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Performance Analysis of Fuzzy Based Image Enhancement Using Particle Swarm Optimization

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Abstract*— Image Enhancement works an important aspect in digital image managing programs for both human and computer viewpoint. The major problem that improves in image improvement is quantifying the way of improvement thus needs interesting techniques to acquire satisfied results. To overcome the limitations of earlier techniques a new technique has been proposed which would evaluate k factor automatically using the particle swarm optimization to find the finest resemblance value among the given set of values which represents the image in more proficient way. The proposed approach has the ability to enhance the contrast in digital images in proficient manner by utilization of the gradient optimization based adaptive k-fuzzy image enhancement algorithm. As gradient optimization has ability to reduce the effectuation of noise and also it conserves the edges in very effective manner hence provides better results.

***Index Terms*— Particle swarm optimization, Contrast Enhancement, Histogram Equalization, Image Enhancement.**

I. INTRODUCTION

The purpose or can say aim of image enhancement is for handling a given picture so that the result is more appropriate than the given unique picture for the particular programs. Enhancement improves and improves the picture functions such as finishes, limitations, comparison to create a noticeable show which is more useful for show and the research. Image improvement is usually a technique that is used for changing electronic pictures so that the result is more appropriate either for displaying or can say for more research. It can be said that if the interruption is being eliminated from a picture, it will create the work simpler for the recognization of the key functions of a picture. It is also identified that improvement never in convert improves the incorporated details and the given material of the important points, but else it in convert improves the impressive extensive variety of the chosen countenance due to which they may be recognized clearly. The improvement never improves the natural in material and the given details of the important points, whereas it improves the impressive extensive variety of the chosen functions for their obvious and simple recognition. Also one can say that if the interruption is being uninvolved from a picture so that it will create simpler for acknowledging the key functions of the particular picture. Image improvement is for the picture sequence which is generally employed for helping the performance of the picture data. Image handling is a field which includes pressure, recognition of functions and type of pictures. There are various picture improvement techniques to enhance the visibility of the pictures, it usually uses comparison improvement way of this purpose and also spatial filtration methods which improves finishes and eliminate much of the picture thinking. Image improvement differs in many picture handling areas, picture improvement works a significant role in digital picture handling programs for both human and pc perspective. Rather it is used to enhance the recognizable quality of details included in an picture, making it simpler for recognizable demonstration, understanding and research by computer perspective system.

Fig 1: Results of Enhancement

The major difficulty that enhances in picture enhancement is quantifying the means for enhancement and indicates that a huge number of picture enhancement techniques are scientific and thus requires interesting procedures and techniques to obtain satisfied results. Thus usually picture enhancement is a technique that is intended for modifying the electronic pictures for the result that turns out to be more appropriate in case of either displaying or for more research for enhancing or can say for helping the excellent company's pictures. Image enhancement varies in many picture handling locations, picture enhancement works a significant role in electronic picture handling applications for both human and pc vision. Enhancement enhances and enhances the picture features such as sides, restrictions, evaluation to make a graphic show which is more useful for show and the research. Image enhancement is usually a technique that is used for modifying electronic pictures so that the result is more appropriate either for displaying or can say for more research. Here it enhances the Exposure or the whole excellent top excellent top great high quality of an picture without introducing the recognizable façade that are not real and non appropriate artifacts. The primary international evaluation enhancement method usually improves the

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luminance thereby improving the recognizable excellent top great high quality of an picture. The real programs of automated evaluation enhancement techniques include different locations including the medical picture, geophysical lead generation, seismic finding, astronomy, camera and movie handling, aerial and ocean picture, receptors and instrumentation, optics, and tracking.

II. APPLICATIONS OF CONTRAST ENHANCEMENT

Medical Imaging: Different pictures are of different low quality and low evaluation makes itself challenging to identify and find out the details. Thus, the pictures has to get down on a procedure known as image improvement which contains an collecting or collecting of methods that raise for helping the noticeable part of an image.

Camera and Movie Processing: Movie improvement is the most general and tough elements in video research. Its aim of video improvement is to enhance the appearance of it and for providing a good convert presentation for future computerized video managing, as of examining and partition of pictures. There are various applications where video is needed, prepared and used, such as tracking, basic identification verification, guests, privileges methods, private or army video managing.

Contrast Enhancement for Visual Imaging: In this one refer that the evaluation improvement is done here by showing the dual-interfering-source as called phased array technique. In-phase and out-of-phase sources assess an interference-like style, which declines the background signals. The perturbation being designed by little things allows for improved identification knowing.

Contrast Enhancement on under water images: Underwater field is the medical areas of research for the researchers. These under water Vehicles and Managed Vehicles are usually decided to catch the details as of marine mines and of coral reefs of coral reefs, sewer lines and telecommunications cables taken by the marine environment. These are usually recognized by the insufficient exposure they form due to light is significantly attenuated as it goes.

III. IMAGE ENHANCEMENT TECHNIQUES

Image Enhancement: Image Enhancement is essentially a simplest and attractive area of digital image processing. Image enhancement is method used to enhance the overall superiority of the corrupted images can be attained by using enhancement mechanisms .So that the human eye can effortlessly detect the key features of the pictures. It is used to eliminate the inappropriate artifacts from the pictures like noise or brighten the photograph and it simply to identify main features and then it looks improved. It is an individual area of digital image processing. To create a graphic display further helpful to visualize and examination, it recover the photograph features such as edges or boundaries. It enlarges the dynamic range of collected features. It does not increase the inbuilt content of data.

Contrast Enhancement: It increases the Visibility and the full quality of an image by not referring to the incorrect noticeable façade or non appropriate artifacts. The international evaluation enhancement methods generally increase the luminance for shiny pixel and thereby decreasing the luminance for the black p. So by not losing the highly effective range stress, the group dependent evaluation enhancement is pleased to get evaluation for image enhancement. The actual life programs of automated evaluation enhancement methods are numerous and include different areas such as the medical image, geophysical prospecting, seismic finding, astronomy, camera and video managing, aerial and sea image, receptors and instrumentation, optics, and tracking. The most heard over technique is the histogram equalization technique being based on the considered information that a continually assigned grayscale histogram thus includes the best noticeable evaluation.

IV. CONTRAST ENHANCEMENT TECHNIQUES HISTOGRAM EQUALIZATION

Histogram equalization accomplishes this by effectively growing out the most regular strength concepts. The strategy is useful in pictures with credentials moments and foregrounds that are both bright or both black. In particular, the strategy can cause to better views of navicular bone framework in x-ray pictures, and to better details in pictures that are over or under-exposed. A key benefit of the strategy is that it is a pretty simple strategy and an invertible owner. So hypothetically, if the histogram equalization function is known, then the exclusive histogram can be recovered. The calculations are not computationally extreme. A disadvantage of the strategy is that it is irregular. It may improve the evaluation of credentials interference, while decreasing the useful sign. In healthcare picture where spatial relationship is more important than focus of sign (such as breaking DNA pieces of quantized length), the small sign to interference rate usually results noticeable identification. Histogram equalization often produces wrong results in photographs; however it is very useful for healthcare pictures like satellite tv tv or x-ray pictures, often the same type of pictures to which one would apply wrong color.

ADAPTIVE HISTOGRAM EQUALIZATION: Versatile histogram equalization (AHE) is a pc picture managing strategy used to improve evaluation in pictures. It differs from common histogram equalization in the respect that the flexible strategy decides several histograms, each corresponding to a exclusive area of the picture, and uses them to redistribute the lightness concepts of the picture. It is therefore appropriate for helping the local evaluation. However, AHE will over amplify interference in relatively homogeneous places of an picture. A edition of flexible histogram equalization known as evaluation limited flexible histogram equalization (CLAHE) prevents this by decreasing the enhancing.

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FUZZY IMAGE ENHANCEMENT TECHNIQUE: Fuzzy-logic is being effectively utilized in different places of picture managing. Recently, uncertain based techniques for picture enhancement have been developed with better efficiency com-pared to traditional and other innovative techniques like GLG. Unclear picture managing includes mainly three stages: picture fuzzification, adjustment of consideration concepts, and, if necessary, picture defuzzification. The main power of uncertain picture managing is in the middle step (modification of consideration values). After the picture data are customized from gray-level industry to the uncertain consideration industry (fuzzification), appropriate uncertain techniques change the consideration concepts. This can be a uncertain clustering, a uncertain rule-based strategy, a uncertain development strategy and so on. In uncertain based picture enhancement techniques histogram is used as the basis for uncertain modeling of pictures. Two major efforts in the field of picture enhancement using the uncertain framework have been established in the past few years.

PARITCLE SWARM OPTIMIZATION: Particle swarm optimization is a computational method that optimizes a problem by iteratively trying to enhance a candidate solution with regard to confirmed way of measuring quality. It optimizes a difficulty by having a population of the candidate solutions, at this point dubbed particles, and moving these particles round the search space in line with the simple mathematical formulae that specifies the particle's position and velocity. Every movement of the particle is influenced by its local most excellent known position but, can be guided toward the most effective positions in the area of the search-space, updated better positions are discovered by another particles expected to move the swarm in direction of the most effective solutions. A fundamental variant of this algorithm works by having a population (known a swarm) of candidate solutions (known as particles). These candidate solutions are moved in the search-space as per the few simple formulae. The moves of candidate solutions are guided by their own most excellent known position in the search-space in addition to the whole population `s best known position. When improved positions are more and more being discovered these will likely then move towards to guide the movements of the population. Procedure is repeated and in so doing it is hoped that a satisfactory solution will eventually be discovered.

V. LITERATURE SURVEY

Chen, Xiaoming, and Lili Lv. [1] recommended a compositive evaluation enhancement requirements program which combinations histogram equalization centered methods (HEBM) along with a multi-scales unsharp protecting up centered methods (UMBM). This recommended requirement uses HEBM to accomplish worldwide evaluation enhancement as well as UMBM to accomplish nearby multi-scales evaluation enhancement. Initial, authors examined the methods created in the particular imaginary works for evaluation enhancement. Following and then, authors exposed the latest requirements program within details. This efficiency of the recommended way is discovered upon test IR information as well as in evaluation with those people created through a couple of more successful methods. This made requirements program provides excellent efficiency within worldwide evaluation as well as local evaluation enhancement along with disturbance as well as toy reduction. Nercessian, Shahan C. [2] provided a multi-scale image enhancement requirements program depending on a new parametric evaluation assess. This parametric evaluation assess comes with not merely the particular luminance protecting up quality, but the evaluation protecting up sign of our noticeable program. This solution with the evaluation assess could be designed for just about any multi-resolution splitting down program in an effort to provide noticeable system-inspired multi-scale transforms. In this article, it is shown using the unique wavelet turn, set wavelet turn, Laplacian graph, and dual-tree complex wavelet turn. This advantages of the recommended technique include of: the particular integrated , with both the luminance and evaluation protecting up phenomena; the particular development with non-linear implementing strategies in order to noticeable process motivated multi-scale evaluation coefficients; the particular development with noticeable system-based image enhancement alternatives to the particular set as well as dual-tree complex wavelet transforms, as well as an immediate way of; changing overall lumination; as well as accomplishing highly effective range pressure designed for image enhancement within just an immediate multi-scale enhancement framework. Trial effects display ale the particular recommended requirements program to accomplish many nearby developments. Maragatham G, and S. Md Mansoor Roomi. [3] Recommended an requirements to style images using its local evaluation assess to classify and distinguish between the images having different evaluation level. The reviews image is classified either as low evaluation or high evaluation image using the style. If the classified image is low evaluation it will be enhanced using the Stochastic Resonance idea. The results show that the recommended computerized process improves the low evaluation image better than the conventional enhancement methods. Kil, Tae Ho et al. [4] recommended dehazing requirements depending on dark path before and evaluation enhancement methods. The conventional dark before technique eliminates mistakes and so maintains shades such as factors in the field, although no take into consideration the enhancement such as image evaluation. However, an image evaluation technique plays a role in the local evaluation such as factors, however the shades are sometimes misshaped a result of the over-stretching of evaluation. The recommended requirements combinations the key benefits of those two conventional methods for keeping along with even though dehazing. For this, marketing function would be recommended to sense of balance in between the evaluation and shades disruptions,

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wherever the evaluation assess uses the conventional image research plus the shaded part be employed to limit along with changes. In accordance with the test success, a recommended technique pays for disadvantages of brochures and cards, as well as improves evaluation by using a lesser amount of color distortion. Celik, Turgay. [5] recommended some kind of movie comparison enhancement criteria that instantly encourages the comparison including videos clip implementing spatial as well as temporary details. The real criteria is in accordance with the observation that this comparison within videos clip supports could be increased by way of helping the grey-level dissimilarities in between each pixel in it clip recording supports and its adjacent p. Moreover, these a marked enhancement must be smooth among successive movie recording supports to be able that procession of comparison progress be achieved. A two-dimensional (2D) histogram including videos clip body be built implementing common connection in between each pixel and its adjacent p. For each movie recording supports, some kind of 2D concentrate on histogram be calculated by way of considering 2D histogram in it clip recording supports, 2D evenly spread histogram, plus the 2D histograms including frontward as well as in reverse adjacent movie recording supports. Reshmalakshmi, C., and M. Sasikumar [6] given a new comparison enhancement criteria, which maps features through pixel aircraft so that one can account aircraft and enhancement/transform aircraft. Disadvantages of current comparison enhancement techniques are usually revised through statistical tool named `Fuzzy set'. All these unclear places can be molded to handle the real doubt and/or vagueness involved in the pictures. To be able to measure the efficiency, this particular new criteria is usually used to distinct pictures as well as couple of review details are usually calculated, which demonstrates the enhancement over other current comparison enhancement techniques depending on unclear places. Gibson, Kristofor Boyd, and Truong Q. Nguyen [7] developed perceptually comparison enhancement measurement as a method for solve the issue of autonomously enhancing pictures deteriorated by fog that are perceptually pleasing to humans. A learning centered approach is considered to develop the comparison enhancement using individual findings and low-level comparison enhancement analytics in accordance with the individual vision program. Moreover, they provide new low-level analytics in accordance with the science of the scene to enhance the performance of current comparison enhancement analytics. This paper shows that a comparison enhancement measurement can be developed to imitate individual preference. Chouhan, Rajlaxmi et al. [8] suggested dynamic stochastic resonance (DSR)-based strategy in spatial domain has become provided to get the enhancement of dark- as well as low-contrast pictures. Stochastic resonance (SR) is a trend when the potency of a program (low-contrast image) can be improved upon through enhancement of disturbance. Nonetheless, inside the provided do the job, the internal disturbance of an picture has become utilized to produce a noise-induced conversion of the deeper impression through a situation of low comparison so that one can those of great comparison. DSR is usually used to a great repetitive fashion through correlating the real bistable procedure details of the double-well probable with all the strength values of the low-contrast picture. The best possible outcome is usually assured through flexible working out of efficiency achievement - relative comparison enhancement aspect (F), perceptual top high quality actions as well as color enhancement aspect. When compared to the real current advancement techniques such as customized high-pass filtering, gamma correction, single-scale retinex, histogram equalization, edge-preserving multi-scale breaking down, multi-scale retinex and automatic manages of popular imaging tools, the provided strategy allows considerable efficiency in terms of comparison as well as color enhancement along with perceptual high quality. Arici, Tarik et al. [9] provided a general structure depending on histogram equalization for picture comparison enhancement. Contrast enhancement is presented as an optimization issue that reduces a cost function. Histogram equalization is an effective strategy for comparison enhancement. However, conventional histogram equalization (HE) usually an outcome in excessive comparison enhancement, which in turn gives the processed picture an artificial look and creates visual relics. By presenting created penalty Aimi Salihah, A. N. et al. [10] provided a two stage methodology to be able to obtain a fully segmented abnormal white blood cell (blast) and nucleus in serious leukemia pictures..Contrast enhancement techniques enhanced the specialized niche of serious leukaemia for reducing the segmentation process. In the second stage, picture segmentation depending on HSI color space is suggested. The suggested strategy helps to enhance the picture exposure and has successfully segmented the serious leukemia pictures into two main components: boost and nucleus. Combination between comparison improvements and picture segmentation has good effect on improving the accuracy of segmentation. Hence, details gain from the resulting pictures would become useful for hematologists to further analysis the types of serious leukemia. Kanwal, Navdeep et al. [11] handled comparison enhancement of X-Ray pictures and provides here a new strategy for comparison improvement centered on Flexible Community strategy. Comparative research of suggested strategy against the current major comparison improvement methods has been conducted and outcomes of suggested strategy are appealing. Lin, Shang-Ching, and Pai-Chi Li [12] mentioned that ultrasound examination nonlinear comparison picture using micro bubble-based comparison providers has been widely examined. However, the degree of comparison improvement is often restricted by overlap between the spectra of the tissue and small percolate nonlinear reactions, which makes it difficult to individual them. The use of collection scientific method breaking down (EEMD) in the Hilbert-Huang convert (HHT) was previously researched with the aim of treating this problem.

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The HHT is designed for examining nonlinear and no stationary information, whereas EEMD is a method associated with the HHT that allows breaking down of information into a restricted number of implicit method features (IMFs). It was found that the comparison can be successfully enhanced in certain IMFs, but guide choice of appropriate IMFs is still required. This persuaded the current research to test the speculation that the comparison can be enhanced without demanding guide choice by summing properly calculated IMFs and demodulating the indication at appropriate wavelengths. That is, a data-driven procedure for identifying loads and demodulation wavelengths was produced and examined. Phantom outcomes display that an overall contrast enhancement of up to 12.5 dB can be carried out. Xu, Hongteng, et al. [13] suggested a novel histogram-based design for comparison improvement. Depending on research about the connections of histogram with comparison, one set up a design which 1) accomplishes comparison improvement by an maximum convert of histogram, 2) gives two analytics called comparison gain and nonlinear-ity of convert to evaluate the strength of improvement and the degree of distortions due to improvement respectively. The rate of the two suggested analytics not only gives a assistance for the configurations of parameter in the criteria, but also provides a useful statistic for comparison distortions, which can be a potential solution to evaluate whether the contrast of an picture is maximum. Trial outcomes display the excellent activities of the suggested criteria in picture improvement. Ahmed, M. Mahmood, and Jasni Mohamad Zain. [14] Targeted to find out the actual characteristics of modification features used by HE. To understand these statistical computations thoroughly, the document dismantles HE into it's foundations. This analysis' decides that HE manipulates solidity – not comparison - which, in turn, accomplishes solidity changes but no comparison improvement. Hence the research indicates that HE is not a real comparison improvement strategy. Jha, Rajib Kumar et al. [15] suggested a comparison improvement strategy using climbing of inner disturbance of a dark picture in distinct cosine convert (DCT) sector. The procedure of improvement is linked to noise-induced conversion of DCT coefficients from a poor condition to an enhanced condition. This conversion is impacted by the inner disturbance current due to lack of sufficient lighting and can be made by a general bistable system presenting powerful stochastic resonance. The suggested strategy assumes a local adaptive handling and considerably increases the picture comparison and shade information while identifying good perceptual high quality. When compared with the existing enhancement methods such as adaptive histogram equalization, gamma modification, single-scale retinex, multi-scale retinex, customized high-pass filtration, multi-contrast improvement, multi-contrast improvement with powerful range pressure, shade improvement by climbing, edge-preserving multi-scale breaking down and automated manages of popular picture device, the suggested strategy gives amazing efficiency in terms of relative comparison improvement, colorfulness. Cheng, H. D., and Yingtao Zhang [16] suggested a novel strategy for the recognition of over-enhancement. The main efforts of the document are as follows. (1) The reasons for producing over-enhancement are examined and examined greatly. (2) An purpose requirements for discovering over-enhancement is suggested. The experimental outcomes illustrate that the suggested strategy can locate the over enhanced areas perfectly and successfully, and provide a quantitative requirements to evaluate the over-enhancement levels well. The suggested strategy will be useful for dynamically tracking the high company's enhanced picture, and improving the parameter configurations of the comparison improvement methods.

VI. GAPS IN LITERATURE

Following are the different gaps in previous research:

1. Static adjustment factor: The present k part has been taken statically i.e. 128 by most of researchers.

2. Color misbalancing: Most of the methods depends on certain pre-specified recommendations no concentrate on the things or places in the given image; so may difference along with of the result image.

3. Edge degradation: Edges performs important part in perspective handling but image enhancement strategy may change the sides too. So can lead to deteriorated edges.

VII. PROPOSED ALGORITHM

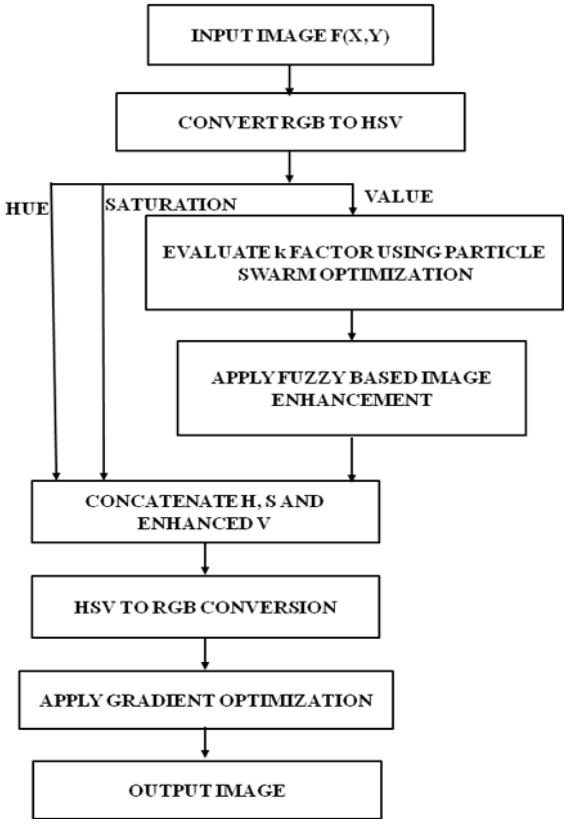

Fig 2: Proposed Algorithm

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The key objective of the recommended requirements is to provide better outcomes than present techniques to improve the visibility of the digital images.

Step 1: In stage 1 image is accepted to the system and some pre-processing features are used on it.

Step 2: In stage 2 images is modified in HSV airplane.

Step 3: As H and S factor stay ongoing but V is the only factors which need some modification while helping the images.

Step 4: Now k modification different will be analyzed for image improvement using compound travel marketing.

Step 5: Now unclear based image improvement is used on the image.

Step 6: Now concatenate H, S and enhanced V factor.

Step 7: Now once again turn given image to HSV to RGB.

Step 8: Now implement advantage maintenance removing.

Step 9: Get result image.

VIII. EXPERIMENTAL RESULTS

Fig 3: Input Image

Fig 4: Histogram Equalization

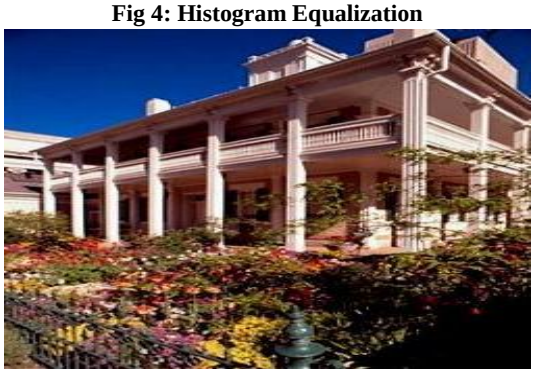

Fig 5: Adaptive Histogram Equalization

Fig 6: fuzzy enhanced image

Fig 7: fuzzy enhanced image using pso without edge preservation

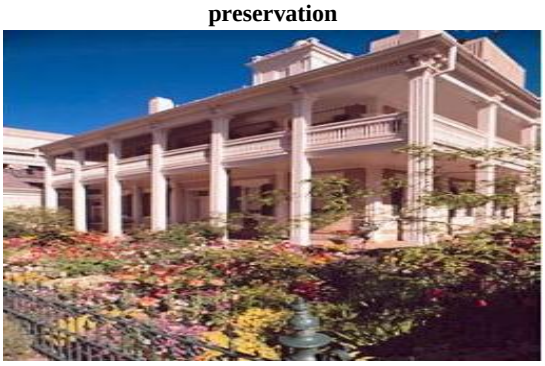

Fig 8: fuzzy enhanced image using pso with edge preservation.

IX. PERFORMANCE ANALYSIS

Table 1: CII ANALYSIS

IMAGES	HE	AHE	FUZZY	PROPOSED
1	1.2710	1.4432	1.6409	1.8112
2	2.3285	2.6481	2.8249	2.9088
3	2.3454	1.8662	2.1624	3.1308
4	0.7804	0.4859	4.2753	6.0585
5	0.3884	0.0926	1.3558	6.5740
6	0	3.1363	1.8435	4.5553
7	2.3454	1.8662	1.8435	3.1308
8	0.3560	0	2.1624	6.4513
9	0.7227	0.2025	0.4496	4.9491
10	0.0556	0.3581	2.6107	7.0554

Table reveals the relative research of the CII that needs to be maximized; it has proven that the CII is highest possible in the situation of the suggested criteria by offering better outcomes than the available techniques.

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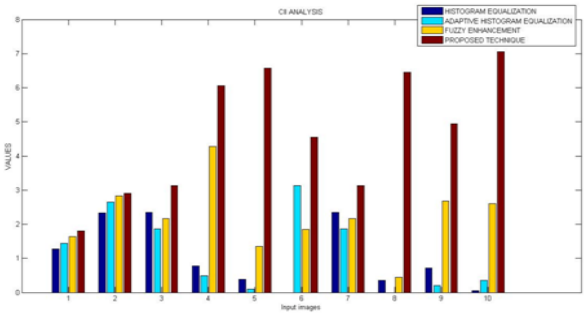

Fig 9: CII Analysis

Figure reveals the research of CII, there is improvement in CII of pictures with the use of suggested technique over other techniques that enhances quality of picture.

Table 2: TENENGRAD ANALYSIS

IMAGES	HE	AHE	FUZZY	PROPOSED
1	2.0562	4.0965	4.8007	5.0742
2	0.3178	3.4023	4.8202	5.8836
3	1.8604	8.3062	9.8746	10.0370
4	1.8069	6.2815	11.2421	12.8158
5	1.4404	2.3747	4.7251	5.8106
6	1.5129	7.3858	6.2610	8.1800
7	1.8604	8.3062	9.8746	10.0370
8	1.9601	3.5348	2.9293	3.9072
9	2.0951	5.0416	4.6949	5.8471
10	2.0869	6.5605	5.9310	7.1768

Table reveals the analysis of the Tenengrad measure. As it needs to be maximized; it has proven that the Tenengrad is maximum in the suggested method thus by providing better results than the available methods.

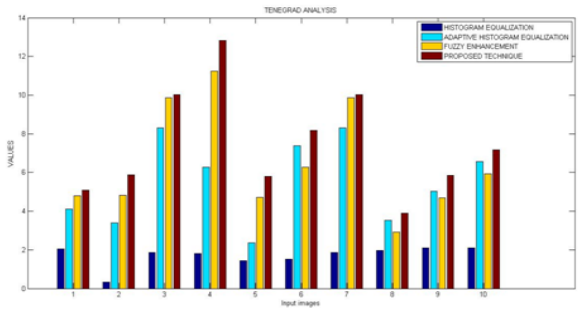

Fig 10: Tenengrad Measure

Figure reveals the research analysis of Tenengrad measure, there is improvement in tenengrad measure of images with the use of suggested method over other methods that improves the quality of the image.

Table 3: EXECUTION TIME ANALYSIS

IMAGES	HE	AHE	FUZZY	PROPOSED
1	1.6394	3.3712	2.0467	1.254
2	0.7516	1.4141	0.8430	0.3537
3	0.8673	1.6065	1.0009	0.4747
4	0.7776	1.5362	0.9041	0.4472
5	0.7174	1.3640	0.8012	0.3369
6	0.8344	1.5355	0.9536	0.4367
7	0.8424	1.6046	0.9936	0.4728
8	0.6895	1.3510	0.7916	0.3482
9	0.6808	1.3163	0.7720	0.3518
10	0.9019	1.7076	1.0652	0.5724

Table reveals the analysis of the execution time that needs to be minimized. Table has proven that the execution time is maximum in the case of the suggested algorithm thus providing better results than the available methods.

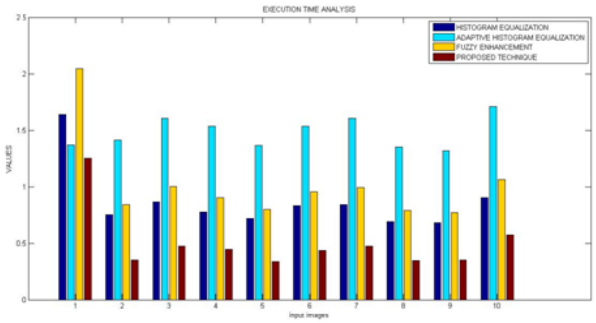

Fig 11: Execution Time Analysis

Figure reveals the quantized research of the performance time, there is decrease in performance duration of pictures with the use of suggested technique over other techniques that enhance the high quality picture.

Table 4: PSNR EVALUATION

IMAGES	HE	AHE	FUZZY	PROPOSED
1	13.8804	13.9345	27.1697	28.8574
2	14.3964	14.4622	24.4933	27.6435
3	13.3256	13.3812	24.8666	28.1244
4	5.9596	5.9619	24.0657	24.1732
5	5.4727	5.4728	24.3456	26.1055
6	9.7791	9.8047	24.0877	25.8139
7	13.3256	13.3812	24.8666	28.1244
8	5.0269	5.0270	24.1054	25.8134
9	7.1011	7.1093	24.2058	25.3433
10	4.9371	4.9359	24.1787	25.1241

Table reveals the relative research of the PSNR that needs to be optimized. It has clearly shown that the PSNR is maximum in the situation of the algorithm; therefore providing better outcomes than the available techniques.

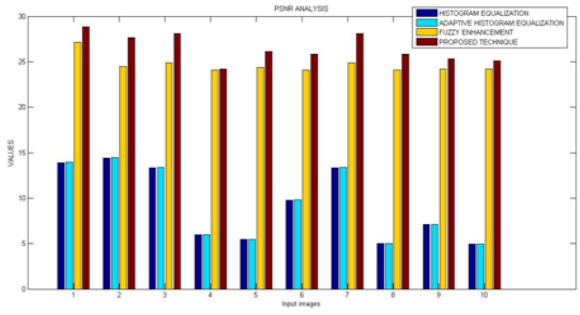

Fig 12: PSNR Evaluation

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Figure reveals the quantized research of the PSNR. It is very clear from here that PSNR value of pictures enhances which symbolizes enhancement in the picture top quality.

Table 5: MSE EVALUATION

IMAGES	HE	AHE	FUZZY	PROPOSED
1	2660.9	2628.0	124.7696	84.5938
2	2362.9	2327.3	231.0712	111.8731
3	3023.6	2985.1	212.0394	100.1486
4	16486.0	16478.0	254.9851	248.7484
5	18442.0	18442.0	239.0682	159.4155
6	6841.8	6801.7	253.6913	170.4867
7	3023.6	2985.1	212.0394	100.1486
8	20436.0	20435.0	252.6636	170.5074
9	1243.5	12652.0	246.8876	189.9979
10	20863.0	20869.0	248.4331	7.1768

Table reveals the quantized research of the mean square error. As it needs to be reduced therefore the criteria is showing the better outcomes than the available techniques as MSE is less in every situation.

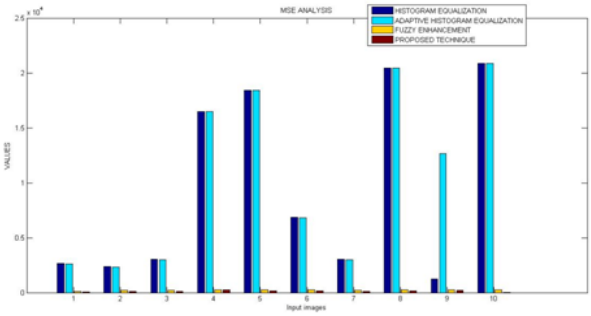

Fig 13: MSE Evaluation

Figure reveals the quantized research of the MSE of different pictures. The MSE value of pictures reduces with the use of technique over current techniques which symbolizes enhancement in the picture top quality.

Table 6: BER EVALUATION

IMAGES	HE	AHE	FUZZY	PROPOSED
1	0.0720	0.0718	0.0368	0.0347
2	0.0695	0.0691	0.0408	0.0362
3	0.0750	0.0747	0.0402	0.0356
4	0.1678	0.1677	0.0416	0.0414
5	0.1827	0.1827	0.0411	0.0383
6	0.1023	0.1020	0.0415	0.0387
7	0.0750	0.0747	0.0402	0.0356
8	0.1989	0.1989	0.0415	0.0387
9	0.1212	0.1407	0.0413	0.0395
10	0.2025	0.2026	0.0414	0.0398

Table reveals the relative research of the BER (bit ERROR ratio). The BER should be minimum in the case of the criteria for better results; therefore criteria is offering better outcomes than the available techniques.

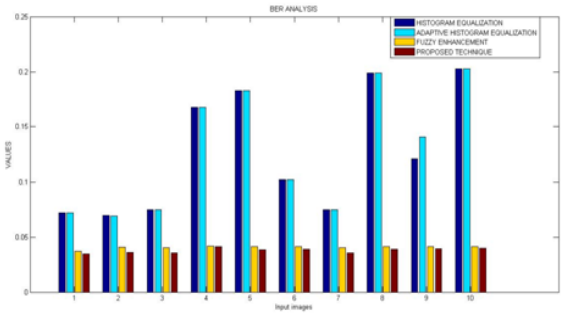

Fig 14: BER Evaluation

Figure reveals the quantized research of the bit error ratio of different pictures. The BER value of pictures reduces with the use of method over current techniques which symbolizes enhancement in the picture quality.

X. CONCLUSION AND FUTURE SCOPE

In this paper, the views has confirmed certain limitations as of misbalancing of color, edge destruction and statically use of k factor, thus to get over the limitations of earlier techniques, a new technique has been proposed which evaluate k factor automatically using the particle swarm optimization to find the furthermost resemblance value among the given set of values that represents the image in more proficient way. The newest approach could have the ability to boost the contrast in digital images in efficient manner by utilizing the gradient optimization based adaptive k-fuzzy image enhancement algorithm. As gradient optimization has ability to reduce the effectuation of noise and also it preserves the edges in efficient manner so provides better results. Additionally the proposed technique uses Particle swarm optimization based k factor which will make it more practical.

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