International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol. 9, Issue.9, September 2021 E-ISSN: 2347-2693

Statistical Evaluation of Image Quality Measures for Improving Iris Recognition Performance

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DOI: https://doi.org/10.26438/ijcse/v9i9.15 | Available online at: www.ijcseonline.org

Received: 29/Aug/2021, Accepted: 20/Sept/2021, Published: 30/Sept/2021

***Abstract*—** Iris image quality assessment is a strategy of estimating data substance of iris imagery at the phase of iris acquisition or at early preprocessing stage. The information substance might be taken to be utilized for iris identification dependent on a single image. The image might be disposed of, or joined with other imagery to improve recognition abilities of an iris system. Evaluate quality metrics would be the rules in settling on choices with respect to additional means regarding gained imagery. Implement this algorithm on open source iris databases (IIT Delhi, UBIRIS and UPOL Iris Database). We compare with the support of quality measure parameters with both original iris image and enhanced iris images. The consequential images quality is tested by using quality measures like PSNR, MSE, MAXERR, L2RAT, it is found that quality has been enhanced. Hence it is shown that the recognition rate is rises.

***Keywords*—**Quality Measure, Iris Recognition System, Biometric, PSNR, MSE, MAXERR, L2RAT

I. INTRODUCTION

Iris recognition is a mechanized strategy for biometric recognizable proof that utilizes numerical pattern-recognition methods on images of either of the irises of a person's eyes, whose perplexing patterns are interesting, stable, and can be seen from some distance. Retinal examining is an alternate, ocular-based biometric innovation that utilizes the one of kind patterns on an individual's retina blood vessels and is regularly mistaken for iris recognition. Iris recognition utilizes video camera innovation with unpretentious close to infrared illumination to gain pictures of the detail-rich, complicated structures of the iris which are obvious remotely. Digital templates encoded from these patterns by numerical and measurable algorithms permit the ID of an individual or somebody professing to be that individual.

Following figure shows the anatomy of human eye. In iris anatomy the pigmented solid drapery close to the front of the eye, between the cornea and the lens, that is punctured by an opening called the pupil. The iris is situated before the lens and ciliary body and behind the cornea. It is washed in front and behind by a liquid known as the vitreous humor. The iris contains of two pieces of smooth muscle with contrary actions: dilation and contraction. These muscles determine the size of the pupil and thus control how much light spreads the sensory tissue of the retina.

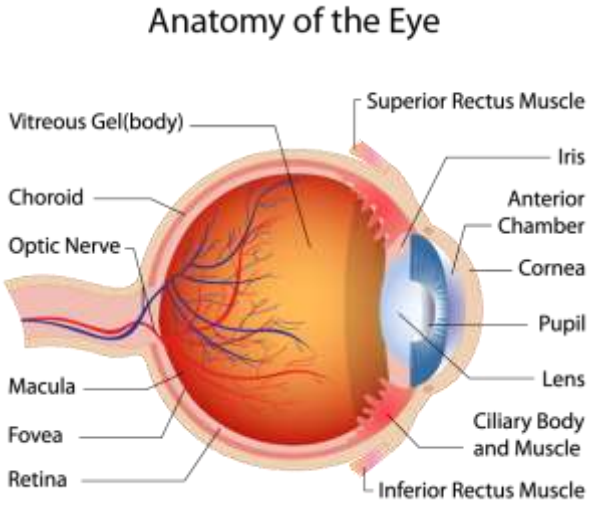

Figure 1. Anatomy of human eye

II. RELATED WORK

Biometric techniques, which recognize individual's dependent on physical or behavioral traits, are of importance since individuals can't fail to remember or lose their a physical characteristics in the manner that they can lose passwords or identity cards. Among these biometric approaches, iris is right now considered as one of the most solid biometrics due to its remarkable surface's arbitrary variety. Additionally, iris is end up being all around shielded from the outside climate behind the cornea, moderately simple to secure and stable everywhere on the

individual's life. For these reasons, iris designs become fascinating as an elective way to deal with dependable visual acknowledgment of people. This recognition system includes four primary modules: iris acquisition, iris segmentation and normalization, feature extraction and encoding and finally matching. Nonetheless, we saw that practically all the iris acknowledgment frameworks continue without controlling the iris picture's quality. Normally, poor image's quality corrupts essentially the exhibition of the recognition system [1].

When working with biometrics, giving little attentiveness to the methodology, it is fundamental to think about information quality, as it can restrict the exactness of acknowledgment frameworks. In this specific situation, the evaluation of biometric tests quality by characterizing quality metrics can be utilized to upgrade the presentation and usefulness of a biometric framework. In this work, the impact of ISO/IEC 29794-6 quality metrics on iris acknowledgment frameworks execution has been investigated. To complete the examination, the comparing metrics have been determined by the computational strategy itemized in the norm and a quality score has been gotten. At that point, to decide the metrics impact, an open source iris acknowledgment framework just as one open accessible dataset, have been utilized. Results show how much an iris recognition system can be influenced by input image quality, and furthermore the most powerful quality metrics on recognition accuracy [2].

Measure the quality of an iris segmentation using GMM model trained on good quality iris [3]. Iris quality measure based on a Gaussian mixture model (GMM). Compare its performance to that of other standard iris quality metrics on two different types of noise which can corrupt the iris texture: occlusions and blurring. For occlusions, GMM-based quality measure to an active contour method for eyelids and eyelashes detection. And for iris blurring, quality measure to a standard method based on Fourier transform and wavelets [4].

Iris recognition, the capacity to perceive and recognize people by their iris design, is the most dependable biometric regarding recognition and identity performance. Performance of these frameworks is influenced by low quality imaging. In this work, iris quality appraisal by investigating the impact of seven quality components: defocus blur, motion blur, off-angle, impediment, specular reflection, lighting, and pixel-depends on the performance of conventional iris recognition framework. Defocus blur, motion blur, and off-angle are the variables that influence recognition performance the most [5].

Image quality assessment assumes a significant part in upgrading the exhibition of pattern recognition frameworks, including biometric frameworks. Quality assessment techniques have been used for iris recognition on grown-ups they have not been examined on iris recognition for kids. Iris recognition on youngsters is troublesome in light of their uncooperative nature and may bring about lower quality iris tests [6].

Iris biometric for personal identification depends on catching an eye image and acquiring highlights that will help in recognizing a human being. Be that as it may, caught images may not be of acceptable quality because of assortment of reasons for example occlusion, blurred images and so on In this way, it is important to survey image quality prior to applying highlight extraction calculation to stay away from lacking outcomes. Iris quality assessment research is reached out by analyzing the impact of entropy, mean intensity, area ratio, occlusion, blur, dilation and sharpness of an iris image. Every boundary is assessed exclusively, and then fused to get a quality score. A combination technique dependent on principal component analysis (PCA) is proposed to decide if an image is acceptable or not. To test the proposed method; Chinese Academy of Science Institute of Automation (CASIA), Internal Iris Database (IID) and University of Beira Interior (UBIRIS) databases are used [7].

No-reference image quality assessment (NRIQA) techniques gauge image quality debasements with no data about the "good quality" reference image. Propose a NRIQA calculation dependent on the possibility of examination two obscured variations of the first image to be assessed [8].

Iris recognition is a biometric technology to recognize humans by taking and analyzing the unique patterns of iris inside the human eye. An open source iris recognition system is designed to verify individualism of the human iris and conjointly its performance as a biometric. To govern the recognition performance of the system databases of grey-scale eye images are used [9].

Image quality is a major question influencing the performance of biometric systems. Assuring the quality of iris images procured in unconstrained imaging conditions in visible light postures numerous difficulties to iris recognition systems. Low quality iris images increment the false dismissal rate and lessening the performance of the systems by quality filtering. Techniques that can precisely expect iris image quality can improve the effectiveness of quality-control conventions in iris recognition systems [10].

III. METHODOLOGY

Implement preprocessing operation to enhance iris database images and determine statistical measure PSNR, MSE, MAXERR, L2rat.

- PSNR: PSNR is the peak signal to noise ratio in decibels. The PSNR is only significant for data encrypted in terms of bits per sample, or bits per pixel. For example, an image with 8 bits per pixel contains integers from 0 to 255.
- MSE: The mean square error (MSE) is the squared norm of the variance between the data and the estimation divided by the number of elements.

- MAXERR: MAXERR is the maximum absolute squared deviation of the data from the estimation.
- L2RAT: L2RAT is the ratio of the squared norm of the signal or image estimation to the input signal or image.

Following are the mathematical expression of quality measures.
The mathematical representation of PSNR:

$$PSNR = 20log_{10}\left(\frac{MAX_f}{\sqrt{MSE}}\right) \quad (1)$$

The mathematical representation of MSE:

$$MSE = \frac{1}{mn}\sum_{0}^{m-1}\sum_{0}^{n-1}||f(i,j) - g(i,j)||^2 \quad (2)$$

The mathematical representation of MAXERR:

$$MAXERR = \sum_{i=1}^{n} f(y_i)(x_i - x_{i-1}) \quad (3)$$

L2RAT is the ratio of the squared norm of the signal or image approximation to the input image.

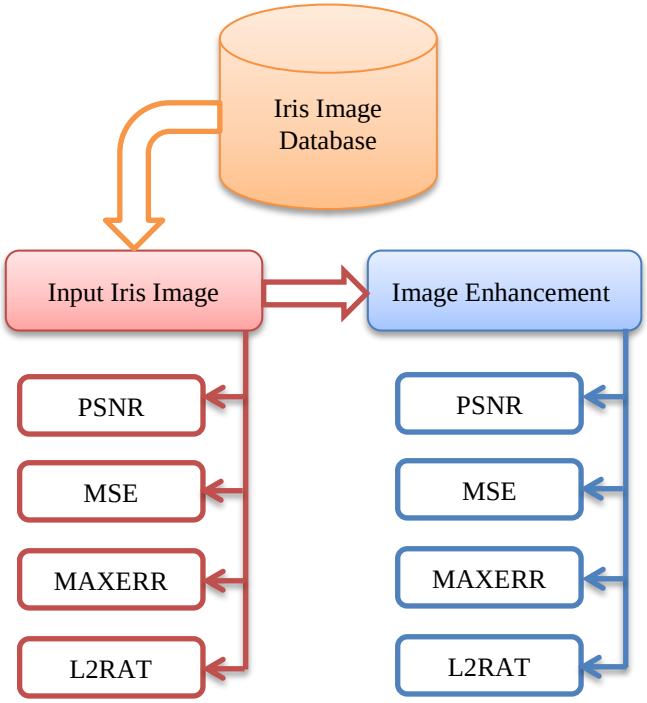

Figure 2. Determine quality measures for improving iris recognition performance

Above figure shows the workflow for determine quality measures for improving iris recognition performance.

IV. Results and Discussion

In this algorithm, read the iris image from database, enhance the iris image using digital image processing techniques. After enhancement, calculate quality measures for both original image and enhanced image. Following table shows the statistical quality measures.

Table 1. Statistical quality measure on original image (IIT Delhi Database)

Sr. No	PSNR	MSE	MAXERR	L2RAT
1	22.45	370.32	99	0.99
2	21.54	456.17	99	0.98
3	21.44	467.25	99	0.98
4	21.15	499	99	0.98
5	21.01	514.77	99	0.98
6	21.48	462.56	99	0.98
7	21.31	480.44	99	0.98
8	21.82	427.62	99	0.98
9	21.71	438.77	99	0.98
10	22.57	359.9	99	0.99

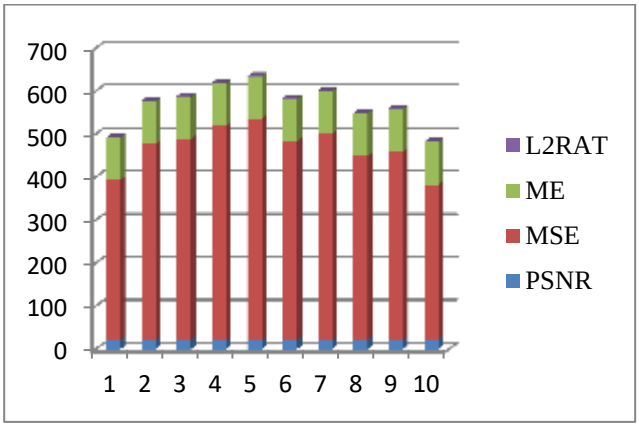

Figure 3. Statistical quality measure on original image (IIT Delhi Database)

Table 2. Statistical quality measure on enhanced image (IIT Delhi Database)

Sr. No	PSNR	MSE	MAXERR	L2RAT
1	17.3	1209.76	96	0.94
2	17.14	1257.33	96	0.94
3	17.25	1223.87	96	0.94
4	17.3	1211.36	96	0.94
5	17.12	1261.73	96	0.94
6	17.09	1270.98	96	0.94
7	17.17	1246.42	96	0.94
8	17.31	1207.03	96	0.94
9	17.25	1224.85	96	0.94
10	17.11	1264.75	96	0.94

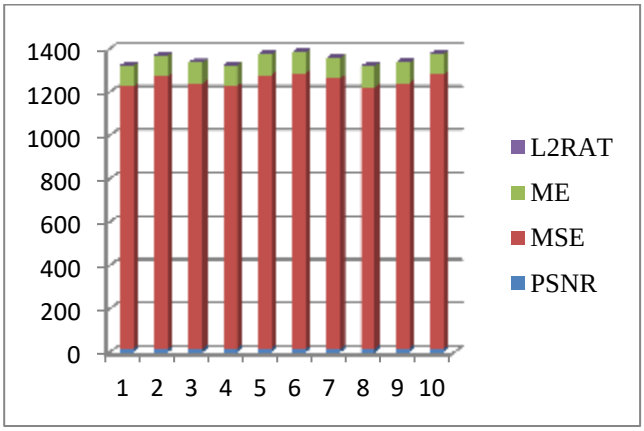

Figure 4. Statistical quality measure on enhanced image (IIT Delhi Database)

Table 3. Statistical quality measure on original image (UBIRIS Database)

Sr. No	PSNR	MSE	MAXERR	L2RAT
1	19.07	805.29	99	0.97
2	18.64	888.56	99	0.97
3	19.14	792.24	99	0.97
4	18.9	837.87	99	0.97
5	19.46	736.09	99	0.98
6	20.35	599.74	99	0.98
7	20.21	618.97	99	0.98
8	20.31	605.66	99	0.98
9	20.11	634.15	99	0.98
10	20.27	611.51	99	0.98

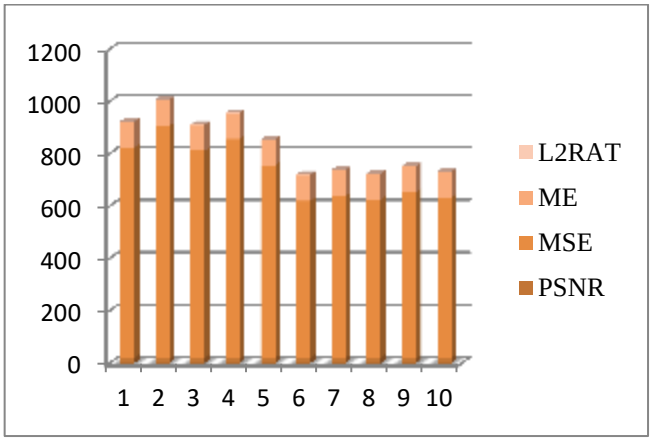

Figure 5. Statistical quality measure on original image (*UBIRIS* Database)

Table 4. Statistical quality measure on enhanced image (UBIRIS Database)

Sr. No	PSNR	MSE	MAXERR	L2RAT
1	17.29	1213.86	96	0.94
2	17.29	1214.46	96	0.94
3	17.27	1220.57	96	0.94
4	17.29	1212.94	96	0.94
5	17.27	1217.92	96	0.94
6	17.3	1211.29	96	0.94
7	17.24	1227.77	96	0.94
8	17.24	1227.44	96	0.94
9	17.31	1208.23	96	0.94
10	17.34	1200.57	96	0.94

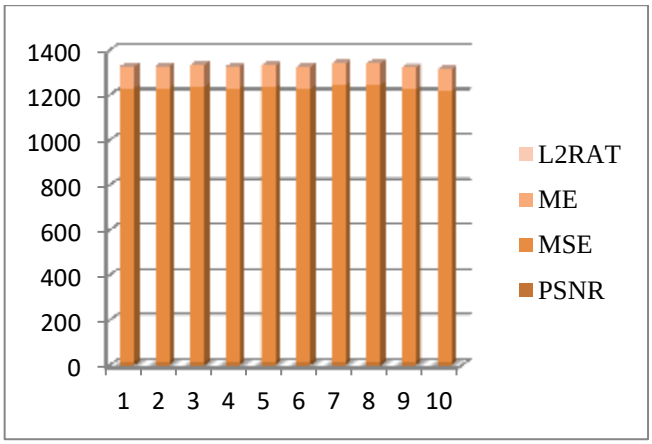

Figure 6. Statistical quality measure on enhanced image *UBIRIS* Database)

Table 5. Statistical quality measure on original image (UPOL Database)

Sr. No	PSNR	MSE	MAXERR	L2RAT
1	17	1295.93	99	0.81
2	17.58	1135.21	99	0.85
3	17.61	1127.51	99	0.85
4	17.03	1287.77	99	0.84
5	17.25	1224.39	99	0.86
6	17.01	1293.07	99	0.83
7	16.04	1616.81	99	0.86
8	16.23	1548.01	99	0.87
9	16.19	1562.29	99	0.87
10	16.11	1593.56	99	0.87

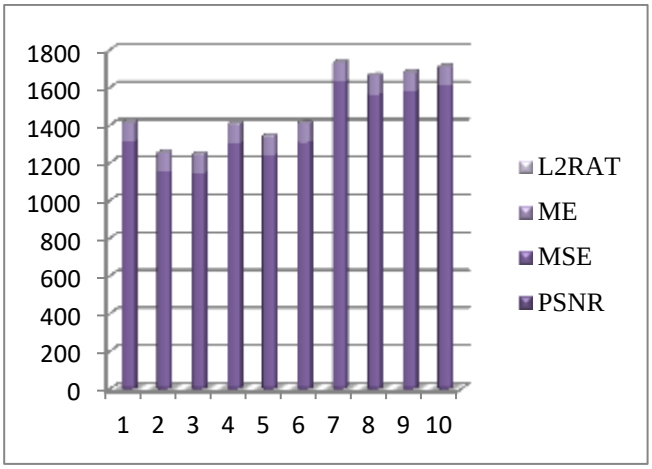

Figure 7. Statistical quality measure on original image (*UPOL* Database)

Table 6. Statistical quality measure on enhanced image (UPOL Database)

Sr. No	PSNR	MSE	MAXERR	L2RAT
1	14.33	2401.1	96	0.89
2	14.23	2455.94	96	0.89
3	14.32	2406.83	96	0.89
4	14.23	2452.83	96	0.89
5	14.33	2400.51	96	0.89
6	14.22	2458.91	96	0.89
7	14.3	2416.36	96	0.89
8	14.31	2411.91	96	0.89
9	14.34	2396.35	96	0.89
10	14.27	2431.82	96	0.89

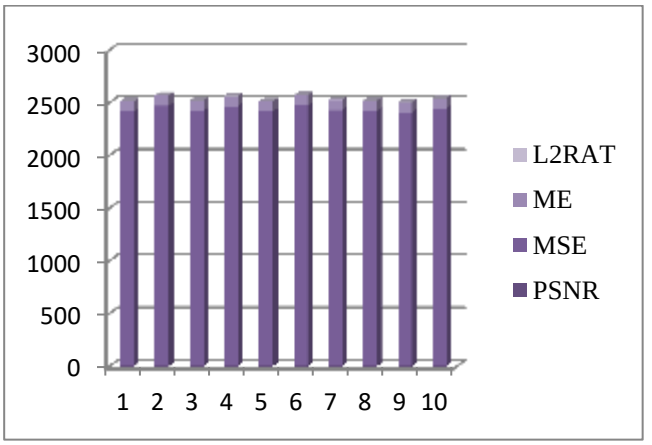

Figure 8. Statistical quality measure on enhanced image *UPOL* Database)

V. CONCLUSION AND FUTURE SCOPE

Biometric techniques, which recognize individual's dependent on physical or behavioral traits, are of importance since individuals can't fail to remember or lose their a physical characteristics in the manner that they can lose passwords or identity cards. Among these biometric approaches, iris is right now considered as one of the most solid biometrics due to its remarkable surface's arbitrary variety. Additionally, iris is end up being all around shielded from the outside climate behind the cornea, moderately simple to secure and stable everywhere on the individual's life. Implement this algorithm on open source iris databases (IIT Delhi, UBIRIS and UPOL Iris Database). We compare with the support of quality measure parameters with both original iris image and enhanced iris images. The consequential images quality is tested by using quality measures like PSNR, MSE, MAXERR, L2RAT, it is found that quality has been enhanced. Hence it is shown that the recognition rate is rises. Our future scope is to design algorithm for iris recognition system.

ACKNOWLEDGMENT

We are thankful to IIT Delhi, UBIRIS and UPOL for providing iris image databases.

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