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A Brief Study of Ant Colony Optimization based Color Medical Image Enhancement

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ABSTRACT

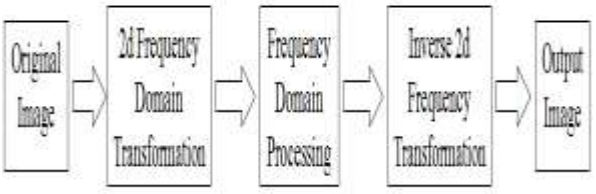
Medical imaging plays an important role in monitoring the patient's health condition and providing an effective treatment. However, the existence of several objects overlapping in an image and the close proximity of adjacent pixels values in medical images make the diagnostic process a difficult task. In order to overcome the above stated limitations, a new algorithm is proposed which will utilize to ant colony optimization to enhance the results further.

Keywords

Image enhancement, Enhancement techniques, Medical images, Ant colony optimization

1. INTRODUCTION

Image enhancement is basically a simplest and attractive area of electronic image processing. Image development is process used to enhance the entire superiority of the broken photos may be accomplished by utilizing development elements .So th



at the human eye may efficiently find the important thing options that come with the pictures. It is used to eradicate the unacceptable artifacts from the pictures like noise or brighten the photograph and it simply to identify major characteristics and then it looks improved. It is a person area of electronic image processing. To create a graphic display further helpful to see and examination, it retrieve the photograph characteristics such as edges or boundaries. It enlarges the active array of collected features. It doesn't boost the inbuilt material of data.

2. ENHANCEMENT TECHNIQUES

Enhancement techniques may be primarily split into two components [1]

2.1. Spatial Domain Method: which directly work on pixel. The procedure can be composed as $g(i,j) = T[f(i,j)]$, where g is the outcome, f is the input and **T** is a process on f defined above a few neighborhood of(i,j).This technique is using the Eq. (1.1) [35].

2.2. Frequency Domain Method: Frequency domain technique method on the Fourier Transform. Frequency domain photograph development is clear-cut. The volume filters recognized a picture in the volume domain. This group filter technique is very easy [2]

l. Change the photograph in to the Fourier domain.
2. Multiply the image or photograph by the filter.
3. Get the inverse convert of the picture.

Figure l: Frequency Domain Method Process

Here we have used the word transformation.

1. Transformation

A signal can be turned from time domain into volume domain applying mathematical operators called transforms. There is a number of conversion that does this. Numerous of them receive the following [3].

1. Fourier Series
2. Fourier transformation
3. Laplace transform
4. Z transform

2. Frequency components

In a frequency domain can be shown any photograph which are in spatial domain. While what this volume basically specifies. We shall segregate volume method into two most important mechanisms [4].

1. **High volume components** - High volume components match sides in a image.
2. **Low volume components** - reduced volume components in graphic match clean regions.

2.1 Techniques used by spatial and frequency domain methods

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1. **Point operations** Wherever every pixel is tailored according to a mainly equation that is not centered on further pixel values.
2. **Mask operations:** Wherever each pixel is tailored according to the prices of pixel's neighbors (Using convolution theory)
3. **Global operations:** When most of the pixels price in a photo are taken into concern.

Figure 2 can be used to exhibit the huge difference between the initial photos i.e insight image and the improved image.

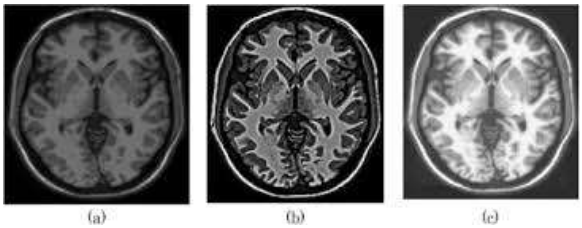

Figure 2: Results of enhancement (a) before enhancement (b) after enhancement

3. APPLICATIONS OF IMAGE ENHANCEMENT

1. **Industrial inspection/quality control:** is just a technique through which operations evaluation the superiority of each factors concerned in construction.
2. **Surveillance and security:** Surveillance is the seeing of the efficiency, measures, or more different knowledge, typically of public for the reason why of affecting, controlling, aiming, or defending them like CCTV cameras [5].
3. **Face recognition:** It is really a pc product for mechanically specifying or justifying someone from an electronic picture or even a movie figure from a movie source.
4. **Gesture recognition:** It is a location in pc technology and language technology with the objective of explaining individual gestures via mathematical operations. Signals can start from any physically motion of human anatomy or state but generally create from the face area or hand.
5. **Medical image analysis:** It is the method, process and ability of creating visual depictions of the internal of a human anatomy for clinical examination and medical interference.
6. **Autonomous vehicles:** It involves the usage of mechatronics, artificial intelligence, and multi-agent program to guide a vehicle's operator.
7. **Virtual reality**: It is called immersive media, is really a computer-simulated atmosphere that may replicate bodily living in areas in the real world. Virtual truth can reconstruct sensory experiences, including electronic taste, scent, an such like [6].

4. ANT COLONY OPTIMIZATION

Ant colony optimization is definitely an algorithm on the basis of the normal conduct of the real insects to obtain the quickest trip from the resource to the food. It utilizes the efficiency of the real insects while searching for the food. It's been seen that the insects deposit a quantity of pheromone over the walk while touring from the nest to the dishes and vice versa. In this way the insects that follow small trip are projected ahead back early in your day and ergo pheromone deposition on small trip reaches a quicker rate. ACO methods could possibly be employed in the device redirecting problems to obtain the quickest path. In a technique redirecting situation, some artificial insects (packets) are simulated from the resource to the strain (destination). The ahead insects will make however yet another node arbitrarily for initially getting the knowledge from the redirecting dining desk and the insects which are powerful in attaining the spot might improving the pheromone deposit at the stops visited. Ant colony optimization escalates the scalability and alarm working period. ACO utilizes the solid freedom and optimization easy the ant colony to obtain the utmost way concerning the alarm nodes.[7]

5. MEDICAL IMAGES

Medical images have an essential position in diagnosing a illness and checking the aftereffect of the selected treatments. In spite of the increasing progress in the strategy of acquiring these photos, the produced photos may not create enough quality for a precise diagnosis. Crisis circumstances, environmental sounds, individuals'particular conditions in images, illumination conditions and complex limitations of imaging tools are among reasons why photos might have low quality. Such instances, picture advancement techniques can be helpful, specially when reimaging is impossible. These new techniques are accustomed to repair the broken photos and to boost their quality and contrast. The technique showed in increases a medical picture using wavelet transformation. In this technique, the high-frequency sub-images are decomposed utilizing the Haar wavelet transform. Then, noise in the high-frequency sub-bands is reduced using soft-thresholding. Ultimately, the increased picture is purchased using inverse wavelet transformation. Still another approach was shown for improving CT medical photographs based on Gaussian Range Combination (GSM) model for wavelet coefficients in multi-scale wavelet analysis. In this technique, first, noise is taken from the loud

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picture using Wiener filtration [8]. Then, through the qualitative evaluation and classification of wavelet coefficients for the signal and noise, the wavelet's approximate distribution and statistical traits are defined, combining GSM model for wavelet coefficient. This algorithm can improve CT photographs whose noise is eliminated [9].

Still another frequent approach for medical picture development is histogram equalization that increases the comparison of picture by increasing distribution of dull levels. This approach does not necessarily obtain accomplishment for several regions of a picture since comparison development may injury the picture and the border areas. As a result of this, you can find various generalizations of this technique to improve their performance. An algorithm for increasing abdominal ultrasound photographs is proposed based on mixture of histogram equalization and wavelet transformation. This algorithm increases edges and surroundings of abdominal surfaces and has real-time performance in dynamic applications. Still another approach for medical picture development is Gamma correction. In this technique, Gamma values of specific pixels are domestically enhanced by reducing the homogeneity of co-occurrence matrix of the initial image. The Gamma modification approach increases dynamic selection and increases the image. In a morphological filtration is proposed for sharpening medical images. In this technique, after finding edges by gradient-based operators, a type of morphological filtration is placed on develop the existing edges. In fact, morphology operators, through increasing and decreasing shades in various areas of a picture, have an important role in handling and sensing numerous current objects in the picture [10]. Locating edges in a picture using morphology gradient is an example that has equivalent performance with this of common edge-detectors such as Canny and Sobel. In another approach the boats in angiography photographs are increased based on their unique patterns and morphological filters. In recording a medical picture from human body, because various organs have been in numerous depths, the picture does not need noise quality to be analyzed by the physician. For example, in a picture obtained from chest by X lewis or ultrasound, organs such as epidermis, center, lung, bone, ligaments, boats, cartilage and lymphatic water seem concurrently in a picture while overlapping. Because each human body organ has various design or consistency, we can distinguished one or many of them in the picture using morphological filtration, ergo provide an suitable picture for analysis. A similar is conducted in handling aerial photographs (taken by jet or balloon) to remove clouds to attain more understanding [11].

A fresh approach based on specific changes of mathematical morphology is proposed to improve the comparison of medical images. To do so, first establish the design and measurement of the required disguise for morphological changes [12]. Achieving acceptable outcome and lowering computation time in morphology-based strategies be determined by the design and measurement of a mask; so, the picked disguise for an issue should be in suitable form and size. Usually, the required disguise is picked arbitrarily. Because disk-shaped disguise is independent of improvements in rotation, it is more generally used in medical imaging in comparison to form of markers [13]. How big disguise is also dependent on feedback picture and can take various values for various photographs; thus with a disk-shaped disguise to apply morphology changes whose original measurement is determined through trial and error and based on the feedback image. Then, peeling method is completed by applying a filtration of Top-Hat changes using various markers in a variety of radii. The very best increased picture is picked

on the list of produced photographs using Distinction Development Proportion (CIR) [14].

6. GRADIENT BASED SMOOTHING

Gradient-based strategies for alignment opinion require two necessary steps:
(1) finite differences in the *x* and *y* instructions
(2) smoothing
Smoothing of the image prior to computing the gradient is generally a must, for applications of preventing big spikes in the derivative because of sharp sides and spurious noise. Smoothing of the gradient vectors (in their doubled-phase representation) can be generally used often as a prefiltering step for subsampling or exclusively for applications of domestically homogenising the movement of the alignment vectors.

7. LITERATURE SURVEY

Hamid Hassanpour et al. (2015) [1] Medical imaging plays an essential position in checking the patient's health condition and giving a fruitful treatment. Nevertheless, the living of a few things overlapping in an image and the shut area of nearby pixels prices in medical photos make the diagnostic method an arduous task. To manage with such issues, this report gifts a

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fresh strategy centered on morphological changes to boost the grade of different medical images. In this technique, a disk designed disguise whose measurement suits that of the original feedback picture is picked for morphological operations. Afterward, the planned filtration from the Top-Hat changes is applied to the picture, utilizing the picked disguise in a multi-step process. At each step, how big the disguise is increased. The amount of expected measures and the final enhanced picture are determined based on the Distinction Improvement Ratio (CIR) measure. Certainly, this approach applies an exfoliation method on the photos, in what type or a few things in the picture are prominently manifested using morphological filtration, thus offer an correct picture for analysis.

Bhandari et al. (2015) [2] explained standard plan for an improved and easy method for advancement of dark and low distinction satellite picture centered on knee purpose and gamma correction using discrete wavelet change with single value decomposition (DWT–SVD) has been planned for quality improvement of feature. This way can also method the high resolution dark or very low distinction photos, and offers greatest improved result using tuning parameter of Gamma. The strategy decomposes the feedback picture into four volume subbands by using DWT and estimates the single value matrix of the low–low subscription band picture, and then compute the knee move purpose using gamma correction for more improvement of the LL component. The planned algorithm overcomes this problem using knee purpose and gamma correction. The tentative benefits show that the planned algorithm enhances the overall distinction and exposure of confined facts a lot better than the prevailing techniques.

Ghosh et al. (2014) [3] discussed the power of a fresh optimization algorithm. The Cuckoo Research algorithm in tuning the picture advancement operates for maximum performance. The evaluation has been done when compared with two of the previous optimization algorithm assisted advancement, namely, Genetic Calculations and Compound Swarm Optimization and early in the day advancement practices Histogram Equalization and Linear Distinction Stretch techniques. The outcomes have explained the power of Cuckoo search algorithm in optimizing the advancement functions.

Mathew et al. (2013) [4] has discussed a fresh satellite picture decision and perfection advancement process based on the discrete wavelet change (DWT) and single value decomposition (SVD) has been proposed. Satellite photos are used in many purposes such as for instance geosciences reports, astronomy, and geographical data systems. Among the most crucial quality factors in photos originates from its resolution. The process decomposes the feedback picture to the four volume sub- bands by using DWT and estimates the single value matrix of the low–low subscription band picture, and, then, it reconstructs the improved picture by applying inverse DWT. The process also estimates the single value matrix of the low–low subscription band of histogram equalized picture and normalize equally single value matrices to obtain perfection enhanced image.

Gupta et al. (2013) [5] explained the various current techniques for the improvement of dark photographs; it has been observed when the photographs have certain brilliant region, then it becomes more brilliant after application of those techniques. The style has surfaced out of this obtainable drawback. In this article he's changed the parameter used previous. In feature of the aesthetic speech the in the pipeline algorithm emerges as fairly simple and well-organized with keeping concentration on the brilliant location that will never to be degraded. The proposed approach is in contrast to other available practices and it has been unearthed that since quantity of iterations has been decreased somewhat, thus the sum total eaten time. The charge of accuracy is very improved and no data loss in the output.

Also along with quality is preserved and sharpness has been increased as well.Huang et al.(2013) [6] explained histogram equalization is a well-known and successful process for improving the distinction of photographs but the standard histogram equalization (HE) process often results in good distinction improvement, which causes an unnatural search and aesthetic artifacts of the prepared image. In this paper, we propose a novel histogram equalization process that is composed of a computerized histogram divorce component and an strength transformation module. Experimental results show that the proposed process not only maintains the form features of the first histogram but also improves the distinction effectively.

Xie et al. (2013) [7] has discussed face recognition which were addressing and realizing faces predicated on subspace discriminant examine but for single sample face recognition these approaches are usually struggling with the generalizability issue because of small samples. That paper proposes new non-statistics features removal approach predicated on fusion of DCT and regional Gabor binary sample Histogram (LGBPH). In DCT and LGBPH, training process is avoidable to generate the face area product, so that the generalizability issue is obviously avoided. The tentative results on ORL face sources show that the worldwide face and regional data could be incorporated effectively after level fusion by worldwide and regional

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features, which enhance the efficiency of single sample face recognition.

Kim et al. (2013) [8] has discussed a fresh contrast improvement strategy predicated on dominant brightness stage examine and flexible power transformation for remote realizing images. The in the pipeline algorithm computes brightness-adaptive power move features using the low-frequency luminance part in the wavelet domain and transforms power prices based on the move function. Depth move features are adaptively estimated using the leg move purpose and the gamma adjustment purpose on the basis of the main brightness stage of every layer. The experimental benefits show that the in the pipeline algorithm enhances the overall contrast and awareness of regional facts much better than present techniques.

Yonghong et al.(2013) [9] has defined mild is attenuated when disseminating in water, the simplicity of photos or films captured under water is generally broken to various degrees. By exploring the huge difference in mild attenuation between in environment and in water, he derive a fresh underwater optical model to describe the forming of an underwater picture in the real bodily technique, and then suggest an effective improvement algorithm with the made optical model to enhance the understanding of underwater photos or video frames. In that algorithm, a story underwater dark station is made to calculate the scattering charge, and an effective method is also shown to calculate the back ground mild in the underwater optical model. Gupta et al. (2012) [10] has referred programs of the Ant Colony Optimization (ACO) to resolve picture running problem with a orientation to a fresh intelligent improvement strategy predicated on real-coded particle ant colony is in the pipeline in that paper. The objective of the in the pipeline ACO is to maximize an aim exercise qualification to be able to increase the contrast and detail in an image by changing the parameters of a story expansion to a nearby improvement method. The probability of the in the pipeline strategy is verified and weighed against Genetic Formulas (GAs) and Chemical Swarm Optimization (PSO) centered picture improvement technique. The obtained benefits show that the in the pipeline ACO produces better benefits in terms of both maximization of the amount of pixels in the edges and the adopted aim evaluation. Computational time is also fairly little in the ACO situation compared to the GA and PSO case.

Khan et al. (2012) [11] exhibited still another system for de-noising of photographs while keeping substantial data such as for instance confused slim edges and low-contrast fine features utilizing an flexible tolerance in singular price decomposition. The shown singular price decomposition system employs a global fixed tolerance for entire picture and does not split the loud knowledge from the picture data for the photos having uneven background. In that various thresholds for the various organized parts of the picture have already been determined relating with regional gradient and gray stage variance at each pixel place of the parts of the image. A maximum tolerance has been estimated by the analysis of indicate to sound ratios of the singular price decomposed photos for various thresholds.

Demirel et al. (2011) [12] proposed a fresh satellite image solution advancement system on the basis of the interpolation of the high-frequency subbands obtained by distinct wavelet transform (DWT) and the feedback image. The projected solution advancement approach employs DWT to decompose the feedback image into various subbands. Then, the high-frequency subband photos and the feedback low-resolution image have already been interpolated, accompanied by mixing all these photos to make a fresh resolution-enhanced image by using inverse DWT. In order to accomplish a sharper image, an intermediate point for costing the high-frequency subbands has been planned. The quantitative (peak signal-to-noise ratio and origin mean square error) and visible results display the superiority of the proposed approach over the traditional image solution advancement techniques.

Braik et al.(2007) [13] has identified purposes of the Compound Swarm Optimization (PSO) to fix image handling trouble with a reference to a story automated advancement approach predicated on real-coded particle swarms is planned in that article. The objective of the planned PSO is to maximize an target fitness common in order to boost the distinction and function in a picture by adapting the parameters of a story addition to a local advancement method. The possibility of the planned process is demonstrated and compared with Genetic Methods (GAs) centered image advancement technique. The results suggest that the proposed PSO produces better results with regards to the maximization of the amount of pixels in the edges and the adopted target evaluation.

C.Munteanu et al. (2004) [14] has mentioned image advancement is the job of applying particular transformations to an input image such as for example to acquire a visually less loud output image. The change usually requires model and reaction from a human evaluator of the output impact image. Hence, image advancement is recognized as a hard task when attempting to automate the analysis process and eliminate the individual intervention. He offers a new purpose common for advancement, and attempts to finding the best image based on the specific standard. Due to the high complication of the advancement

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common planned, he utilize an transformative algorithm (EA) as a worldwide research plan to discover the best enhancement. He compared this method with other automated advancement practices, like distinction extending and histogram equalization. With regards to subjective and target evaluation, display the superiority of this method.

Atta et al. (2015) [15] has proposed an alteration of the low contrast enhancement techniques that are based on the singular value decomposition (SVD) for preserving the mean intensity of a given image. While the SVD-based techniques enhance the low contrast images by scaling its singular value matrix, they may fail to produce satisfactory results for some low contrast images. With the proposed method, the weighted sum of singular matrices of the input image and its global histogram equalization (GHE) image is calculated to obtain the singular value matrix of the equalized image. Simulation results show that the proposed method preserves the image brightness more accurately and enhances it with relatively negligible visual artifacts. It outperforms the conventional image equalization such as GHE and local histogram equalization (LHE), as well as the SVD techniques that based on scaling its singular value both qualitatively and quantitatively.

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8. COMPARISON TABLE:

Name of author	Title of the paper	Technique	Benefits	Limitations
Hamid Hassanpour	Using morphological transforms to enhance the contrast of medical images	Top-Hat transforms	The results indicate that the proposed approach makes a better contrast and works much better than the other existing methods in improving the quality of medical images.	NA
Pooja Rana	ENHANCEMENT OF REMOTE SENSING IMAGES BASED ON BACTERIAL FORAGING OPTIMIZATION ALGORITHM USING DWT-SVD	BACTERIAL FORAGING OPTIMIZATION	Various techniques are available for enhancing remote sensing images.	NA
Amira S. Ashour	Computed Tomography Image Enhancement Using Cuckoo Search: A Log Transform Based Approach	Cuckoo Search	the results clearly show that the CS based approach has superior convergence and fitness values compared to PSO as the CS converge faster that proves the efficacy of the CS based technique.	NA

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Ammu Anna Mathew	Brightness and Resolution Enhancement of Satellite Images using SVD and DWT	SVD and DWT	The technique also estimates the singular value matrix of the low–low sub band of histogram equalized image and normalize both singular value matrices to obtain brightness enhanced image.	NA
Rajlaxmi Chouhan	Contrast Enhancement of Dark Images using Stochastic Resonance in Wavelet Domain	Stochastic Resonance in Wavelet Domain	The DSR-based technique significantly enhances the image without introducing any blocking, ringing or spot artifacts.	NA
Ramesh E	CONTRAST ENHANCEMENT USING DOMINANT BRIGHTNESS LEVEL ANALYSIS ADAPTIVE INTENSITY TRANSFORM	discrete wavelet transform	Increase contrast and you increase the separation between dark and bright, making shadows darker and highlights brighter	NA

9. CONCLUSION

Ant colony optimization has ability to find optimistic adjustment factor for better fuzzy based enhancement. Therefore will provide more optimistic results than available methods. In this paper, make use of the ant colony optimization to find optimistic adjustment factor for morphological transforms to enhance the contrast of color medical images. Also to reduce ringing artifacts further gradient smoothing will be used. The main scope of this paper is to apply proposed technique for colored medical images.

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