Effective Deep Learning Methods and Feature Extraction for Improving Enhance and Efficient Covid-19 Chest Xray Images Classification.

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Abstract:

An outbreak of unidentified infections known as COVID-19 primarily affected the circulatory tract. The illness spreads throughout the entire world and eventually gets worse significantly declining population. The well developed & perfected Covid-19 prediction method is still debatable. In this article, we suggested using affordable lots of X-ray images scans to diagnose COVID-19 patients. The majority of healthcare facilities have access to X-ray imaging contrasted to other imaging techniques. By employing deep learning models CNN with the goal of analyzing its regular exponential behaviour as well as making predictions about the COVID-2019's potential reach across countries by using real-time data.We aim to enhance COVID-19 classification accuracy and efficiency. On the premise of accuracy, class specifications TP rate, FP rate, precision, recall, as well as F-measure, the suggested CNN is validated to other existing methods Naive Bayes, Support Vector Machine, Random Forest, as well as decision tree. The suggested method's accuracy is 99.07. percent. The improved accuracy of our model demonstrates its efficacy in aiding healthcare professionals and mitigating the spread of the disease.

Keywords: Covid-19 Prediction, Deep Learning, Covid-19 Testing, CNN.

I. INTRODUCTION

Earlier times were mostly marked by epidemics. Following a number of investigations, the first case of the Corona virus was found in 1960. Up until 2003, there were 500 recorded instances, which were all handled as the common flu. Many researchers believe the corona virus originated in bats, but it is uncertain how it was transmitted to humans. Hubei Province received notification from the first case in China on November 17, 2019. The virus began to spread slowly to large populations before spreading to the entire world [1].

There are approximately six different varieties of corona viruses, to be more precise. Severe Acute Respiratory Syndrome (SARS), one of six forms of respiratory illnesses that have been identified in humans to date, is well-known for raising body temperatures in its victims and frequently ending in death from rapid or progressive failure of the respiratory and gastrointestinal systems. The virus has a negative impact on the planet. More than 6.2 million people had been exposed to this virus as of June 5. With more than 105,000 deaths, the USA has the highest rate in all of America. Europe too took a huge impact. In the middle of June, Spain had the most patients. More than 6.2 million people had been exposed to this virus as of June 5. With more than 105,000 deaths, the USA has the highest rate in all of America. Europe too took a huge impact. In the middle of June, Spain had the most patients. The new wave of the Corona virus began by mostly affecting India in the Sub-Continent in western America by the middle of September and into October. Inaccurate viral forecasts had reduced the lockdown's effectiveness. Lack of widespread testing & delayed results in inaccurate forecasts[2]. Additionally, 37% of the results frequently turn out to be inaccurate. Accurately predicting the future day's viral load with precise timings and quickly identifying COVID are essential to stopping the spread of this virus.

On the other hand, DL makes medical optimizations worse. While a lot of user instructions are needed for ML, only a few instructions are needed for DL. First, a novel strategy has been developed to address the predicting problem. The COVID patients' registration forms had been gathered. Timings had already been observed precisely. Most likely, when a patient notices problems, they will come in for testing.

The organization of the paper is arranged as follows. In section II describes the Local Binary pattern. Section III contain the GLCM. Section IV gives the literature Survey. Section V contains the problem formulation and objectives. Section VI contains the results and discussion part. Finally, section VII ends the paper with conclusion followed by references.

II. LOCAL BINARY PATTERN

In a number of applications, such as texture classification and segmentation, image retrieval, or surface inspection, LBP features have excelled. By thresholding the 3-by-3 neighborhood surrounding every pixel with its centre pixel value and employing the result as a binary form, the original LBP operator identifies the pixels of a picture. A LBP computation example is shown in Figure 1.

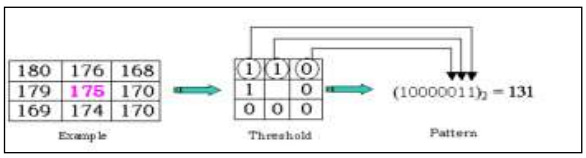
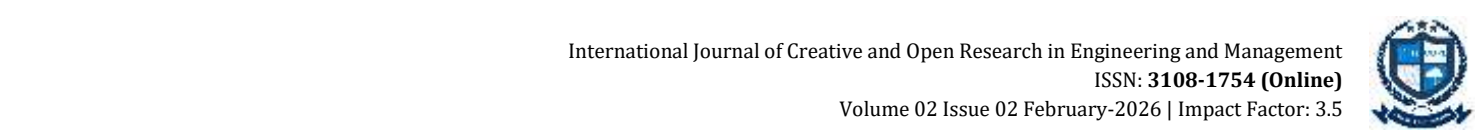


Figure 1. Example of LBP calculation [3]



An picture's tags generated across a 256-bin distribution could be utilized as a texture descriptor. Every histogram bin (LBP code) could be thought of as a little text on. These containers codify many kinds of curved edges, spots, flat surfaces, and other local primitives. Illustrations are shown in Figure 2.

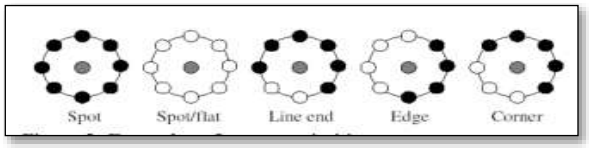


Figure 2. Examples of texture primitives [4]

Varying neighbor sizes are now taken into consideration by the LBP operator. As an illustration, the operators LBP4, 1 employs four neighbors, while LBP16, 2 takes into account sixteen neighbors on a radius of two. A neighborhood dimension of P evenly spaced pixel on a circle of radius R that constitutes a collection of circularly symmetric neighbors is generally referred to by the operators LBPP, R. In accordance with the 2P distinct binary patterns that can be created by the P pixels in the neighbor set, LBPP, R generates 2P distinct correct output. It has been demonstrated that some bins have a high data density than others. As a result, only a portion of the 2P LBPs can be used to represent the textured images. These basic patterns were described by [4] having a limited amount of bitwise transitions from 0 to 1 and vice versa. For instance, the transition between 00000000 & 11111111 is zero, but the transition between 00000110 and 01111110 is two, and so on. An LBP description is produced by grouping patterns with much more than two transitions into a single bin. The toleration for monotonic illumination changes and computation efficiency of LBP characteristics are its key characteristics.

III. Gray-Level Co-Occurrence Matrix (GLCM)

The technique for analyzing textures has advanced significantly in recent years and could be divided into four groups: statistical, geometrical, model-based, and signal analysis. Despite various statistical techniques, GLCM has been demonstrated to be one of the most successful methods to texture analysis[5]. The spatial distribution of an image's grey value and the frequency of grey occurrence pattern at particular angles and distances are both described by GLCM. GLCM can be used for texture categorization and identification. Haralick[4] developed the GLCM for texture analysis. N is the grayscale significant limitations, and N is the length of the GLCM matrix. The values of the matrix elements on (i,j) are each determined using the source grayscale image's numerical pattern, which must include a specific pattern. The supplied pattern provides grey pixels I & j next to each other at angle & length d. The variable d denotes the separation between two adjacent grayscale pixels, while the variable denotes the length of the discrete angle (00, 450, 90 0, 1350). the usual angle value for GLCM.

IV. LITERATURE SURVEY

Tahir et al.,(2021) features two layers. First Dimension: Using the registration slips from COVID-19 patients, a new technique of prediction has been devised. The native data set of COVID-19 patient registration slips has been used with ResNet-101. 5003 E-registration slips with precise timings are included in the database. In terms of timing, forecasting accuracy was 82%. It was decided how many COVID-19 positive instances would occur the following day. A framework for errors was also devised, using the juxtaposition of MOE and MAE. The COVID-19 chest X-ray prediction is part of the second Dimension. Chest X-ray data from 8009 was gathered locally. Three neural networks—Faster R-CNN, Mask-CNN, or ResNet-50—were suggested to be at fault. The best accuracy is displayed by faster R-CNN at 87%. Mask RCNN's accuracy came up at 83%, whereas resNet-50's was 72%. ACC, PRC, or RCL were used as performance criteria. The addition of the batch normalizing method enhanced SVM performance.

Mohammed Akram et al., (2024) This study focuses on COVID-19 classification from Chest Xray images, employing an innovative approach: adapting the Xception model into a U-Net architecture via theSegmentation_Models package. Leveraging deep learning and image segmentation, the U-Net architecture, a

CNN variant, proves ideal for this task, particularly after tailoring its output layer for classification. By utilizing the Xception model, we aim to enhance COVID-19 classification accuracy and efficiency. The results demonstrate promising autonomous identification of COVID-19 cases, offering valuable support to healthcare professionals. The fusion of medical imaging data with advanced neural network architectures highlights avenues for improving diagnostic accuracy during the pandemic. Notably, precision, recall, and F1 scores for each class are reported: Normal (Precision = 0.98, Recall = 0.9608, F1 Score = 0.9704), Pneumonia (Precision = 0.9579, Recall = 0.9579, F1 Score = 0.9579), and COVID-19 (Precision = 0.96, Recall = 0.9796, F1 Score = 0.9698).

Nour et al.,(2021) From patients' chest X-ray pictures, DL algorithms have been utilised to identify COVID-19 sick patients (CXR). ResNet, GoogleNet, or AlexNet, three well-known CNNs, were used to remove features from the database. Additionally, the principle component analysis (PCA) method was applied, which further decreased the dataset's dimensionality. To detect COVID-19 disease from the photos, the collected features were fed into classifiers like SVM and KNN. With KNN & SVM, the suggested technique had an accuracy level of 97.7% & 98.1%, respectively. The model's sensitivity and specificity were calculated to be 97% and 98%, correspondingly, demonstrating the model's effectiveness in accurately diagnosing the condition.

Sravan Kiran Vangipuram et al., (2025) This research proposes a novel feature extraction method to extract representative features from medical images, combining extracted features with original image pixel features. Additionally, we propose a new method that uses data values from Andrews's curve function to transform chest x-ray images into spectrograms. The spectrogram images are believed to aid in distinguishing near-similar medical images, such as COVID and pneumonia. The study aims to build an efficient machine learning system that applies the proposed feature extraction method and utilizes spectrogram images for distinguishing nearsimilar medical images. For experimental analysis, we have used the award winning Kaggle Chest Radiography image dataset. The test results show that among all machine learning classifiers, the logistic regression classifier could correctly distinguish COVID and pneumonia images with a 97.18% test accuracy, a 98.34% detection rate, a 97.8% precision rate, and an AUC value of 0.99 on the test dataset. The machine learning model has learned to distinguish between medical images that appear similar using features found through the proposed feature extraction and spectrogram images. The results also proved that the proposed approach using XGBoost has outperformed state-of-the-art models in recent research studies when (i) binary classification is performed using COVID-19 and Normal Chest x-ray images and (ii) multiclass classification is performed using Normal, COVID and Pneumonia Chest x-ray images.

Samiul et al.,(2021) examined how well COVID-19 diagnosis using SSL from chest X-ray pictures worked. In order to train our SSL algorithm in the teacher/student typology, we looked at a prepossessing method that involved extracting and combining local phases picture features into multi-feature images. Our research has demonstrated that the SSL method achieved 93.45% accuracy while using 17.0% of the total dataset for training. We also offer metrics that contrast the SSL method to other fully supervised methods.

Duaa F. Eljamassi et al.,(2020) provided a classification approach that uses the chest X-ray pictures to identify the diseased state. Images from chest x-rays of healthy individuals, patients with pneumonia caused by SARS, streptococci, or pneumococcus, as well as additional COVID-19 patients, were gathered in a database. The extraction of visual features is performed using a histogram of oriented gradients (HOG). SVM, RF, KNN are then used to classify the photos, with classification rates of 98.14%, 96.29%, & 88.89%, etc. These findings might be useful in accurately diagnosing COVID-19 disease.

Shubham Mathesul et al.,(2023) In this research paper, we propose a deep learning (DL) approach based on Convolutional Neural Networks (CNNs) to enhance the detection of COVID-19 and its variants from chest X-ray images. Building upon the existing research in SARS and COVID-19 identification using AI and machine learning techniques, our DL model aims to extract the most significant features from the X-ray scans of affected individuals. By employing an explanatory CNN-based technique, we achieved a promising accuracy of up to 97% in detecting COVID-19 cases, which can assist physicians in effectively screening and identifying probable COVID-19 patients.

This study highlights the potential of DL in medical imaging, specifically in detecting COVID-19 from radiological images. The improved accuracy of our model demonstrates its efficacy in aiding healthcare professionals and mitigating the spread of the disease.

V. PROPOSED WORK

The year 2020 will certainly be remembered in human history as the year in which humans faced a global pandemic that drastically affected every living soul on planet earth. The COVID-19 pandemic certainly had a massive impact on human's social and daily lives. The economy and relations of all countries were also radically impacted. Due to such unexpected situations, healthcare systems either collapsed or failed under colossal pressure to cope with the overwhelming numbers of patients arriving at emergency rooms and intensive care units. The COVID -19 tests used for diagnosis were expensive, slow, and gave indecisive results. Unfortunately, such a hindered diagnosis of the infection prevented abrupt isolation of the infected people which, in turn, caused the rapid spread of the virus. As per the literature review, author proposed the use of cost-effective X-ray images in diagnosing COVID-19 patients. Compared to other imaging modalities, X-ray imaging is available in most healthcare units. Deep learning method is used for feature extraction and classification by implementing a multi-stream convolutional neural network model. The model extracts and concatenates features from its three inputs, namely; grayscale, local binary patterns, and histograms of oriented gradients images. Major drawback of traditional detection system is that features were extracted by using the Histogram of oriented gradients (HOG), which no doubt is providing good results. However, HOG has a major disadvantage that they are highly sensitive to image rotations. Due to this reason, HOG feature extraction is not recommended for classification phases where images rotate.

Objectives

1. To propose a Hybrid LBP and GLCM feature extraction technique for enhance pre-processing.
2. To implement an effective deep learning method to improve classification.
3. To perform an analysis and comparison of the proposed scheme

VI.RESULTS

MALTAB is used because it has been highly validated simulation software by the networking research community.

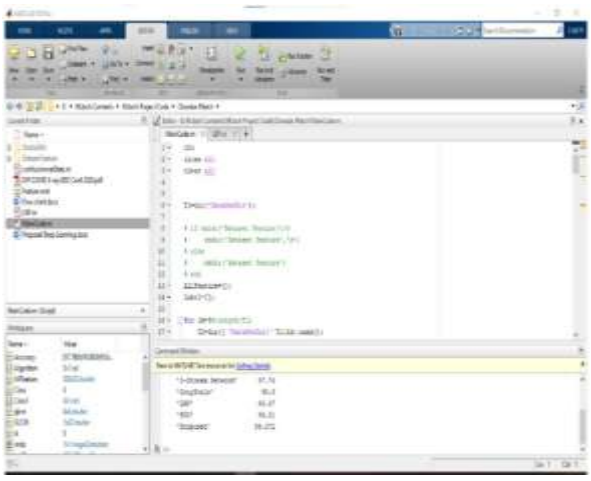


Figure 3: MATLAB

In figure 4, We use a original image of chest x-ray for the research.

Figure 4: Original Image

The Local Binary Pattern (LBP) texturing operator labels every pixel in an image by thresholding its immediate surroundings and treating the result as a binary number. The LBP texture operator has gained popularity as a strategy in many areas due to its discriminative power & computational simplicity.

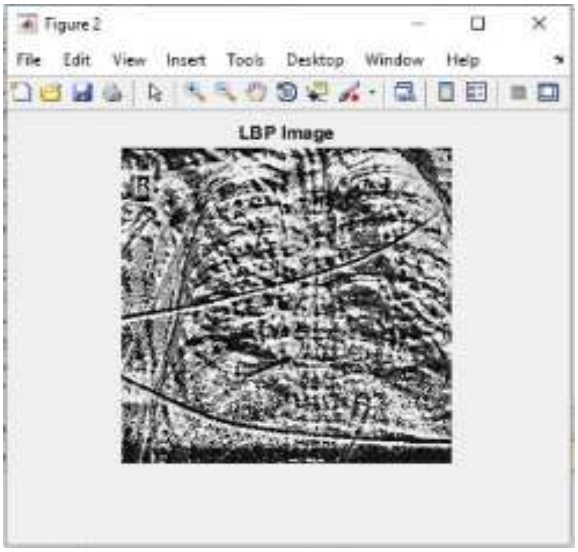


Figure 5: LBP Image

Accuracy: The most popular measure for classification performance is accuracy. Accuracy is calculated by dividing the set of correctly classified instances by the total number of samples, whereas error rate is calculated by dividing the set of incorrectly classified instances by the set of correctly classified instances.

Accuracy = (True Positive + True Negative)/(True Positive + False Positive + True Negative + False Negative)

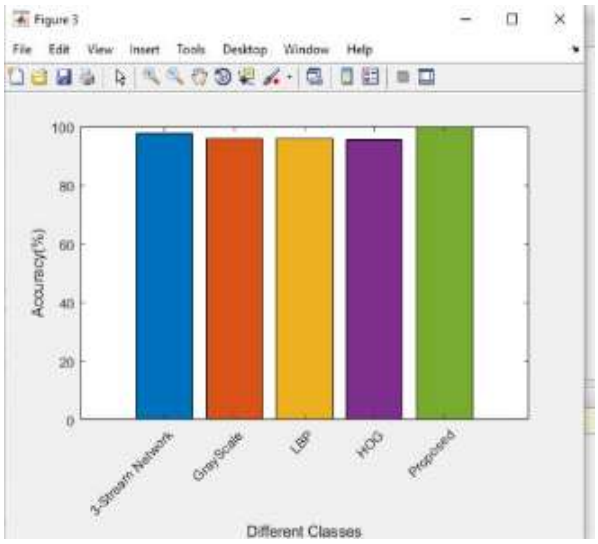


Figure 6: Accuracy

It is clear from figure 6 that the proposed technique has a higher accuracy 99.07 % as compared to other existing techniques.

Specificity: A model's ability to predict true negatives for each available category is measured using the specificity metric.

Specificity =True Negative/ (True Negative + False Positive)

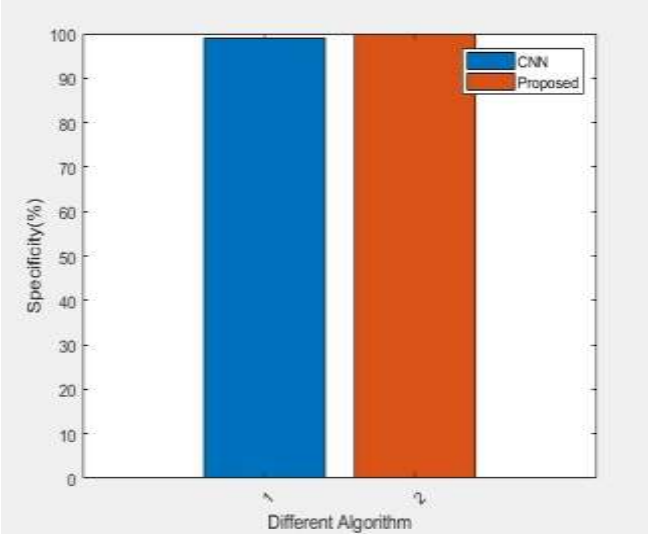
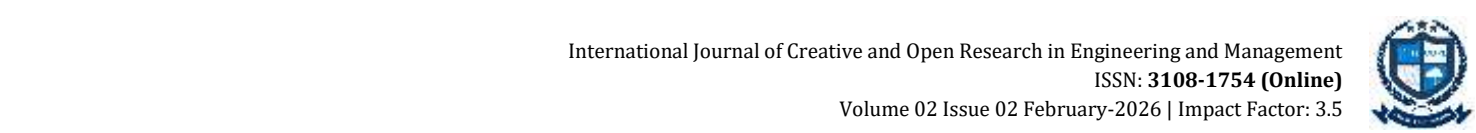


Figure 7: Specificity

It is clear from figure 7 that the proposed technique has higher specificity 100% as compared to CNN

Precision & recall: These are two metrics commonly used to evaluate performance in text classification as well as other text mining fields such as information retrieval. These variables are utilized to determine preciseness as well as correctness.



Precision = (True Positive)/ (True Positive +False Positive)

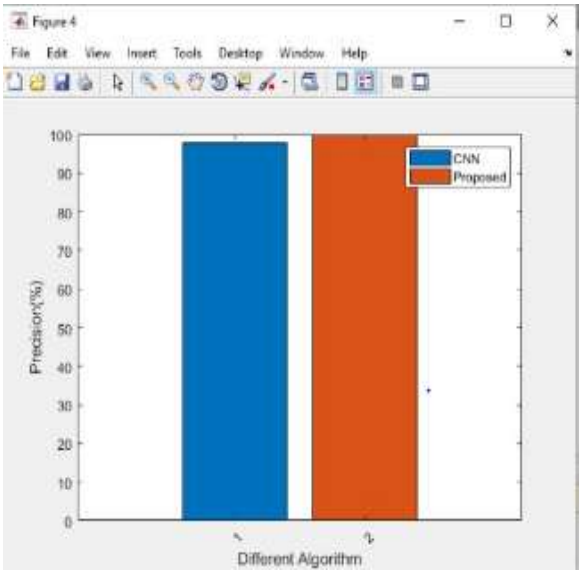


Figure 8: Precision

From figure 8 and 9 shows the proposed approach has precision 100 % and highest recall as compare to the CNN.

Recall = (True Positive)/ (True Positive + False Negative)

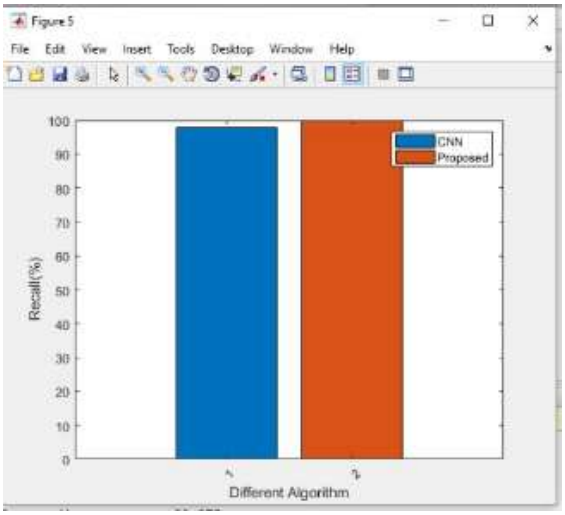
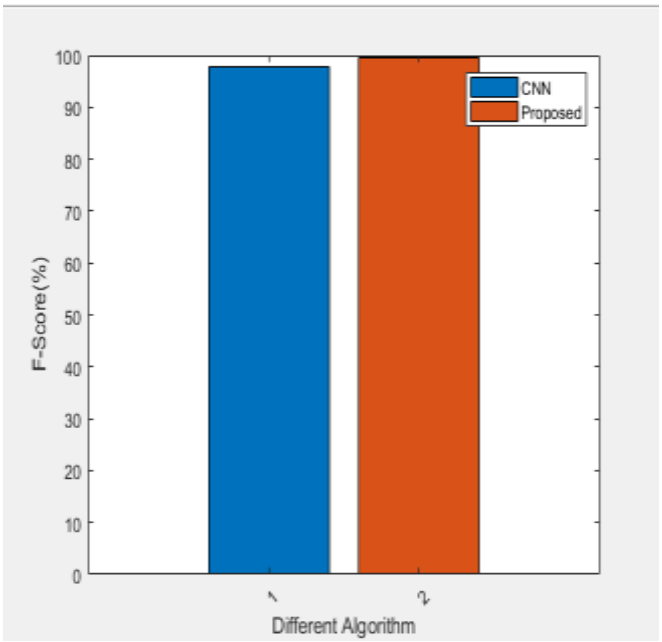


Figure 9: Recall



F1- Score: It is the result of weighing the means of Precision and Recall**.**

$$F1-Score = 2 * \frac{((Precision * Recall)}{((Precision + Recall)}$$

Figure 10: F1-Score

From the figure 10 we can seem that suggested approach has higher F1- Score as compared to CNN.

VII.CONCLUSION

A speedy & accurate identification of COVID-19 is made possible by effective SARS-CoV-2 screening, which can also lessen the strain on medical systems. There have been built forecasting model that assess the likelihood of infection by combining a number of parameters. These are intended to help medical professionals worldwide prioritize patients, particularly when there are little healthcare resources available.

This result paper proposes a effective deep learning methods and feature extraction for improving enhance and efficient COVID-19 chest x-ray images classification. On the premise of accuracy, class specifications TP rate, FP rate, precision, recall, as well as F-measure, the suggested CNN is validated to other existing methods Naive Bayes, Support Vector Machine, Random Forest, as well as decision tree. The suggested method's accuracy is 99.07 percent. The findings obtained demonstrate that the suggested approach outperforms the other methodologies across all performance variables.

For future work, more optimization technologies will be integrated to decrease the time complexity in addition to reducing the classifier construction time. Certain ensemble methods, like Adaboost, Bagging, as well as Stacking, could also be used to improve the outcomes.

REFERENCES

1. Zoabi, Y., Deri-Rozov, S., & Shomron, N. (2021). Machine learning-based prediction of COVID-19 diagnosis based on symptoms. Npj Digital Medicine, Vol. 4, No. 1,2021.
2. Gozes, O. et al. Rapid AI development cycle for the coronavirus (COVID-19) pandemic: initial results for automated detection & patient monitoring using deep learning CT image analysis. arXiv e-prints, 2020.

3. Lahdenoja, O., Poikonen, J., & Laiho, M., " Towards understanding the formation of uniform local binary patterns.", ISRN Machine Vision, 2013.
4. Hu, Y., Zhao, C. X., & Wang, H. N., "Directional analysis of texture images using gray level co-occurrence matrix", In Computational Intelligence and Industrial Application, PACIIA'08. Pacific-Asia Workshop on (Vol. 2, pp. 277-281). IEEE,2008.
5. Tahir, H., Iftikhar, A., & Mumraiz, M. (2021). Forecasting COVID-19 via Registration Slips of Patients using ResNet-101 and Performance Analysis and Comparison of Prediction for COVID-19 using Faster R-CNN, Mask R-CNN, and ResNet-50. International Conference on Advances in Electrical, Computing, Communication and Sustainable Technologies (ICAECT),2021.
6. Ayesh Meepaganithage; Mgnas Fernando, "Detecting COVID-19 Pneumonia using Chest X-rays through Deep Learning Techniques", 2nd International Conference on Advanced Research in Computing (ICARC),2022.
7. Nour Haj Hammadah; Nilima R. Das; Mamata Nayak; Tripti Swarnkar, "A hybrid approach of Deep Learning Algorithms for Identification of COVID-19 disease using Chest X-Ray Images", International Conference in Advances in Power, Signal, and Information Technology (APSIT),2021.
8. Rohan Tomar, Abhilasha Sharma, "Analysis & Detection of COVID-19 on Chest X- Ray Images based on Support Vector Machines", International Conference on Sustainable Computing and Data Communication Systems (ICSCDS),2022.
9. Samiul Haque; Mohammad Akidul Hoque; Mohammad Ariful Islam Khan; Sabbir Ahmed, "COVID-19 Detection Using Feature Extraction and Semi-Supervised Learning from Chest X-ray Images", IEEE Region 10 Symposium (TENSYMP),2021.
10. Duaa F. Eljamassi; Ashraf Yunis Maghari, "COVID-19 Detection from Chest X-ray Scans using Machine Learning", 2020 International Conference on Promising Electronic Technologies (ICPET),2020.
11. Mohammed Akram,"Diagnosis of COVID-19 in X-ray Images using Deep Neural Networks", (IRJMT),2024.
12. Shubham Mathesul,"COVID-19 Detection from Chest X-ray Images Based on Deep Learning Techniques", (Algorithms),2023.
13. Enas M. F. E,"COVID-19 detection from chest X-ray images using transfer learning",(Scientific Reports),2024.
14. Chih-TaYen ,"Lightweight convolutional neural network for chest X-ray images classification",(Scientific Reports),2024.