An Improved enhancement method for colorful image

Sharanpreet Kaur, Manit, Naveen Dhillon
PG Student at RIET, Phagwara
Asst. Professor, RIET, Phagwara
HOD, RIET, Phagwara
komal.vicky18@gmail.com

Abstract: **Digital image processing (DIP) entails the change of electronic information regarding improving the particular image characteristics with the support of computer system. The completing helps with maximizing quality, sharpness and details of characteristics associated with interest towards data removal and extra analysis. Contrast is an important factor in just about any subjective evaluation of picture quality. Recently much work is performed in the field of images enhancement. In this paper, modification is done by using fuzzy fusion as well as ant colony optimization based image enhancement further by utilizing the edge preserving smoothing hypothesis.**

Keywords: **Image enhancement, Image enhancement techniques, Color Management, Color Spaces.**

Fig. 1.1: Image enhancement

2. Pixels and Bitmaps

Digital images are consists of pixels (short for image elements). Each pixel presents along with (or gray stage for black and bright photos) at a single stage in the image, therefore a pixel is like a little dot of a specific color. By measuring along with of a picture at a large number of items, we can create a digital approximation of the image from which a replicate of the original can be reconstructed. Pixels really are a small like feed particles in a conventional final image, but organized in a typical sample of rows and articles and keep information significantly differently.

3. Color Management

The method of getting a picture to appear exactly the same between two or more various media or products is known as shade management, and there are many various shade management programs available today. Regrettably, most are complicated, high priced, and maybe not readily available for the full range of devices.

A. Hue

The hue of a color recognizes what's generally named "color&rdquo ;.As an example, all yellows have a similar hue value whether they're gentle, black, extreme, or pastel.

B. Saturation

The saturation of a shade recognizes how natural or intense along with is. A fully soaked shade is heavy and brilliant— whilst the saturation decreases, along with gets paler and more washed out till it eventually ends to neutral.

1. IMAGE ENHANCEMENT

Image enhancement techniques have now been widely employed in many software of picture processing where in fact the subjective excellent of images is essential for people interpretation. Contrast is completed by the difference inside luminance returned from two adjacent kinds of surface. In certain other words, contrast will be the difference inside visual properties that produces an target distinguishable by other objects combined with background. Throughout visual belief, contrast is influenced by the difference in the color as well as brightness from the item with other things. Our image system is really more at risk of compare than absolute luminance; consequently, we could certainly perceive our planet similarly regardless of considerable changes in illumination conditions. Many algorithms regarding accomplishing compare enhancement have now been developed and used on problems inside image running [6].

Enhancement would be the modification of your image to enhance impact for the viewer seeing that shown in fig 1.1. Generally enlargement distorts the main digital prices; therefore enhancement is simply not done ahead of the restoration procedures are completed. In pc graphics, the procedure for improving the grade of a digitally stored image through manipulating your image having software. It could be very simple, for case in point, to produce a picture lighter as well as darker, as well as to increase as well as decrease compare. Advanced impression enhancement computer software also supports many filtrations for shifting images in numerous ways. Programs specific for impression enhancement are often called impression editors.

C. Brightness

The brightness of a shade recognizes how mild or dark along with is. Any shade whose brightness is zero is dark, regardless of their hue or saturation. In order to find various schemes for specifying a color's brightness and based on which one is used, the outcomes of lightening a shade may differ considerably.

D. Luminance

The luminance of a shade is really a way of measuring their perceived brightness. The computation of luminance requires into consideration the fact the eye is far more sensitive to specific colors (like yellow-green) than to others (like blue).

E. Chrominance

Chrominance is really a complementary principle to luminance. If you were to think of how a television signal operates, there are two components—a black and white image which presents the luminance and a shade signal which contains the chrominance information. Chrominance is really a 2-dimensional shade place that presents hue and saturation, independent of brightness. An electronic digital image is a square array of pixels often called a bitmap.

4. Color Spaces

A color spaces is really a mathematical system for representing colors. Because it takes at the least three independent measurements to determine a shade, most shade places are three-dimensional. A variety of color spaces have already been produced through the years in an attempt to classify the full gamut of probable colors based on various characteristics. Image Screen uses three various shade places:

A. RGB

Most pc screens work by specifying colors according for their red, natural, and blue components. These three prices determine a 3-dimensional shade place call the RGB shade space. The RGB shade place can be visualized as a cube with red various along one axis, natural various along the next, and blue various across the third. Every shade which can be developed by pairing red, natural, and blue mild is found somewhere within the cube.

The seven corners of the cube correspond to the three main colors (Red, Natural, Blue), the three secondary colors (Cyan, Magenta, Yellow) and dark and white. All different basic grays are located on the strait of the cube that links the dark and the white vertices.
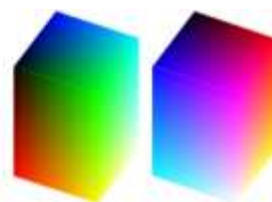

Fig. 1.2: RGB color space

B. HSV (Hue Saturation Value)

The HSV shade space efforts to characterize colors according to their color, saturation, and value (brightness). This shade space is based on a alleged hexcone model which may be visualized as a prism with a hexagon on one conclusion that tapers down seriously to an individual place at the other. The hexagonal face of the prism is taken by looking at the RGB dice predicated on their white corner.
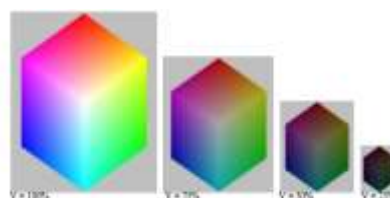

Fig. 1.3: HSV (Hue Saturation Value)

The dice, when considered using this viewpoint, seems like a hexagon with white in the guts and the primary and secondary colors creating the six vertices of the hexagon. This shade hexagon is the main one Picture Window uses in their shade picker to display the smartest possible versions of most possible colors centered on the color and saturation. Successive crossections of the HSV hexcone since it narrows to their vertex are highlighted under featuring how colors get deeper and deeper, ultimately hitting black.

C. HSL (Hue Saturation Lightness)

The HSL shade space (also occasionally named HSB) efforts to characterize colors according to their color, saturation, and lightness (brightness). This shade space is based on a double hexcone model which includes a hexagon in the middle that converges down seriously to a point at each end. Just like the HSV shade space, the HSL space visits black at one conclusion, but unlike HSV, it tends toward white at the contrary end. The absolute most soaked colors come in the middle. Remember that unlike in the HSL shade space, this main crossection has 50% gray in the guts and not white.
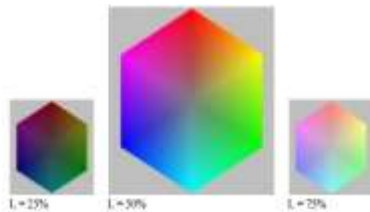
Fig. 1.4: HSL (Hue Saturation Lightness)

5. ENHANCEMENT TECHNIQUES

The visual nature associated with images has approaching be far more really substantial inside our day-to-day life. But, the info images which can be given to the machine are every now and then in decreased contrast. Subsequently, a system frequently referred to as image advancement must make the character of these kind of reduced denseness images. Image advancement is the pre-processing associated with image to boost the interpretability as well as tenderness associated with data in photos regarding human visitors also to give an even better insight regarding different planned image working techniques. The key idea associated with image advancement is always to modify features of your image to produce it befitting established task and a specific viewer. During this technique, one or more quality of an image is generally transformed. The product range of features as well as just how likely tailored is often exact with a provided task [14].

Additionally, observer-specific features, such considering that the human visual process as well as the observer's knowledge, will present a great deal of separately in the decision associated with image advancement methods. Image advancement is generally applied inside the following several instances: disturbance reduction through image, contrast advancement in the excessively uninteresting and fantastic image, and high-light your edges in the items in the blurring impression. Noise reduction is the process associated with eliminating disturbance type a sign or even a photo. In normal, photos associated with equally camera and typical movie cameras will choose noise from numerous sources. Subsequently, it is critical that your noise is generally eliminated for many people more uses of those images. Contrast advancement is purchasing clear image laterally lighting energy value rearrangement. That is obviously, this really is usually increasing features as increasing time concerning black and also lighting region. The aspect advancement method is essentially applied impression reduction tool. Image edges keeping decomposition algorithms could possibly be divided into two types: regional filtration centered and also international seo based. Image advancement is the process associated with altering digital electronic photos so as that the answers are more suitable regarding present or even more impression examination [15].

The Image advancement practices are divided into two principal groups:
1. Spatial domain methods.
2. Frequency domain methods.

A) Spatial Domain Techniques

Spatial domain practices immediately look after the visual pixels. The pixel costs are manipulated to attain preferred improvement. Spatial website practices such as the logarithmic improvements, energy regulation converts, histogram equalization, are based on the strong treatment with the pixels within the image. Spatial practices are particularly ideal for immediately modifying the grey stage rates of unique pixels and therefore the overall comparison with the whole graphic. But many of them improve the total picture within a uniform fashion which on many situations generates unwelcome results. It is not possible to selectively increase ends in addition to different estimated information effectively. Now the majority of us see 2 practices related to spatial website techniques. Photos are second operates $f(x, y)$ within spatial coordinates (x, y) in a graphic plane [16]. An alternative picture representation is based on spatial wavelengths regarding grey significance or shade variations in the picture plane. That two representation by means of a spectrum regarding various uniformity parts apparently equivalent towards the traditional spatial manifestation: the powerful transformation of any 2D spatial purpose $f(x, y)$ in to the 2D choice $F(u, v)$ regarding spatial wavelengths in addition to the opposite transformation on the latter directly into a spatial manifestation $f(x, y)$ are often lossless, when i. e. include no reduction in information. Such spectral manifestation sometimes simplifies image running [17].

The idea of spatial domain describes the blend of pixels composing a picture. Spatial domain practices are often procedures that work on these pixels. Spatial domain procedures is going to be denoted through the phrase,

$$G(x,y) = T[f(x,y)]\ldots\ldots\ldots(2)$$

a. Log Transformation Technique

Log transformation is just about the elementary visual improvement practices with the spatial domain that would be efficiently utilized by distinction innovations of darker images. The signal transform is simply a greyish level transform so that the grey degrees of image pixels are often altered. That modify for better routes a brand new thin number of reduced greyish level prices from the feedback image with a larger number of result ranges [18]. The ultimate sort with the log transformation could possibly be mathematically

$$L = C \log(1 + R)\ldots\ldots\ldots(3)$$

Where, L is the output grey level, R is the input grey level and C is a constant. It is assumed that $R \geq 0$.

b. Power Law Transformation Technique

Power law transformation is one of many elementary still another frequent dull amount change in the spatial website. It will be conceptually similar to leader rooting in the volume internet site as this really is performed through increasing your feedback dull level through some strength [19]. It's similar functioning to your log changes because energy legislation changes with fractional attitudes of γ street a slender collection of black feedback values right into a wider collection of result attitudes thus increasing the comparison. The modify for greater can revealed as:

$$L = B \, R^{\gamma} \ldots\ldots\ldots(4)$$

Where L is the output grey level, R is the input grey level, B is a scaling constant and γ is the power to which the input grey level is raised. One significant advantage of the transformation is that it is possible to control the transformation function by varying the parameter γ.

B) Frequency domain method

In frequency domain method, compute the particular Fourier convert with the picture to obtain increased, multiply the effect with a new filter as opposed to convolve in the spatial region and have the inverse convert to produce the increased image. Transformation or maybe volume region practices gain from the manipulation with the orthogonal convert with the picture instead of the picture by itself. Transformation region practices are suited for control the particular picture based on the volume material [24].

The theory behind the particular volume domain ways of picture enhancement contains research a brand new 2-D separately different unitary convert with the picture, being an illustration the 2-D DFT, influencing the particular convert coefficients simply by an owner M, and doing the particular inverse convert. The orthogonal convert with the picture offers two aspects magnitude as well as phase. The magnitude contains the volume content with the image. The period is used to recuperate the picture time for the spatial region [25]. The most typical orthogonal switches are separately different cosine change, distinct Fourier change, Hartley Change etc. The change domain enables operation on the volume content with the picture, and as a consequence high volume material such as for example edges in addition to other subtle information can quickly be enhanced. The volume domain can be quite a place wherever each picture price in picture site F presents the quantity that the particular power values in picture I vary around the particular range linked to F. Within the volume region, improvements with picture place fit improvements in the spatial volume, (or the particular rate that picture power values) tend to be changing in the spatial region picture I.

The Alpha rooting can be a easy but successful means of image advancement in the transform or maybe frequency area. The process is applied on the orthogonal switches of images. It is applied to increase the large frequency material in the image. The method is reliant upon the belief that after utilizing an orthogonal change, high frequency coefficients related with an image, may have smaller magnitudes than minimal frequency coefficients. By rearing the magnitude related with an image to some price, α, where by 0 < α < 1, greater respected decrease frequency pieces of an image can be decreased more in proportion to the underside respected large frequency elements. The effect is observable in the majority of the photographs where leader rooting is really applied as well as becomes additional conspicuous in case there is richer first images. Therefore several a period, the result image, despite the fact that sharp, is really unacceptably richer; it is really bad on the other hand and options expected of the good improvement.

Image smoothening:

The goal of image smoothening is always to diminish the results of digital camera noise, spurious pixel beliefs and missing pixels beliefs etc.

C) Fuzzy based image enhancement

Along the way of imaging and indication [1], it's hard to prevent the disturbance of different varieties of noise. So, in the presence of sound, pre-processing steps such as for instance image improvement are widely used. The objectives of image improvement are to eliminate impulsive sound, to clean low impulsive sound, and to boost the edges or other salient structures in the feedback image. In the techniques of image improvement, image smoothing and image maintenance are two crucial methods. Pictures could be contaminated [2] with various kinds of sound, for various reasons. Like, sound can happen due to the conditions of saving, indication, or storage, burning, checking etc. Impulse sound and additive sound are many generally found. It is a superb challenge to produce methods that can eliminate sound from the image without worrisome their content. The neighborhood averaging and smoothing by image averaging would be the classical image running procedures for sound removal. Since unclear collection principle [3] gets the potential capacity to successfully represent input/output relationships of active techniques, that principle has acquired popularity, especially in pattern recognition and pc vision applications. In the well-known rule-based strategy, for image running one, might use human understanding indicated heuristically in linguistic terms.

6. Guided image Filter

Guided image Filter is absolutely an direct visual filtration that has been resulting from a local linear type. It makes

the stopping production by getting into consideration the content of an advice visual, which will be almost certainly the feedback visual itself or even another distinctive image. The cautiously guided filtration includes a rapid along with non-approximate linear-time standards, whose computational complication is free from the stopping kernel dimension. The cautiously guided filtration manufacturing is in your community a linear convert from the advice graphic. That filtration gets the edge-preserving removing home like the bilateral split up out, but isn't likely to experience through the gradient change artifacts. It is also correlated towards matting Laplacian matrix, so is generally a more normal principle which will be applicable with other purposes beyond this range associated with smoothing. Also, the cautiously guided filtration possesses an O(N) time (in the amount of pixels N) genuine algorithm with regard to both gray-scale along with shade images. It has been demonstrated by numerous tests that your guided split up out performs sufficiently as it pertains to both quality and effectiveness in the great choice of applications, for example sound reducing, depth smoothing/enhancement, HDR compression, picture matting/feathering, haze elimination, and provided up sampling..

7. Gaussian Filters

Gaussian filters would be the only kinds which can be separable along with, at the least to some lattice approximation, circularly symmetric. In addition, they overcome one other mentioned drawback of moving average filtration since weight fill rot to greatly help zero. Gaussian filtration has weight fill specified through the chance security purpose of an bivariate Gaussian [30].

8. LITERATURE REVIEW

Gorai et al. [1] in the offing a PSO centered color conserving shade visual development strategy. The process is going to be as follows. Image development is considered as as a good optimization dilemma and chemical swarm marketing (PSO) is employed to treat it. The grade of the strength image may be improved by way of a parameterized modify for better function, whereby parameters are often enhanced through PSO according to a function. The strength change accomplishes employs nearby and global information in the feedback image and the objective accomplish views this entropy alongside edge facts to evaluate the visual quality. The conditions is attempted on several shade images and answers are compared alongside two additional common shade image development methods much like hue-preserving color image development without extent problem (HPCIE) along with a genetic conditions centered method of shade visual development (GACIE).

Xiao, Feng et al. [2] in the offing a multi-scale edge detection conditions which expected delicate tolerance strategy to apply facts development alongside sound

lowering of the real color image. To begin with, obtaining the true shade images at diverse scales as a result of wavelet multi-scale edge detection conditions, then using the improved easy tolerance filter function, choosing proper tolerance in the received visual sides to perform sound reducing while increase the edge home elevators the reservation; and finally, holding out the weighted 2-norm mixture of factors of different-scale-image.

Zhang, Chaofu et al. [3] revealed a crossbreed algorithm to boost the graphic. It is using the Gauss filter running to boost image facts in the volume website and easy the curve in the image because of the top-hat alongside bot-hat converts in spatial site. Through this cross conditions to increase the infra-red graphic. Perhaps not simply increased this infra-red image of the key points, but this outline in the image has moreover been smooth. Ultimately, the increased image surpasses different conditions of effects.

Choudhury, Anustup et al. [4] revealed a story method of depth development utilizing a dictionary-based strategy. For each low-resolution recommendations image place, they locate a sparse illustration from the great over-complete thesaurus and use that to estimate this high-resolution area. These changes include versatile development of reconstructed facts patches according to edge analysis to be able to avoid phone items and employing an versatile regularization expression allow sound suppression while boosting detail. They considered against state-of-the-art methods and indicate better benefits regarding development alongside suppression of noise.

Cho, Sung Throughout et al. [5] proposed a sophisticated backlight dimming technique that preserves the grade of shade alongside details with photographs even though the backlight luminance of water really present (LCD) products is lowered. The simulation consequences showed that the proposed approach successfully selected the acceptable backlight luminance degrees and prevented extreme colour distortion, while standard approach activated substantial shade distortion in a few images.

Kou, Fei et al. [6] in the pipeline a detail-enhanced direct exposure fusion requirement by presenting an L0 normal based marketing in gradient site. The in the pipeline algorithm concentrated amounts great details from the vector subject that is obviously made utilising the gradient areas in the input photographs and gives the great details to an advanced picture that is obviously fused by way of a current exposure mix algorithm. Experimental consequences show that the proposed approach may boost great facts for fused images.

Moniruzzaman, M . d . et al. [7] propose a fresh process to help enhance the distinction of an image. The strategy is detailed parts structured and it may be applied on medical graphics. By utilizing matlab the actual proposed approach was coded in addition to tested. The proposed process

preserves the love of the image by giving low benefit of popular mean love mistake (AMBE). As effectively large benefit of PSNR will be acquired because of the proposed process this implies the impact is struggling with inferior of noises.

Teng, Yanwen et al. [8] described theory tenets of the Laplacian chart decomposition, and analysis using user-defined tolerance prices to tell apart between the actual picture details and ends of the shortcomings, and propose to make use of the world-wide data immediately to have the ceiling benefit method. Because they demonstrated that their approach generates continually supreme quality results in the act of impact depth improvement.

Tan, Yunlan et al. [9] proposed a better depth improvement process by means of advised impression. This method may make high-quality facts improvement as well as edge-preserving smoothing. Also, it produces halo-free edge-preserving smoothing as it blows unreadable edges across the world. Studies show that the improved light emitting diode filter is going to be both successful and effective in the fantastic selection of computer perception and laptop or computer design software, including edge-aware smoothing, facts improvement, and so on.

Shin, Yonghun et al. [10] provided a new color impact improvement solution to improve the particular image perfection dependant on retinex concept. Particularly, the proposed process comes with an adaptive gamma modification for the light parts dependant on pixels. Also, they restored the facts and coloring using reflectance elements. Studies demonstrate that the proposed process outperforms current algorithm with regard to subjective examination and digesting speed.

Jaehyun et al. [11] presented a guide distinction enlargement method regarding backlit photographs which contains three methods: i) computation in the transmission coefficients through the gray route previous, ii) technology of several photographs obtaining various exposures in accordance with the transmission coefficients, along with iii) image fusion. In comparison to global high intensity transformation approaches and spatially invariant sort a distinction improvement algorithms approach first parts under-exposed parts when using black course previous chart, and next performs spatially adaptive sort a distinction particularly regarding backlit moments and people with exceedingly wide energetic range, though still guarding image facts and coloration.

Shuhang et al. [12] presented a qualification evaluation method based on black route right before construct a fresh level road from your simple next image of the outdoor landscape for 3d screen apps. The process computes a fresh level road having a routine related to image running strategies including black course computation, gain detection, that edge-based iterative thresholding process,

the spot split-and-merge method, the headlines and history categorization, along with the level estimation with mixed black course and level information. Experimental outcomes and opinions display the proposed plan gives valuable level examination in bedrooms and borders and parts of air along with buildings.

Matlin et al. [13] characteristics encouraged a new product consistent with the bodily process of imaging through the duration of foggy climate. In this type of product an appropriate haze removing algorithm that is dependent on a quickly bilateral selection with poor shade past is explained. The atmospheric dispersing product is used to date June 2011 the formation of haze image.

9. EXPERIMENTAL RESULTS

For the experimental results proposed algorithm, design and implementation has been performed in MATLAB using image processing toolbox. Various color images are taken for experimental purposes for the existing technique i.e. the fuzzy fusion enhanced algorithm as well as for proposed technique i.e. ACO fuzzy fusion enhanced algorithm. The results show that our proposed approach gives better results than the existing techniques.

A) INPUT TMAGE:

Any input image (color image) is taken for producing the result of proposed as well as existing algorithms. For the existing results, the fuzzy fusion enhanced algorithm is used. Also for the proposed results, the ACO fuzzy fusion enhanced algorithm is used for experimental purposes.

B) ENHANCED IMAGE:

The color input images used for experimental analysis. The fuzzy fusion enhanced algorithm is used as the existing algorithm.

C) OUTPUT IMAGE:

This is the output image i.e the resultant image of our experiment. This final output of colored image is clearer as compared to existing results. The New ACO Fuzzy Enhanced Image is used as proposed algorithm. We observed that the proposed results are quite better than the existing results.
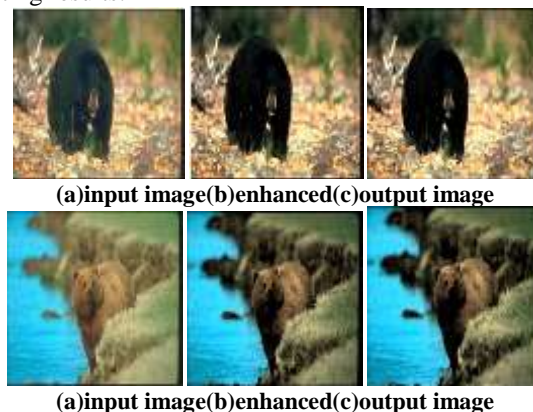

(a)input image(b)enhanced(c)output image

(a)input image(b)enhanced(c)output image

Figure 1.5:Experimental Results of image 7,8

This color input images is used for experimental analysis. Then the enhanced images are shown and at last there is the output image. The final output of colored image is clearer as compared to existing image. We observed that the proposed results are quite better than the existing results.
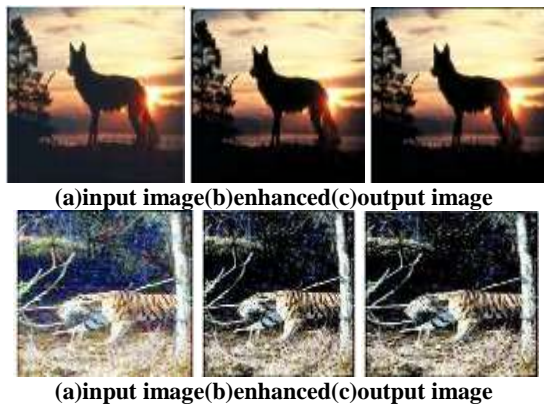

(a)input image(b)enhanced(c)output image

(a)input image(b)enhanced(c)output image
Figure 1.6:Experimental Results of image 9.10

This color input images is used for experimental analysis. Then the enhanced images are shown and at last there is the output image. The final output of colored image is clearer as compared to existing image. We observed that the proposed results are quite better than the existing results.
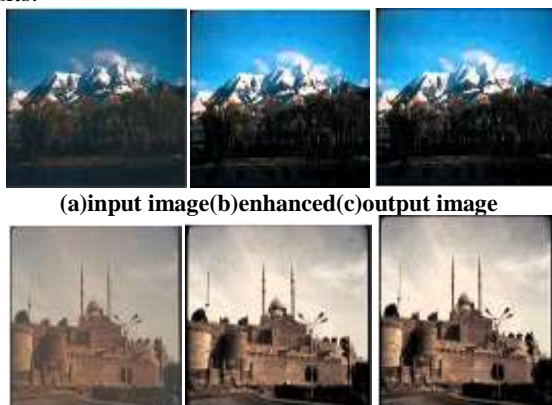

(a)input image(b)enhanced(c)output image

Figure 1.7:Experimental Results of image 13,14

This color input images is used for experimental analysis. Then the enhanced images are shown and at last there is the output image. The final output of colored image is clearer as compared to existing image. We observed that the proposed results are quite better than the existing results.

10. PERFORMANCE ANALYSIS

This section contains the cross validation considering existing and proposed techniques. Some well-known image performance evaluation parameters for digital images have been selected to prove that the performance of the proposed algorithm is quite better than the existing methods.

A) ENTROPY: Discrete entropy is used to measure the content of an image .Higher the value of discrete entropy indicates then richer the details in an image.

Discrete entropy can be calculated by:
$$H = -\sum_{s=0}^{255} j(s) \log_2 j(s) \quad (4)$$

TABLE 1:Entropy Comparison Table of Existing and Proposed algorithm

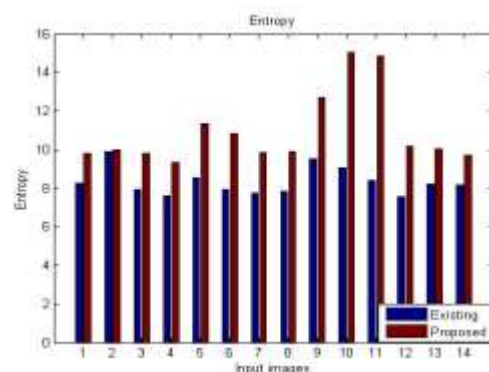| INPUT IMAGES	FUZZY (EXISTING)	ACO FUZZY(PROPOSED)
P1	8.2640	9.8184
P2	9.8796	9.9996
P3	7.9510	9.8077
P4	7.6234	9.3277
P5	8.5561	11.3221
P6	7.9496	10.8128
P7	7.7414	9.8516
P8	7.8182	9.9048
P9	9.5142	12.7218
P10	9.0404	15.0404
P11	8.3957	14.8587
P12	7.5664	10.1913
P13	8.1929	10.0359
P14	8.1858	9.6848

Figure 1.8: Entropy Graph

B) Mean absolute Error: In statistics, the mean absolute error (MAE) is a quantity used to measure how close forecasts or predictions are to the eventual outcomes. The mean absolute error is given by: MAE $= \frac{1}{n}\sum_{i=1}^{n}|f_i - y_i|$ (3)

TABLE 2: MAE Comparison Table of Existing and Proposed algorithm

INPUT IMAGES	FUZZY (EXISTING)	ACO FUZZY(PROPOSED)
P1	0.0527	0.0488
P2	0.3368	0.3216
P3	0.0550	0.0496
P4	0.1012	0.0565
P5	0.1771	0.1009
P6	0.0698	0.0663
P7	0.0662	0.0505
P8	0.2722	0.2650
P9	0.0122	0.0120
P10	0.0421	0.0378
P11	0.0413	0.0375
P12	0.0938	0.0769

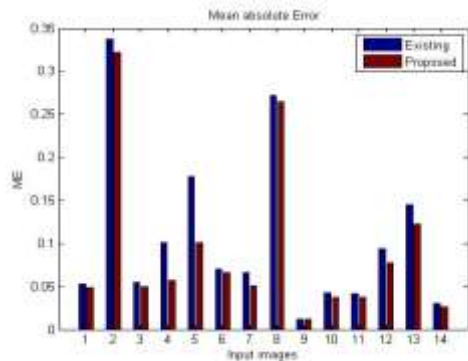| P13 | 0.1446 | 0.1227 |
| P14 | 0.0307 | 0.0266 |

Figure 1.9: MAE Graph

This graph shown in fig 5.10 depicts the results of existing and proposed algorithm. This ME graph proves that the values of proposed algorithm must be low than the existing algorithm.

Conclusion: In this paper, the evaluation value of k i.e. adjustment factor automatically using the ant colony optimization is calculated. Also the comparison between the proposed algorithm i.e.(Fuzzy fusion image enhancement techniques as well as ACO) and the existing algorithm i.e.(Fuzzy fusion image enhancement) based upon the following parameters:-Entropy and the Mean absolute error. The simulation results of proposed method shows best results which are calculated by using MATLAB programming language.

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