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PELICAN OPTIMIZATION ALGORITHM BASED IMAGE ENRICHMENT FOR RADIOGRAPHIC CHEST IMAGES

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ABSTRACT
The degraded class of images produced after acquisition and transmission has a significant impact on clinical diagnosis and observation, making medical image improvement a tough image-processing framework. In this work, a unique medical image enhancement technique adaptive histogram equalization (AHE) with pelican optimization algorithm is suggested to enhance the visual quality of the images. To handle optimization issues in several scientific areas, optimization is a significant and essential difficulty. This study presents the Pelican Optimization technique (POA), a novel stochastic nature-inspired optimization method. In this paper AHE+POA algorithm is designed for image enhancement. For experimentation purpose we have used radiography ribcage images. In conclusion, thesimulation experiments demonstrate that our suggested approach beats state-of-the-art experimental techniques in both quality and quantity. To judge POA's efficacy in optimization, its results are contrasted with five well-known metaheuristic algorithms. The simulation outcomes and their analysis demonstrate that POA outperforms five competingalgorithms in terms of offering the best answers to optimization issues by achieving a proportional balance between exploration and exploitation.

Keywords:
Optimization, Nature inspired, Optimization problem, Pelican, Image enhancement.

I. Introduction
A ground-breaking meta-heuristic system called Pelican-Optimization system is impacted by social activities and pelican’s propensity for stalking. The Pelican Optimization Algorithm (POA) is a meta-heuristic procedure that draws inspiration from pelicans' natural behaviour when looking for aquatic prey. Pelicans are primarily found in rivers, lakes, and swamps. Fish is the principal food source for pelicans; frogs, turtles, and crustaceans are only occasionally eaten. It benefits from adjustable parameters like quick convergence and easy calculations. By achieving a proportional balance between exploration and exploitation to offer the best solutions, POA has greater competitive performance [1][2]. Deterministic methods and stochastic methods are the two broad categories into which optimization problem-solving methodologies fall. With irregular, high-dimensional, non-convex, and non- derivative objective functions, deterministic approaches have trouble addressing complex optimization problems [2]. However, stochastic methods are able to get around the limitations of deterministic methods and offer suitable answers to optimisation problems by using random search in the problem-solving space and avoiding the use of derivative and gradient information from the optimization problem's objective function.
Once the algorithm has been totally employed, the ideal proposed solution for the optimization problem is selected. Global optimum is the fundamentally ideal response to an optimization problem. The solutions offered by the optimisation algorithms, however, are not always the same as the overall best. The result of the optimization techniques is therefore referred to as quasi-optimal. Researchers have created innumerable optimization algorithms in an effort to improve quasi-optimal solutions and get closer to the global ideal. In the past ten years, a number of metaheuristic techniques have been developed as a result of natural inspiration from the natural world. Certain metaheuristics were

activated by the swarming or collective behaviour of various natural organisms (insects, birds, animals, etc.). Some of the prominent SI (Swarm Intelligence) based metaheuristics are PSO(Particle-Swarm Optimisation),[3] ALO(Ant-Lion Optimisation), ABC(Artificial-Bee Colony), [4] CSA(Crow- Search Algorithm), POA, FA(Firefly Algorithm), and BOA(Butterfly- Optimization Algorithm) etc. Many metaheuristic computing techniques have been used in the past to handle heterogeneous issues in industries like healthcare, bioinformatics, business, agriculture, image-processing, etc.

In this paper we have considered application as image enhancement. Image enhancement methods, the procedure is more involved. The enhancing operation was made more difficult by acquisition errors, image fuzziness, and the heterogeneity of illumination and noise ranks. For the efficient visualization of images, a number of enhancing approaches have been suggested. Based on their processing impact, these techniques are categorized as spatial and transform domain techniques. One of the traditional spatial domain methods is histogram equalization (HE) [5], which makes the grayscale distribution of the image more uniform. The traditional HE-based technique known as mean histogram equalization (MHE) [6] is used for local regions and is efficient at preventing the loss of image features. However, this method's flaw is the excessive noise amplification. On the basis of this, we provide a novel method for improving images called AHE+POA. The suggested methodology is helpful for determining the most precise contrast- limit value to obtain an enhanced performance that is superior.

Following is the flow of our paper content: Brief information about the introduction of AHE+POV techniques and their use is provided in Section first. The works of several researchers who have used Boosted Nature-Inspired POA strategies to address various problems are highlighted in Section second. Showcase design of AHE+POA in Section third. Section fourth demonstrate experimental outcomes.

II. Literature

The following table shows the advantages and shortcoming of POA methods so that by observing limitation oflatest paper one can find the best solution.

Table 1: Literature review of POA techniques

Reference no.	Application domain	Advantages	Limitations
Trojovský (2022)	Unimodal and multimodal functions	1.The performance of POA is evaluated on twenty-three objective functions of different unimodal and multimodal types 2.POA Exploration and Exploitation showgood accuracy with unimodal and multimodal functions. 3.Result comparison done for eight different algorithm.	1.It cannot be guaranteed that the solutions obtained using POA for optimization problems are exactly equal to the global optimum for all optimization problems. 2.Stochasticnature of algorithm Author fail toexplore new application domains like big data & AI.
Trojovský (2023)	Unimodal and multimodal functions	1.Proposed WaOA is numerically demonstrated in three stages: investigation, exploitation, and migration. 2.Ten well-known metaheuristic algorithms' performances are compared withWaOA performance. 3.The proficiency of WaOA in giving theideal solution 68 standardobjective functions	1.Limit of WaOA is that theproposed technique might fail in some improvement applications 2.There is no assurance that this method will reach the global optimum due to the nature of random search.

Zhang, Chuang, et al. (2023)	NA	1.Multi-threshold color image segmentationis proposed and used. 2.The accurateness and speed of multi-threshold image segmentation are significantly enhanced by combining MSIPOA with symmetric cross-entropymulti-threshold segmentation.	1. Though the results are tested through simulation testing, it does not incorporate real-world applications.
Al-Wesabi,et al (2023)	IoT	1.POAFL-DDC procedure has been created for attack recognition in the IoT environment. 2.In this work, the deep belief network (DBN) model is used for the attack detection process.	1. The optimal feature selection algorithms can used to improve the performance of POAFL-DDC algorithm's.
Kusuma, (2022)	NA	1. Guide Pelican Algorithm (GPA) can handle two significant in metaheuristic calculations: avoiding the local optimal entrapment by locating the suboptimalsolution.	1.POA and GPA can still be changed in many cases. These algorithms can be can be merged with different methods, for example: Metaheuristic, heuristic, and exact methods. 2.More execution of thesecalculations can be used to handle a lot more genuine streamlining issues.
Sharma (2023)		1.POA's performance has been improved bythe deployment of six distinct chaotic maps. 2.In terms of average accuracy, the best performance is provided by CPOA_4.	1.Observation says, if only dimension size is a concern, the original POA produces better results. 2.Other standard benchmarkdatasets and functions can be used totest and compare proposed variants' performance.
Alamir (2023)	Optimal Energy Managementin Microgrid	1.New application of POA is suggested to tackle the microgrid's multi-objective optimization EM 2.Two distinct MG test systems were used to evaluate the efficacy ofproposed methods.	The suggested approach may be expanded to include probabilistic estimation and account for demand and renewable energy generation uncertainty as well as how those factors will impact the functioning of the Energy Management in Microgrid .
Tuerxun, Wumaier, et al.(2022)	NA	1. The experimental data were normalized, and the enhanced POA method was used to optimize the hyperparameters with the objective to boostthe classification accuracy of the wide learning system model.	1.The suggested model is ideally suited for fault classification in wind turbines in future practical applications. 2.Deep learning-based classification models will be examined, as well as the

			evolution ofalgorithms for defect feature extraction.

III. Methodology and Materials

3.1 Materials and Methods

Image enhancement is an important preprocessing activity in classification of images. Image enhancement help to improve classification results. In this characteristics of the dataset and the requirements of the classification task. Selection of proper technique with optimal parameters are time consuming and critical task.

Adaptive histogram equalization (AHE): AHE is a conventional histogram equalization-based solution for local regions that is beneficial in terms of reducing image detail loss. AHE used to enhance the contrast of images. It breaks down the image into distinct sections and computes histogram equalization for each. As a result, AHE generates a large number of histograms, each corresponding to a different portion of the image. Proposed model utilizes a AHE technique for image enhancement. AHE algorithms that maximize specific objective criteria is necessary to optimize the outcomes of image enhancement utilizing metaheuristic algorithms [7][8].

Pelican optimization algorithm (POA): POA is a most recent metaheuristic algorithm which study the simulation of the natural behavior of pelicans during hunting. Pelican is a large water bird known for its long beak and large throat pouch, which it uses to catch and consume fish. POA study a foraging behavior of pelican bird which involves individual and collective movements to search for food.

$$Pa,b = tb + rand.\ (hb - tb), \quad a=1\ldots n, b=1\ldots. m$$

Where Pa,b is a bth candidate solution identify ath variable value, n is number of variables, m is number of problems and rand means random number[9][10]. Algorithm shows the steps involve in POA.

Algorithm : *AHE based image enhancement with Pelican Optimization*

Input: *Input image, Population Size, Neighborhood size, movement strategies*
Output: *Optimize values*

1.Input radio chest x-ray image (Original image)
2. AHE enhancement function
for each (h, t) in image do
rank=0
for each(a, b) in contextual region of (h, t) do
if image[h,t] > image[a,b] then
rank = rank+1
*output[h,t] = rank * max_intensity //pixel in contextual region*
3.Randomly Population Initialization of pelican agents.
4. Evaluate the fitness of each pelican agent.
5. Pelican Movements
a. Individual Movement: based on its current position, velocity, and personal experience.
b. Local Collective Movement: specified neighborhood communicate
c. Global Collective Movement: Adaptive movement with global information.
6. Feeding Phase: Identify the best solution among their neighboring agents and consume it.
7. Update the fitness values.
8. Repeat steps 3 to 5
9. Reaching a maximum number of iterations
10. Return the best solution found.
11.End

The POA aims to strike a balance between exploration and exploitation by incorporating individual, local, and global movements. This allows for efficient search and convergence to promising regions of the search space [11]. The POA for image enhancement, you would need to define an appropriate fitness function that captures the quality or performance measure you want to optimize, such as image quality metrics or classification accuracy. The algorithm can then be used to find optimal or near-optimal parameters or configurations for image enhancement algorithms based on this fitness function. Figure 1 show the architectural flow of POA in image enhancement [12] [13].
Parameters or configurations for image enhancement algorithms based on this fitness function. Figure 1 show the architectural flow of POA in image enhancement [14] [15].

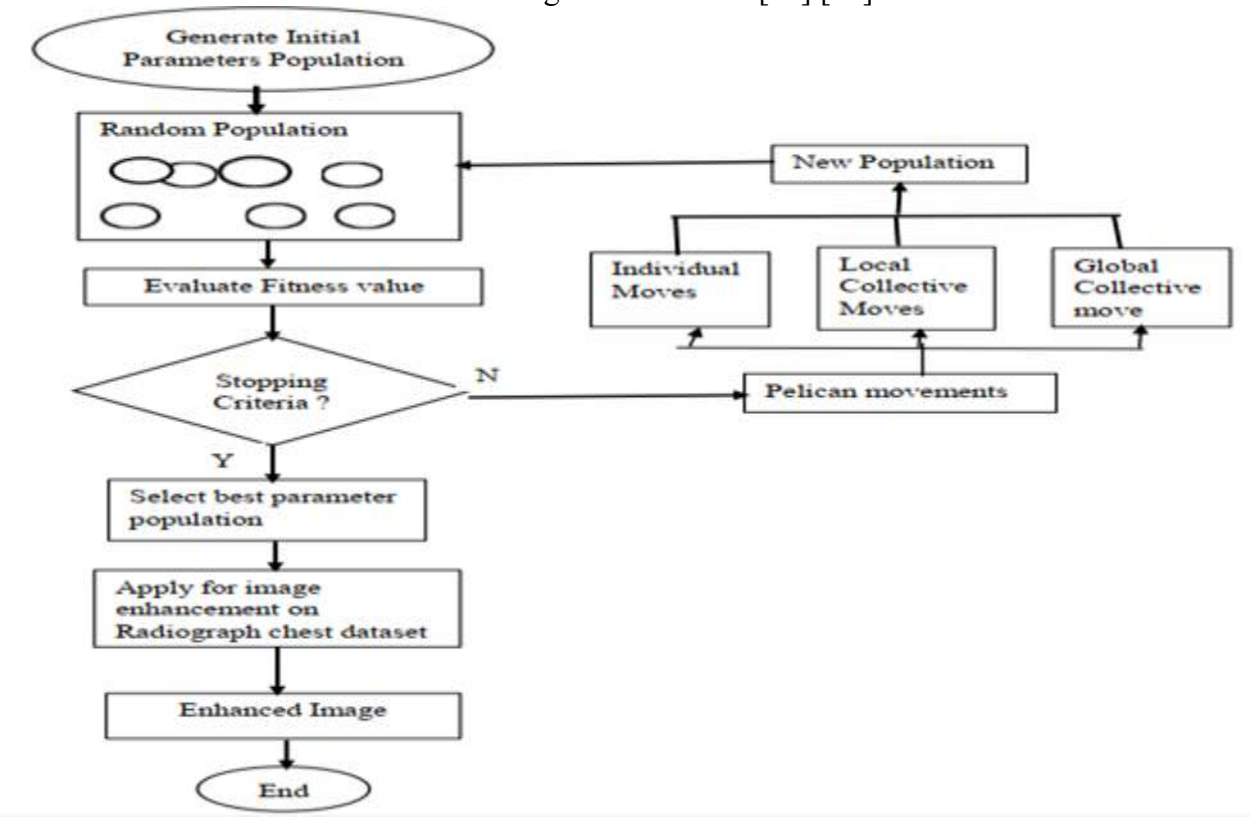

Figure 1: Workflow of POA in image enhancement

IV. Result

For experimental purpose we have used radiography data from. https://stanfordmlgroup.github.io/competitions/chexpert/. The TIFF format is used to save experimental data of different medical imaging modalities

(a) (b)

Figure 2: Enhancing medical images with our suggested model, (a) Sample radiography chest image (b) Enhanced image.
We have compared four advanced methods, with our proposed method.

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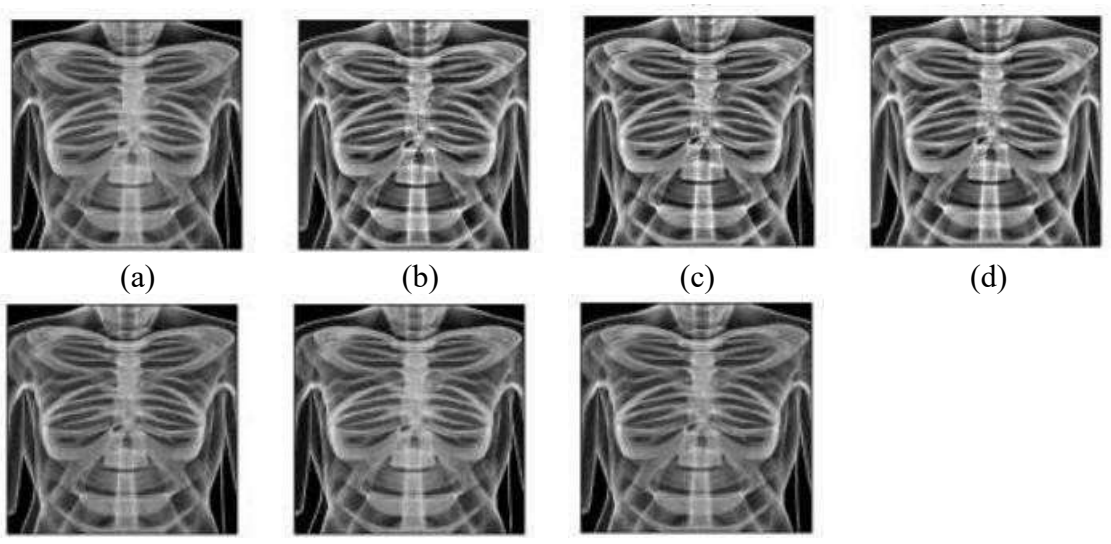


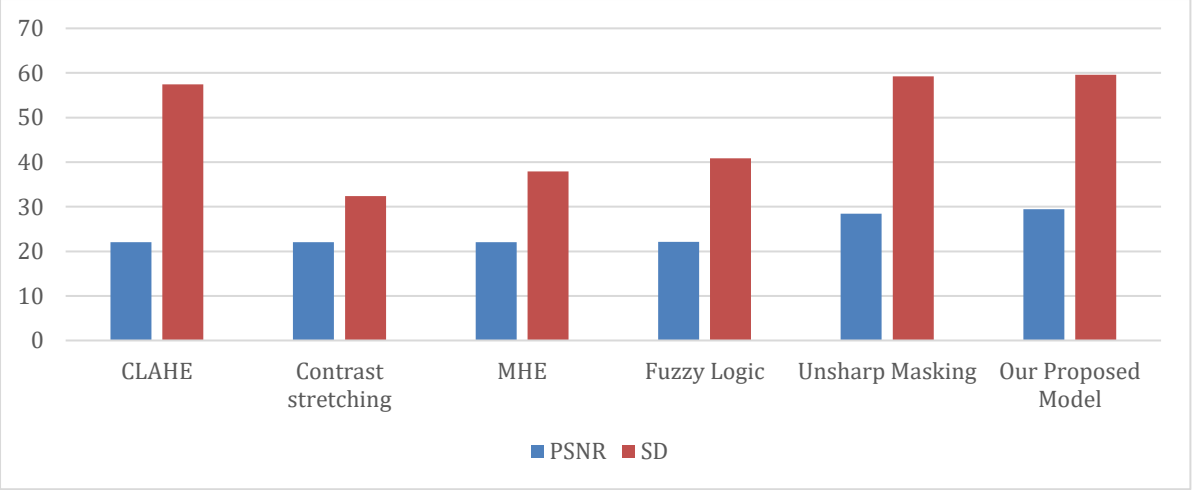
Figure 3: Comparison of the performance of the enhancement utilising the previous experimental approaches and our suggested model. (a) Original chest radiography image, (b)Enhanced image using CLAHE,(c) Contrast stretching (d)MHE model (e) Fuzzy Logic (f) Unsharp Masking (g) Enhanced image using our proposed model.

We evaluated the effectiveness of radiography chest image enhancement using our suggested model and the other experimental approaches. Table 1 representing the same.

Table 2: Literature review of POA techniques

Performance Parameter	CLAHE	Contrast stretching	MHE	Fuzzy Logic	Unsharp Masking	Our Proposed Model(AHE+POA)
PSNR	22.026	22.037	22.08	22.09	28.42	29.42
SD	57.42	32.4	37.9	40.89	59.211	59.604
SSIM	0.923	0.899	0.840	0.912	0.945	0.998

Figure 4: Performance analysis of the proposed method with the existing method



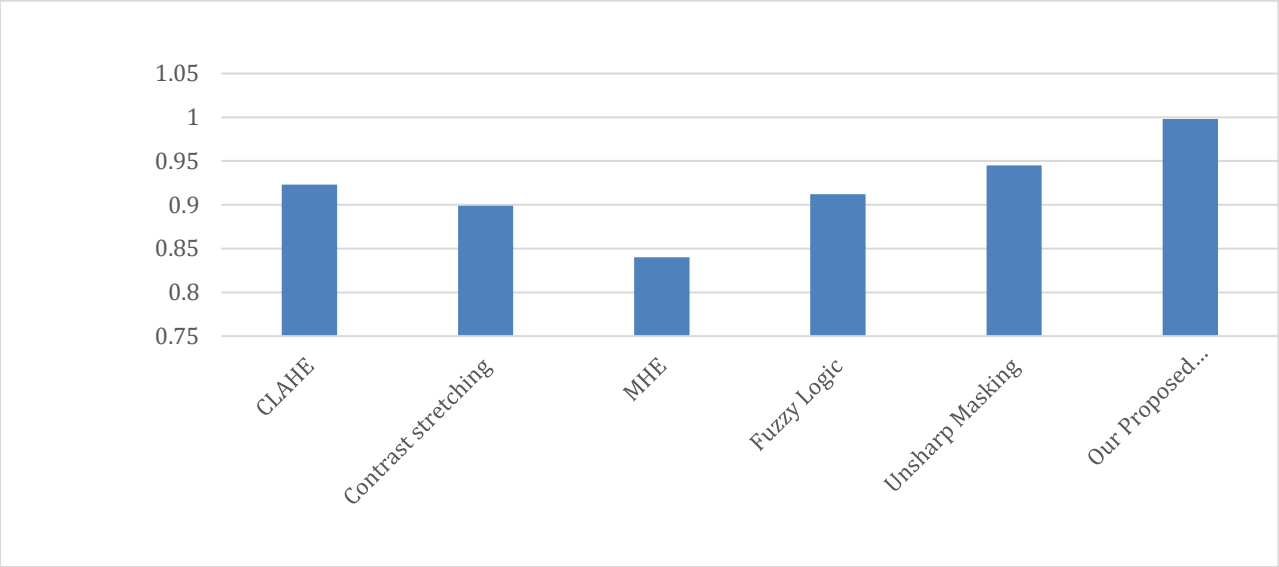


Figure 4 shows the results of our comparison of the radiography shows chest image enhancing effectiveness between our suggested model and other experimental methods based on performance criteria. From above table it shows that PSNR of proposed method id high, SSIM value is near to one which is good score as compared to all other method.

V. Conclusion

Our unique strategy for improving images is based on adaptive histogram equalization with Pelican Optimization Algorithm. In comparison to other algorithms, we have demonstrated our model's superiority. The results of AHE+POA approach are nearly comparable, with our method having a tiny edge in the final contrast. In our experimental result our prosed method got good SSIM (0.998) and better PSNR (29.42). The experimental findings demonstrate our model's superiority, both qualitatively and numerically, over other cutting-edge approaches. The structure and pertinent details that are included in the medical photos can be illustrated using the way we've suggested. All of these actions increase overall contrast on the one hand while improving observation and visual perception on the other.

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