly a conventional line parallel to the axis which is used to demonstrate the noise variations and these variations are greater than the other three.

TABLE-III

COMPARISON OF IMAGE QUALITY MEASUREMENTS APPLIED ON IMAGES

Image	Noise	PSNR	SSIM	UIQI	DSSIM
Buildings	0.1	18.40	0.77	0.99	4.34
	0.2	15.31	0.66	0.98	2.91
	0.3	13.46	0.56	0.97	2.28
	0.4	12.10	0.47	0.95	1.89
	0.5	11.04	0.39	0.93	1.64
	0.6	10.17	0.31	0.92	1.45
	0.7	9.42	0.23	0.90	1.31
	0.8	8.74	0.15	0.88	1.18

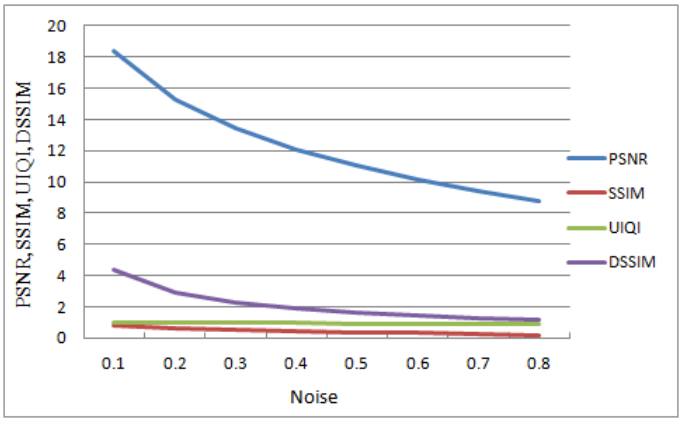

Fig. 4 Plot for buildings image with different noise density

V. DISCUSSION

From Table II and Table it can be seen that diverse sorts of picture quality measurements vary in value depending upon the types of mutilate in the picture and difficult to get the similar quality esteem regardless of possibility that a similar distortion is implemented on various pictures. Even though the SSIM was constructed from UIQI; the outcome produced by UIQI is near to one than SSIM but still lots of work is needed to get close to subjective image quality measurement.

VI. CONCLUSION

Picture Quality estimation is a critical and testing errand in various picture handling applications like therapeutic imaging, biomedical frameworks, checking and interchanges. Numerous systems can impact the way of pictures. Consequently, exact estimation of the photo quality is an essential stride. The aim of objective IQA is to plan calculations which consequently assess the picture quality. As of late a lot of exertion has been made to create target picture quality measurements however there square measure still constraints. In this paper we discussed diverse strategies (subjective and objective) used for picture quality assessment. From the audit plainly subjective IQM are tedious and costly. Target techniques are helpful than subjective strategies yet at the same time require heaps of work.

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REFERENCES

[1] Ahmet M. Eskicioglu, Paul S. Fisher, "Image Quality Measures and Their Performance" IEEE Transactions on Communication, Vol. 43, No. 12, pp. 2959-2965, December 1995.

[2] Anu et al., "Comparative Analysis of Image Quality Assessment Using HVS Model", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 2, Issue 7, July 2014.

[3] Cavtat, Croatia,"Combining and Selecting Indicators for Image Quality Assessment" 31st Int. Conf. on Information Technology Interfaces Proceedings of the ITI 2009, June 22-25, 2009.

[4] C.Sasi varnan, et al., "Image Quality Assessment Techniques pn Spatial Domain", International Journal of Computer Science and Telecommunications, Vol. 2, Issue 3, September 2011.

[5] Hore, A., Ziou, D., "Image Quality Metric: PSNR Vs SSIM", IEEE conference on Pattern recognition, pp 2366-2369,2010.

[6] H. R. Sheikh and A. C. Bovik, "Image information and visual quality", IEEE Trans. Image Process., vol. 15, no. 2, pp. 430–444, Feb. 2006.

[7] Ke Gu, Guangtao Zhai, Xiaokang Yang, Wenjun Zhang, and Min Liu, "Subjective and Objective Quality Assessment For images with Contrast Change 978-1-4799-2341-0\13\$31.00@2013 IEEE.

[8] Nisha, and Sunil Kumar, "Image Quality Assessment Techniques", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 7, July 2013.

[9] Wang Z. , Bovik A. C., "A universal image quality index," IEEE Processing Letters, vol. 9, pp. 81–84, Mar. 2002.

[10] X.ZhuandP. Milanfar, "A no-reference sharpness metric sensitive to blur and noise," in Proc. Int. Workshop Qual. Multimedia Expert., 2009, pp. 64–69.

[11] Z. Wang and A. C. Bovik. Modern Image Quality Assessment. Morgan and Claypool Publishing Company, New York, 2006.

[12] Yusra A. Y. Al-Najjar, Dr. Der Chen Soong, "Comparison of Image Quality Assessment: PSNR, HVS, SSIM, UIQI", International Journal of Scientific & Engineering Research, Volume 3, Issue 8, August-2012 ISSN 2229-5518

[13] Z. Wang, H. R. Sheikh, and A. C. Bovik, "No-reference perceptual quality assessment of JPEG compressed images," in Proc. IEEE ICIP, Sep. 2002, pp. 477–480.