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COVID - 19 Segmentation with Particle Swam Optimization Technique using X-ray Images

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Abstract: The COVID-19 pandemic has brought about the need for accurate and efficient detection of the virus to curb its spread. One approach is the use of chest X-rays for diagnosis, which requires accurate segmentation of the infected area. In this study, we propose a COVID-19 X-ray segmentation approach using Particle Swarm Optimization (PSO). The methodology involved preprocessing the X-ray images using Discrete Wavelet Transform (DWT), followed by PSO-based segmentation of the infected area. The segmented images were then quantitatively evaluated for accuracy. Our findings demonstrated that the suggested method successfully segmented the affected region, indicating its potential for use in COVID-19 diagnosis. This study contributes to the development of efficient and accurate COVID-19 detection approaches, which are essential in controlling the spread of the virus.

Keywords: *Covid-19,X-ray, Particle Swam Optimization, Discrete Wavelet Transform*

I. INTRODUCTION

This coronavirus 2 that causes COVID-19 is responsible for a severe form of the respiratory illness known as severe acute respiratory syndrome (SARS-CoV-2). A strain of the virus reportedly discovered in Wuhan, China in December 2019, while the following year, a worldwide pandemic had broken out. Droplets expelled during speech, coughing, and sneezing are the most common modes of transmission for COVID-19. Contacting an infected surface and would then contacting your lips, nose, and eyes is another way to transfer the virus. Temperature, cough, exhaustion, body aches, lack of senses such as smell and taste, with breathing difficulties are only a few of the varying degrees of symptoms that can be brought on by this virus. Even if a person shows no indications, they could still infect others with the virus.

In response to the pandemic, scientists and researchers around the world have been working to develop treatments and vaccines for COVID-19. Several vaccinations were produced and seem to be currently in use; these vaccines have really been demonstrated to significantly reduce the likelihood of contracting the virus as well as contracting a serious illness or dying as a result of it. The epidemic, however, persists, but much must be accomplished to slow its development and lessen its damage. The avoidance of both erroneous positives and negatives emphasizes the importance of precise detection. Unwanted worry, social withdrawal, and medical intervention may ensue from a false positive, while false negatives can result in infected individuals unknowingly spreading the virus to others.Timely and accurate detection of COVID-19 can also help inform public health decisions and interventions, such as contact tracing, quarantining, and vaccination campaigns. Overall, early, and accurate detection is a crucial component in the global efforts to control the COVID-19 pandemic.

Segmenting a picture into discrete sections that each represent a unique object or feature is known as image localization. Object recognition, driverless vehicles, as well as diagnostic devices are just a few of the many areas where image segmentation has found value in machine learning. In order to find optimal solutions, particle swarm optimization (PSO) mimics the motion of a swarm moving particles across a search space. Particles' positions and velocities are updated repeatedly according to the optimal solution identified by the swarming as well as the components' own past positions, with each particle representing a potential solution to the issue in question.

To achieve the best possible results when segmenting an image, PSO can be utilized parameters, such as the number of segments or the threshold values used to separate different regions in the image. y optimizing certain parameters, such as threshold values or segmentation criteria, By using PSO, picture segmentation techniques can be made more precise and efficient. PSO can also be used in combination with other techniques, such as neural networks or fuzzy logic, to further improve the performance of segmentation models.

Objective of this study:

1. To analyze the effectiveness of the segmentation methods of COVID-19 images.
2. To contribute to the existing body of knowledge on the use of particle swarm optimization for image segmentation, particularly in the context of COVID-19 detection
3. A Lastly, the dot product of the grayscale picture and the mask data matrix was used to segment the effective region. Chest X-ray images without any background were acquired after the unnecessary components were taken out.

II. LITERATURE REVIEW

Using AI approaches, image-based solutions have reliably and repeatedly produced accurate results. For the past several years, scientists have used deep learning as well as machine learning techniques to study X-ray images for COVID-19. This paper evaluates the multilevel image method as well as Kapur's entropy-based fitness function determined using 2D bar chart of gray scale used in Sanjoy chakraborty et al proposed .'s altered whale optimization algorithm to population thermal reduction for segmenting six benchmark images[1]. Using characteristics extracted from chest X-ray pictures and a discrete social learning particle swarm optimization method (DSLPSO), ChaonanShen et al. suggested an approach to detect that could really detect COVID-19 successfully; they then advocated using support vector machines (SVMs) to classify the pictures. A.A. Harsan et al. provide a Neural Network as well as a particle swarm optimization technique, both of which are useful in modern medical diagnosis and in identifying rough development of covid 19 characteristics. It

enhances the final images [3]. It was Abishekseum and company who created In order to boost the f1core and accuracy of the classification model, we combine a transfer learning framework with both a segmentation (unet) technique. Also, he evaluates competing models in relation to his own[4]. The study by Aditi Joshi et. al. To make the suggested SRIS model resilient to contour initiation, an unique adaptive level-set evolutionary protocol that utilizes both internal & external variables is suggested. Because of this, the photographer's classification technique and processing speed are both enhanced [5]. Using density peaked clustering as well as a generalised extreme value distributions, the image segmentation method described by Mohamed Abd ElazizID1 et al. is significantly more efficient than competing clustering methods. This improves the PSNR, SSIM and entropy [6]. For the objective of identifying floods, Anbarasanet.al [7] combines big data, IoT, and convolutional neural networks. Big data is the term used to describe the information that IoT devices collect. The pre-processed data is then subjected to a normalization and imputation procedure, which is employed as one of the inputs of a convolution deep neural network that is used to determine whether or not floods are likely to occur.

Segmentation techniques are used to identify and isolate specific regions or objects within an image. Image segmentation could be accomplished by a variety of methods, some of which are:

- Thresholding: Thresholding is a simple and widely used technique for image segmentation. It involves setting a threshold value and then classifying all pixels in the image as either foreground or background based on their intensity value relative to the threshold.
- Edge-based segmentation: Edge-based segmentation techniques detect edges or boundaries in an image and use them to separate different regions or objects. Edge detection can be performed using techniques such as Sobel edge detection, Canny edge detection, as well as Laplacian of Gaussian edge detection.
- Region-based segmentation:To organize pixels, segmentation methods that focus on regions do so, in an image based on their similarity in terms of color, texture, or other features. One popular region-based technique is the watershed algorithm, which is often used for segmenting medical images.
- Contour-based segmentation: Contour-based segmentation techniques involve detecting and tracing the contours or boundaries of objects in an image. Approaches like active contours and level sets can be used for this purpose.
- Clustering-based segmentation: Clustering-based segmentation techniques group pixels in an image based on their similarity in terms of intensity or color, and then usingclustering algorithms like k-means or fuzzy c-means to identify the different regions.

Every segmentation method possesses a distinct set of pros and cons, and selecting one will rely on the details of the photos being divided and the needs of the program.In the context of COVID-19 detection and segmentation, several of these techniques have been applied, including region-based segmentation, thresholding,as well as edge-based segmentation. In order to enhance the performance of covid-19 identification using xray dataset, we present PSO(Particle Swarm Optimization) model with for segmentation of covid19 x-ray dataset.

Dataset:

Research involving COVID-19 identification utilizing machine learning approaches has made extensive use of the COVIDx data. There have been multiple attempts to use the dataset to create and test deep learning models with COVID-19 recognition in chest X-ray as well as CT scan pictures. Also, many distinct machine learning methods have been compared to one another and the impact of data preprocessing strategies on prediction accuracy has been studied using this dataset.While the COVIDx dataset has been a valuable resource for COVID-19 research, some limitations should be noted. The dataset contains images from multiple sources, which may introduce variability in the image uality and disease severity. Additionally, the dataset only includes chest X-ray and CT images, and other imaging modalities such as MRI or ultrasound are not included.

Covid-19 Segmentation Architecture:

The use of AI for detecting COVID-19 using medical images typically involves training machine learning algorithms on large datasets of medical images and clinical data. The goal is to identify characteristic patterns in the images that are associated with COVID-19, and to use this information to make predictions about whether an individual has the disease. Architecture.

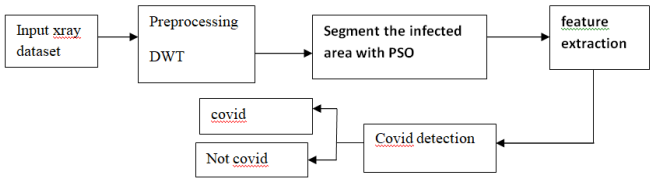

Fig 1: block digram

Preprocessing:

In COVID-19 X-ray segmentation with PSO, Discrete Wavelet Transform (DWT) is used as a preprocessing step to prepare the images for segmentation. DWT is a popular signal processing technique that allows for signal decomposition into different frequency bands. In this research, we use DWT to break down the initial X-ray pictures into four distinct frequency ranges (LL, LH, HL, HH). The bulk of the image's energy is located with in LL sub-band, is used for image reconstruction. The DWT-based preprocessing step helps in reducing the image noise and enhancing the contrast of the images, thereby improving the accuracy of the segmentation process. The preprocessed images are then used as input to the particle swarm optimization algorithm for segmentation.

Segment the infected area with PSO:

Particle Swarm Optimization (PSO) can be used for COVID-19 segmentation in chest X-rays, by optimizing the location and size of the segmented regions based on a fitness function that evaluates how well the segmentation aligns with the expected COVID-19 abnormalities.The PSO method approximates its performance by modelling the actions of a cloud of particles, wherein each particle stands for a feasible optimization strategy. Particles navigate the subspace using both their individual perfect option and the collective optimal idea. The diagram (figure 2) explains the process.

To use PSO for COVID-19 segmentation, the algorithm is typically applied to a preprocessed chest X-ray image to identify the regions of the lung that are affected by COVID-19. The optimization problem is formulated as an objective function that takes into account the characteristics of COVID-

19 abnormalities, such as the shape, texture, and location of the lesions. By tweaking the particles' velocities and positions, the PSO algorithm finds the optimal placement for the segmentation results. PSO may be utilized in tandem with certain other methods to enhance the quality and speed of the segmentation process, like feature extraction, clustering, as well as deep learning. In order to improve the discriminative power of a deep teaching process like a convolution neural network (CNN), PSO is capable of helping optimise the model's variables.

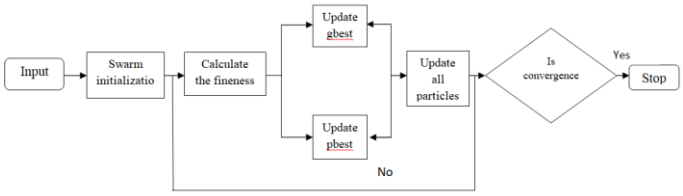

Fig:2 flowchart of infected region of covid19 with

Steps for segmentation of Covid x-ray:

1. Load the preprocessed image and initialize the PSO parameters, including the number of particles, the number of iterations, and the swarm size.
2. Define the fitness function, which evaluates the accuracy of the current particle position in segmenting the infected area. The fitness function should be able to compare the segmented image with the ground truth mask and calculate the similarity index, such as the Dice coefficient or Jaccard index.
3. Initialize the particles with random positions and velocities.
4. Evaluate the fitness of each particle and update its personal best position.
5. Update the global best position by selecting the particle with the best fitness.
6. Update the velocity and position of each particle using the PSO equation.
7. Iterate over steps 4-6 till the maximum limit or the target fitness is met.Use the global best position as the final segmented image.
8. Evaluate the accuracy of the segmentation using metrics.
9. Repeat the process for multiple images and report the average accuracy.

By using PSO, the infected area in COVID-19 x-ray images can be accurately segmented, which can help in early and accurate detection of COVID-19.

III. RESULT

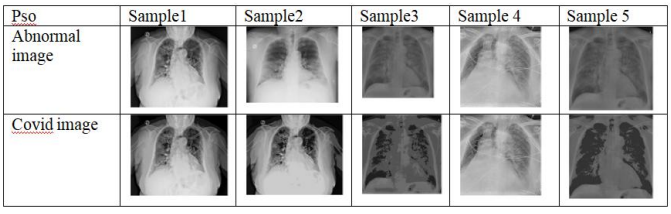

Fig:3 output of segmented image

Here, COVID-19 X-ray pictures were segmented using Particle Swarm Optimization (PSO) algorithm. The segmented images were presented through visual representations of the infected area, which were highlighted in red color on the original X-ray images. The segmented images showed clear demarcation of the infected areas, which can aid in early diagnosis and accurate diagnosis of COVID-19 it shows in the fig:3.

Accuracy is the percentage of correctly classified pixels in the segmented image. The sensitivity of an algorithm can be defined as the percentage of "true positive" dots (affected area) that something that correctly identifies. Measured in terms of the percentage of non-infected areas (true negative pixels) which the algorithm properly identifies. To calculate F1-score, we take the natural logarithm of both recall and accuracy, wherein precision has been the fraction of truly infected pixels out of all the infectious pixels categorized while recall is the fraction of truly infected pixels compared to the total contaminated pixels with in underlying data. The dice frequency is a metric for evaluating how well an artificially segmented image matches the ground truth; a value of one means perfect overlapping. With the use of these data, we can better understand where the segmented algorithm excels and where it may use some work.

CONCLUSION

The purpose of this investigation was to use particle swarm optimization to isolate the diseased regions in COVID-19 X-ray pictures (PSO). Prior to further processing, the images were preprocessed with contrast bending and Discrete Wavelet Transform (DWT) methods to improve image quality. The infected region was subsequently segmented using PSO, and the findings were statistically examined. The findings confirmed that the suggested approach successfully isolated the contaminated region from COVID-19 X-ray pictures. The findings from this research have significant ramifications for the timely and correct identification of COVID-19, which is essential for controlling this infectious disease. As a diagnostic tool, the suggested approach may assist radiologists pinpoint contaminated areas in X-ray pictures caused by the COVID-19 virus.

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