

An Efficient Ant Colony Optimization Based Medical Image Enhancement

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ABSTRACT: Medical imaging have become popular in today's era. Many doctors and hospitals are now adopting visual medical image system to handle their patients in efficient manner. 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. Ant colony optimization has ability to find optimistic adjustment factor for better fuzzy based enhancement. Therefore has provided more optimistic results than available methods. Also to reduce ringing artifacts further gradient smoothing is used. The main scope of this work is to apply proposed technique for colored medical images.

KEYWORDS: Image enhancement, ant colony optimization, medical images, gradient smoothing, color images.

I. INTRODUCTION

Image enhancement problem can be developed the following: given an insight low quality picture and the productivity top quality picture for particular applications. It's well-known that picture enhancement as a dynamic topic in medical imaging has received much attention in recent years. Desire to is to boost the aesthetic appearance of the picture, or to offer a "better" convert representation for future computerized picture running, such as evaluation, recognition, segmentation and recognition. Moreover, it can help analyses background data that is essential to know subject behaviour without requiring costly individual aesthetic inspection. Holding out picture enhancement knowledge below low quality picture is a complicated problem because of these reasons. Because of minimal comparison, we can not clearly remove items from the dark background. Most shade centered techniques will crash on this matter if the colour of the items and that of the back ground are similar. The review of available techniques is on the basis of the active techniques of picture enhancement, which may be categorized into two extensive categories: Spatial centered domain picture enhancement and Frequency centered domain picture enhancement. Spatial centered domain picture enhancement operates directly on pixels. The key advantage of spatial centered domain technique is they conceptually simple to know and the complexity of these techniques is minimal which favours real time implementations. But these techniques typically lacks in providing satisfactory robustness and imperceptibility requirements. Frequency centered domain picture enhancement is a expression applied to explain the evaluation of mathematical functions or signs with respect to volume and operate directly on the convert coefficients of the picture, such as Fourier convert, distinct wavelet convert (DWT), and distinct cosine convert (DCT). The fundamental strategy in applying this technique is always to boost the picture by adjusting the convert coefficients. The benefits of volume centered picture enhancement includes minimal complexity of computations, ease of seeing and adjusting the volume arrangement of the picture and the easy applicability of special developed domain properties. The fundamental limits including are it can not simultaneously increase all areas of picture well and it can also be hard to automate the picture enhancement procedure. In that paper according to if enhanced picture embed top quality background data, the present techniques of picture enhancement like spatial domain techniques may again be categorized into two extensive categories: Position Processing function and Spatial filtration operations. Standard ways of picture enhancement are to boost the lower quality picture itself. It does not embed any top quality background information. Associated with that in the dark

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picture, some places are so dark that all the info is already missing in these regions. Irrespective of just how much lighting enhancement you apply, it will not be able to recreate missing information. Frequency domain techniques may again be categorized into three categories: Image Removing, Image Sharpening, Periodic Sound reduction by volume domain filtering.

II. TECHNIQUES USED BY SPATIAL AND FREQUENCY DOMAIN METHODS

1. Sometimes Point operations: Where every pixel is personalized according to a mainly situation that is not based on further pixel values.
2. Mask operations: Where each pixel is personalized based on the values of pixel's neighbors (Using convolution theory).
3. Global operations: When most of the pixels price in an image are taken into concern.

Figure1 is used to show the difference between the original images i.e. input image and the enhanced image.

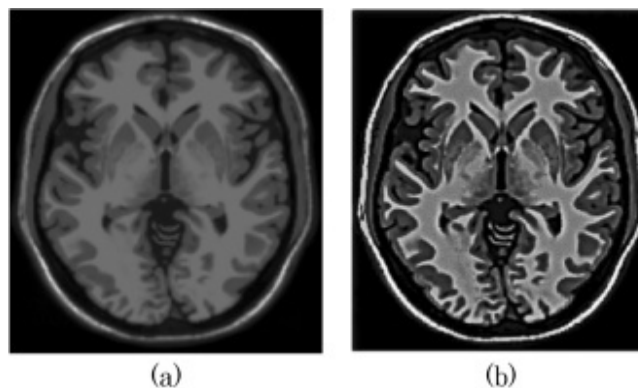


Fig 1: Results of enhancement (a) before enhancement (b) after enhancement

A. Applications of Image Enhancement

1. Industrial inspection/quality control: *Quality get a handle on* is really a process where procedures examination the superiority of each and every factors worried in construction.
2. Surveillance and security: Detective is the seeing of the efficiency, actions, or further varying data, usually of public for the reason of affecting, handling, directing, or guarding them like CCTV cameras [5].
3. Face recognition It is really a pc equipment for mechanically specifying or justifying a person from an electronic digital photograph or even a movie figure from a movie source.
4. Gesture recognition: It is an area in pc science and language technology with the goal of describing individual signals via mathematical operations. Motions may begin from any physically motion of body or state but frequently develop from the face or hand.
5. Medical image analysis: It is the strategy, process and power of making visible depictions of the interior of a body for clinical examination and medical interference.
6. Autonomous vehicles: It involves the usage of mechatronics, synthetic intelligence, and multi-agent program to aid a vehicle's operator.

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7. Virtual reality: It is called immersive media, is really a computer-simulated environment that can replicate bodily living in places in the true world. Virtual reality may reconstruct physical experiences, including virtual flavor, fragrance, and such like [6].
8. Histogram Equalization It reveals greater benefits in the majority of the instances if the image includes a wide gentle shade region then Versatile Histogram Equalization could be used.

III. ANT COLONY OPTIMIZATION

Ant colony optimization (ACO) is truly a nature-propelled improvement calculation supported by the natural pattern that ants store pheromone on the floor to have the capacity to label some good course that should be joined by different clients of the province. The living of the considered Ant Colony Optimization (ACO) is dependant on a natural motivation. It is identified with the idea of stigmergy is the natural form that separates ACO from different frameworks. It can be a roundabout method of association in which ants being far off from each other endeavors to contact with each other through making and reacting with the jolts. Along these lines they store a substance like substance called pheromone on the floor while searching for sustenance. In ACO, the engineered ants after the manufactured knowledge standard recreates the encompassing conduct and connected it in the combinatorial enhancement issue like Traveling Jeweler Problem. Ants store pheromone on the floor to label trails between a nourishment source and their province, which ought to be joined by different clients of the state. With time, pheromone ways dissipate. The lengthier it will take for an insect to go down the way and once more, the more hours the pheromones require unquestionably to vanish. Littler – and subsequently, good – trails get walked over snappier and acquire bigger settlement for pheromone vanishing. Pheromone densities stay on top of littler trails since pheromone is introduced down quicker. That positive input gadget at last conveys the ants to look at the littler ways

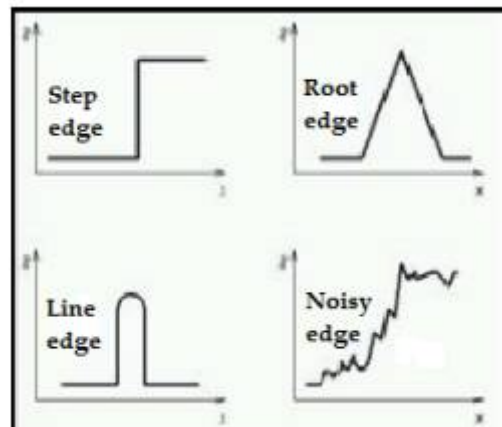


Fig2. Different types of edges

It is this regular wonder that roused the advancement of the ACO met heuristic. Numerous calculations have been created on ACO like Max-Min subterranean insect framework and the Ant Colony System to distinguish an edge from computerized pictures. An Ant Colony Optimization calculation (ACO) is basically a framework taking into account specialists which recreate the characteristic conduct of ants, including systems of collaboration and adjustment. In numerous insect species, subterranean insect strolling to and from a nourishment source store some substance on the ground called pheromone. Distinctive ants embrace diverse ways to achieve the nourishment source and store the pheromone in view of the way that higher centralization of pheromone is saved on shorter ways and littler fixation on longer ways.

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IV. EDGE DETECTION

An edge might be outlined as a masterminded set of cogonated pixels that structures a limit between two disjoined areas An edge is the generous or profound line that repairs the point of confinement and this edge separate the plane or a few articles. Edges are the sudden bounced having high recurrence. In the event that we can find or unmask edges in a right and precise way we get to be ready to discover and find the essential properties about the pictures. Along these lines, by distinguishing the edges in the picture the distinctive elements can be measured precisely. As indicated by variety of force, distinctive sorts of edges are appeared in fig. Calculation for edge location

1. Take shading/greyscale picture
2. Smooth the picture which has bi commotion in pictures. The smoothing procedure is managed without exasperating the edges.
3. Play out the separation on the pictures, which will complex the nature of edges.
4. Apply the thresholding to discover edge pixels
5. Limit the edges
6. Appraisal with the calculations.
7. Get the picture after edge unmasking

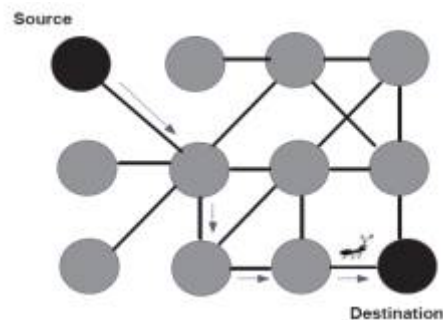


Fig 3: ACO Technique

Edge Detection is a piece of different picture handling operations. Generally picture is smoothen, hone even deblurred before performing edge discovery in order to create better edges. This methodology does functions admirably in different cases, however there are situations where such things can harm the genuine information present in picture, which can be because of dishonorable smoothening or de-obscuring or unnecessary of both. In such cases edge identification may miss some second rate and less conspicuous edges which can be essential piece of picture structure. Along these lines a methodology which keeps second rate edges yet at the same time recognizes them from the other noticeable edges is required. Their methodology includes a shading plan for visual positioning of edges, a stamping technique for edge likelihood checking, correlation limit framework and benchmarking for positioning. The methodology utilized is affected by conduct of ants in true, along these lines will include distinctive subterranean insect bots in various strides for stamping of pixels and later on benchmarking them. A static benchmarking table having values going from 20-240 is utilized to dispense positions to edges according to their coordinating quality, along these lines relative shading from characterized shading plan. Shading Scheme assumes a vital part in prioritization as the request and the hole in visual band of shading plan prompts clear refinement of unmistakable and second rate edges [4].

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5. Pollination based optimization (PBO) algorithm.

The utilization of PBO for edge identification PBO based edge discovery is another procedure and it execute too in therapeutic field likewise and afterward utilized MRI pictures [6]. Edge location is essential piece of picture preparing for article identification. So it turns out to be critical to have a decent comprehension of edge location calculations. An edge is the genuine or envisioned line that denote the farthest point and partitions of plane, item or appearance from different spots or things. This implies if the edges in a picture can be recognized precisely, the majority of the articles can be found and fundamental properties can be measured. The need to distinguish edges all the more effectively prompts create more current methods and more up to date calculations. The edges get more degenerate in loud environment. So it gets to be hard to identify edges in such cases. So a methodology that could create edges with thick edge force should be produced.

V. LITERATURE SURVEY

Gupta et al. (2013) [9] characterized the different existing methodology for the upgrade of dull pictures; it has been watched that if the pictures have guaranteed splendid zone, then it turns out to be all the more brilliant after utilization of those procedures. The outline has risen up out of this reachable downside. In this article he has changed the parameter utilized past. In highlight of the visual presentation the arranged calculation rises as very straightforward and all around composed with keeping fixation on the brilliant locale that ought not to be corrupted. The deterioration of territories has been done on the premise of entropy of the picture. Dynamic SR has been connected in iterative way and the most ideal yield reaction is guaranteed by the different parameter measurements of the picture.

Huang et al.(2013) [10] clarified histogram detachment module is a blend of the proposed prompts various thresholding strategy and an ideal top sign to-clamor proportion (PSNR) estimation to isolate the histogram in little scale subtle element. As the last stride of the proposed procedure, the utilization of the power change module can upgrade the picture with complete shine protection for each created sub-histogram. Trial results demonstrate that the proposed technique not just holds the shape elements of the first histogram additionally improves the complexity adequately.

Xie et al. (2013) [11] has examined face acknowledgment that have been speaking to and perceiving faces in light of subspace discriminant concentrate yet for single specimen face acknowledgment these methodologies are continually experiencing the generalizability issue in view of little examples. This paper proposes new non-insights highlights extraction approach in light of combination of DCT and nearby Gabor parallel example Histogram (LGBPH). The worldwide and low recurrence components are acquired by low recurrence coefficients of discrete cosine change (DCT). The nearby and high recurrence elements are removed by LGBPH. To join the worldwide and neighborhood includes, the last acknowledgment can be accomplished by comparable mix of arrangement consequences of the worldwide and nearby elements. In DCT and LGBPH, preparing procedure is avoidable to make the face model, so that the generalizability issue is actually stayed away from.

Kim et al. (2013) [12] has talked about another difference upgrade approach taking into account predominant brilliance level study and versatile force change for remote detecting pictures. The arranged calculation processes shine versatile force exchange capacities utilizing the low-recurrence luminance segment in the wavelet space and changes power values as indicated by the exchange capacity. All the more particularly first perform discrete wavelet change (DWT) on the information pictures and after that disintegrate the LL subband into low, center, and high-power layers utilizing the log-normal luminance. Force exchange capacities are adaptively evaluated by utilizing the knee exchange capacity and the gamma change capacity in light of the primary splendor level of every layer.

Yonghong et al. (2013) [13] has portrayed light is weakened when dispersing in water, the effortlessness of pictures or recordings caught submerged is generally tainted to shifting degrees. By investigating the distinction in light lessening between in climate and in water, he determine another submerged optical model to depict the arrangement of a submerged picture in the genuine physical system, and afterward propose a successful upgrade calculation with the inferred optical model to enhance the view of submerged pictures or video outlines. In this calculation, a novel

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submerged dim channel is determined to evaluate the spreading rate, and a compelling procedure is additionally displayed to appraise the foundation light in the submerged optical model.

Xumin Liu et al. (2013) [14] They displayed that the fundamental subterranean insect province calculation has a few negatives, for example, for instance developed investigating time, huge levels of estimation, and harsh picture division results. They proposes a superior insect settlement calculation. Applying distinctive move standards and pheromone redesign techniques to various parts of a picture, including foundation, target, side and commotion, he construct a profoundly versatile picture division process with substantial side recognition exactness and vast calculation execution proficiency. In the first phase of picture division, they apply the possibility of fluffy grouping, which helps ants to gather rapidly to the side in the setting and the imprint part of the picture. In the later phase of picture division, he present an advantage research procedure in the side territory.

S Gnanapriya et al. (2013) [15] Proposed that ACO can be characterized on the grounds that the adaptable heuristic examination calculation introduced on the significant a few thoughts of natural behavior of ants. From the new impacts, it's watched that the use of ACO impacts in more noteworthy grouping impact when contrasting with dynamic methods (KM). To decrease the issue rate, they devoted to applying ACO. The motivation behind applying ACO is its capacity of meeting and it takes after the behavior of insect. As uncovered by the result on all datasets KM with ACO is get ready to get huge grouping accuracy if contrasted with different calculations.

Vahidsolemani et al. (2013) [16] The improved subterranean insect settlement calculation was accomplished through expanding inclination of subterranean insect to migrate stand-out course in probabilistic decision guideline. The calculation demonstrated a harmony between the subterranean insect's way and flow of pheromone. The area discovered in light of the fact that the tumor was more particular, clear and with no extra edge, that was all things considered presented by means of disturbance.

VI. EXPERIMENTAL RESULTS

For the experimental purposes, different color medical image are taken. All the results examined, designed and implemented by using MATLAB R2013a utilizing image processing toolbox. The Proposed approach is ant colony optimization to find optimistic adjustment factor for morphological transforms to enhance the contrast of color medical images. The Results show that our proposed approach gives better results than the existing techniques.

INPUT TMAGE: Figure 4 shows the input color medical image for producing the result of proposed as well as existing algorithms.

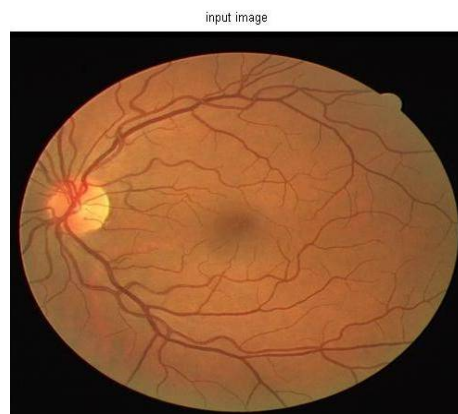


Fig4: Color Medical Image

ENHANCED IMAGE: Figure 5 shows the output of existing algorithms. This image shows the output performance of morphological transforms to enhance the contrast of color medical images. But results of the existing technique are not effective.

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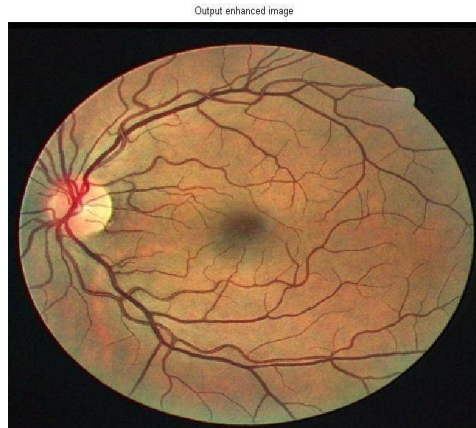


Fig 5: Existing Enhanced Image

OUTPUT IMAGE: Figure 6 shows the output of proposed algorithms. This image shows the output performance of ant colony optimization which is used to find optimistic adjustment factor for morphological transforms to enhance the contrast of color medical images.

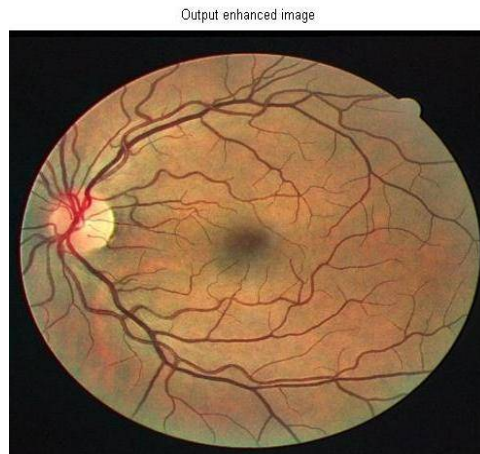


Fig 6: Proposed Enhanced Image

This figure showing input image for experimental analysis. Then showing enhanced images .and at last there is a output image. We observed that the proposed results are quite better than the existing results.

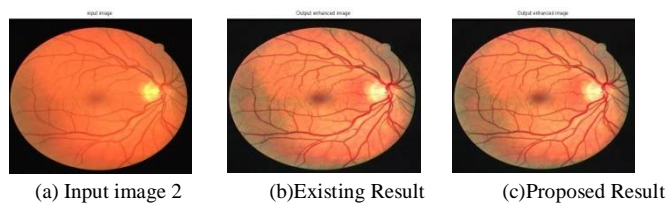


Figure 7: Experimental Results

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VII. PERFORMANCE EVALUATION

This section contains the comparison table and graphs of the 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 method.

1. MSE – Mean square error is to compute an error signal by subtracting the test signal from the reference, and then computing the average energy of the error signal. It can be explained as:

$$MSE = \frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N (f(i,j) - f'(i,j))^2 \quad (1)$$

The values of Mean square error are shown below in the comparison Table 1

Table 1: Mean square error comparison table

Input Image	Existing Result	Proposed Result
1	0.2104	0.0935
2	0.0853	0.0379
3	0.0732	0.0325
4	0.0896	0.0398
5	0.1777	0.0790
6	0.2352	0.1045
7	0.0863	0.0384
8	0.1699	0.0755
9	0.1074	0.0477
10	0.1253	0.0557
11	0.0794	0.0353
12	0.1729	0.0768
13	0.1081	0.0480
14	0.1528	0.0679
15	0.0686	0.0305

Figure 8 has shown the quantized analysis of the mean square error of different images by Existing value in (Blue line) & proposed values in (Red lines). It is very clear from the graph that there is decrease in MSE value of color medical images with the use of proposed method over existing methods. This decrease represents improvement in the contrast of the image.

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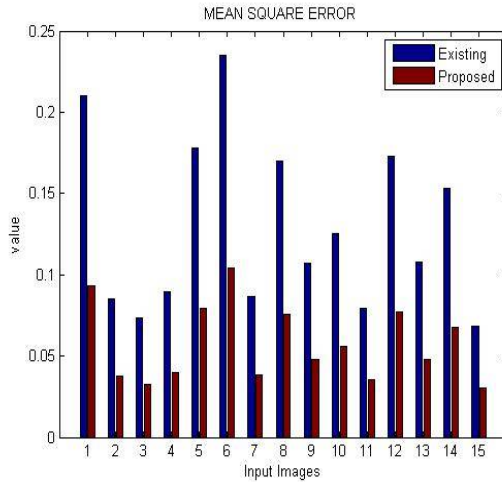


Fig 8: Mean square error graph

2. PSNR - Peak square noise ratio is the ratio between the maximum possible value of the signal and the power of the corrupting noise. It is measured in decibels (db). It can be explained as:

$$PSNR = 10 \cdot \log_{10} \left(\frac{MAX_I^2}{MSE} \right) \quad (2)$$

The values of Peak signal to noise ratio are shown below in the comparison Table 2.

Table 2: Peak signal to noise ratio comparison table

Input Image	Existing Result	Proposed Result
1	54.8997	58.4216
2	58.8213	62.3431
3	59.4854	63.0072
4	58.6092	62.1310
5	55.6330	59.1548
6	54.4163	57.9382
7	58.7694	62.2913
8	55.8294	59.3512
9	57.8226	61.3444
10	57.1506	60.6724
11	59.1321	62.6539
12	55.7534	59.2752
13	57.7944	61.3162
14	56.2894	59.8113
15	59.7657	63.2875

Figure 9 has shown the quantized analysis of the peak signal to noise ratio of different images by Existing value in (Blue line) & proposed values in (Red lines). It is very clear from the graph that there is increase in PSNR value of color medical images with the use of proposed method over existing methods. This increase represents improvement in the contrast of the image.

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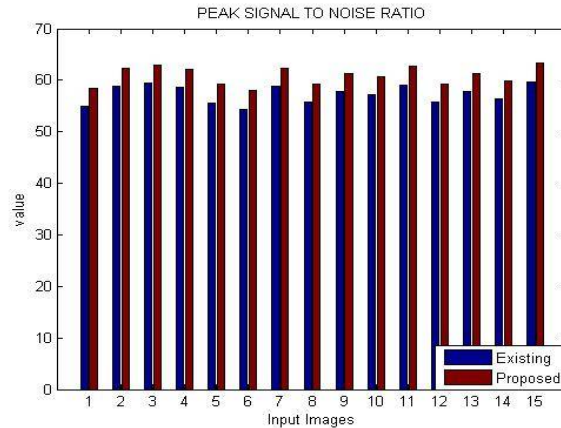


Fig: Peak signal to noise ratio graph

- Execution Time** - The values of execution time are shown below in the comparison Table 3. As execution time needs to be minimized in the proposed work results. This table has shown the results of existing algorithm as well as proposed algorithm.

Table 3: Execution Time comparison table

Input Image	Existing Result	Proposed Result
1	38.0670	33.1432
2	40.8574	31.9117
3	37.2995	31.3912
4	37.0030	31.2497
5	37.6152	32.5985
6	39.2597	34.5845
7	37.9033	32.5355
8	37.8806	35.9784
9	39.0351	35.2961
10	40.8335	36.5247
11	38.4804	33.9131
12	39.0881	33.5129
13	41.8814	36.4800
14	39.3364	35.6787
15	40.9565	33.8074

Figure 10 has shown the quantized analysis of the execution time of different images by Existing value in(Blue line) & proposed values in(Red lines) . It is very clear from the plot that there is value of image quality is minimum in every case with the use of proposed method over other methods. This represents improvement in the contrast of the image. This image quality graph proves that the values of proposed algorithm are lower than the existing algorithm.

This graph proves that proposed work results are much better than the existing results.

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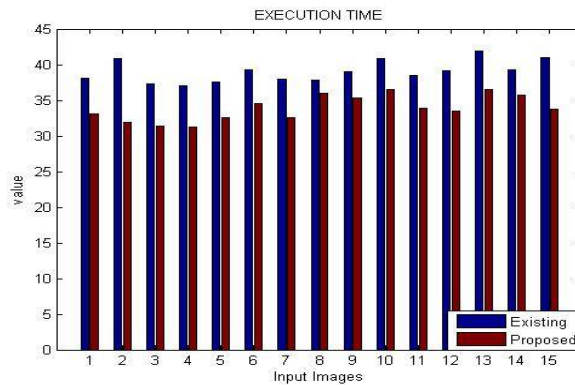


Fig 10: Execution Time graph

VIII. CONCLUSION

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. Ant colony optimization has ability to find optimistic adjustment factor for better fuzzy based enhancement. Therefore will provide more optimistic results than available methods. Also to reduce ringing artifacts further gradient smoothing will be used. The main scope of this work is to apply proposed technique for colored medical images. The proposed technique is designed and implemented in the MATLAB 2013 tool. The comparisons have clearly demonstrate that proposed technique outperforms over the available methods. This work has not considered the effect of noise on images, so in near future we will work for noisy images.

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