International Journal of Advance Research in Science and Engineering
Volume No. 11, Issue No. 06, June 2022
www.ijarse.com
IJARSE
ISSN 2319 - 8354

CNN based deep learning technique for COVID-19 chest X-Ray diagnosis to find abnormality

Prof. Tejaswini Upadhye[1], Prof. Smita Kadam[2],
Prof. Dr. (Mrs.) V. Jayashree[3]
[1,2] Asst. Professor, Department of Electronics & Telecommunication Engineering,
ATS SBGI MIRAJ, pan INDIA
[3]Professor, Department of Electronics Engineering, DKTE, Ichalkaranji, pan INDIA

Abstract

Coronavirus (COVID-19) disease is an infectious disease caused by Coronavirus2, a new and fatal pneumonia strain (SARS-CoV-2). Strict requirements and a limited supply of RT-PCR kits for the laboratory setting cause delays in correct patient diagnosis, and the test itself takes 4-6 hours to complete. To address this issue, radiological images such as chest X-rays and CT scans may be the answer for quickly and effectively testing the COVID-19 infection.

The goal of this study is to develop a robust deep learning model that can categories chest X-ray images into COVID-19 and normal cases using convolutional neural networks (CNNs). The proposed model is designed to give accurate binary categorization detection (Normal vs. COVID-19). This paper presents an effective architecture for COVID-19 diagnosis based on X-ray datasets obtained from websites and X-Ray centers to investigate COVID-19 cases in India and throughout the world.

The suggested CNN model is used to extractfeatures by deep learning and is compared to the Support Vector Machine (SVM). The proposed model can classify COVID-19 images with good accuracies of 93.06 percent and 90.28 percent for the globally available dataset and for the Indian scenario, respectively, according to CNN Simulation results.

Keywords:*Convolution Neural Network, Dataset, Deep Learning, Support vector machine, X-Ray Images*

I INTRODUCTION

COVID-19, is a current critical medical problem worldwide. In Wuhan, China it was first reported and mostly affects human respiratory system. COVID-19 is caused by a virus condition known as SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2). Coronaviruses (COV) is broad a viral family that causes sickness including Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome as it results of colds (SARS-CoV). The World Health Organization (WHO) designated the rapid global growth of coronavirus disease in 2019. They announced COVID-19 as a epidemic on March 11, 2020, and urged for immediate international action in four important areas: awareness, detection, protection, and treatment; for transmission reduction.

COVID-19 has caused more than 33.1 million illnesses and 998 thousand deaths worldwide. Respiratory symptoms such as fever, cough, and dyspnea are signs of infection. The contamination can lead to multi-organ failure, pneumonia, septic shock, severe acute respiratory syndrome and death in more serious cases. Older individuals and children have a high death rate, which is a major risk factor for community transmission. The main symptom of this disease is difficulty breathing, which can develop to acute Pneumonia. Social isolation is one of the most effective ways to prevent community spread, yet the only means to detect a respiratory infection is with a chest X-ray. Doctors can detect the presence of a respiratory disease via a chest X-ray. Because COVID-19 is contagious, a quick and safe screening approach is required to treat the infected patient as soon as possible.

Traditional COVID-19 swab tests need specific testing facilities, personal protective equipment (PPE) for health care professionals, and sanitising equipment. Because the costs and efforts of healthcare practitioners involved in all of this screening are so high, we must consider a different screening strategy, such as an X-Ray-based approach. In this pandemic situation worldwide doctors are already burdened in many tasks, which creates fatigue in health care workers due to continuous work. It is necessary to find the infected cases earlier to minimize community transmission, by to automating the screening process. So in this direction Deep learning Model designed for finding abnormalities chest X-Ray of COVID-19 infected patients is a great choice to correctly and quickly test for the risk of disease.

To achieve this, a dissertation describes the work carried out on chest X-Ray of COVID-19 infected cases for automatic diagnosis using CNN based deep learning. The current theories and practise are differentiated in the literature review in order to understand and construct a model based on CNN for diagnosis of COVID-19 with high accuracy and suitable performance parameters.

II SYSTEM ARCHITECTURE

Image pre-processing, which includes image scaling, gamma correction, grey conversion, and segmentation, is the first step in the suggested architecture. The suggested CNN model is used to extract deep features and is compared to the Support Vector Machine (SVM). The proposed model can classify COVID-19 images with good accuracies of 93.06 percent and 90.28 percent for the globally available dataset and for the Indian scenario, respectively, according to CNN Simulation results. The processing time, accuracy, sensitivity, confusion matrix, Receiver Operating Characteristic (ROC) curve, and specificity are the performance metrics. The findings show that CNN-based deep learning is an effective technique for early COVID-19 identification, since it allows automatic detection with high reliability, assisting healthcare professionals and preventing the pandemic from spreading further.

IJARSE
ISSN 2319 - 8354

III PROPOSED SYSTEM

3.1 The block diagram for the proposed COVID-19 chest X-Ray diagnosis using CNN based deep learning technique is as illustrated in fig. 3.1 below;

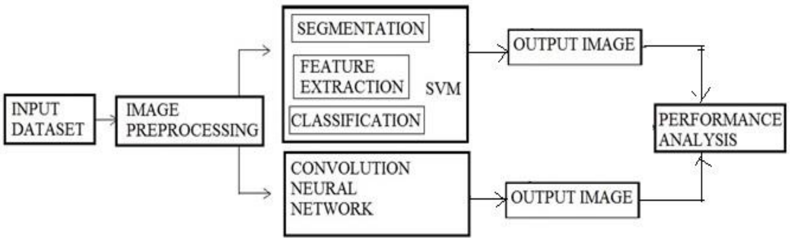


Fig. 3.1 : Block Diagram of proposed system

The above Fig. 3.1 shows a generalized block diagram for proposed dissertation work. The block diagram is basically divided into 5 main blocks as i)Input dataset ii)image preprocessing iii)SVM iv)CNN based diagnosis & v)Performance Analysis. To understand the theoretical background of the proposed work we have to understand the theoretical concepts for Image Preprocessing & Feature extraction, SVM, CNN & Performance analysis parameters which are explained in the further sections.

3.2. Image Preprocessing & Feature Extraction

The proposed system basically works with medical images i.e. X-Ray images which should be enhanced qualitatively and quantitatively to abstract features of the particular image. For medical images texture feature are playing important role and can be calculated using GLCM matrix. There are various image preprocessing techniques from which we used i. Image resizing, ii. Gamma Correction, iii. Grey Conversion & iv. Segmented mask generation for further feature extraction. The basic theory behind each image processing technique is explained further;

3.3. Convolution Neural Network

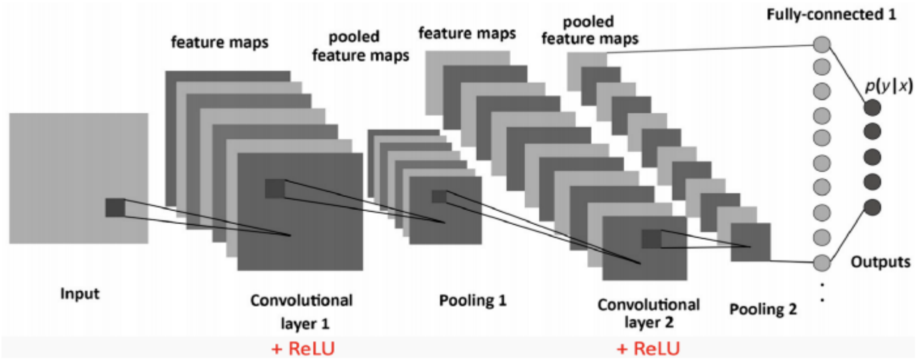


Fig. 3.2. CNN LeNet Architecture

ConvNets or CNNs (Convolutional neural networks) is most common types of neural networks. CNN is used to identify and categorize pictures. CNNs are commonly utilised in domains like face recognition, object detection and so on.

To train and assess models of deep learning CNN , each input image is going through a sequence of convolution layers using Kernels, filters, Pooling, FC (fully connected layers), as well as the Softmax function to categorize an object by probabilistic values having range from 0 to 1.

3.4. Performance Analysis Parameters

The following parameters are used to calculate the performance of the designed system:

To interpret the parameters listed below, first understand the confusion matrix.

Confusion matrix: It's a performance matrix for classification tasks using machine learning and two or more classes as output.

Predicted Values \ Actual Values	Positive (1)	Negative (0)
Positive (1)	TP	FP
Negative (0)	FN	TN

Fig. 3.3Confusion Matrix

It's ideal for determining precision, specificity, and accuracy. Let us understand the TP, TN, FP, FN terms:

True Positive: Perception: You predicted that it would be positive, and you were correct.

True Negative: Perception: You correctly anticipated negative.

False Positive: (Type 1 Error) Perception: You expected something positive, but it turned out to be untrue.

False Negative (False Negative): (Type 2 Error) Perception: You projected a negative outcome, but it was incorrect.

Performance is calculated using these terms by measuring a) Accuracy b)Sensitivity and c)Specificity, as described below.

a. **Accuracy** – It is the extent of the accurately entitled subjects to the whole pool of subjects. Accuracy is the most intuitive one.

$$\text{Accuracy} = \frac{(\text{ True Positive rate} + \text{True Negative rate })}{(\text{True Positive} + \text{False Positive} + \text{False Negative} + \text{True Negative}) \quad \text{Rate}}$$

b. **Sensitivity-** It's also referred as the true positive rate, and it's a metric for how many actual positives are correctly identified.

Sensitivity = TP/(TP+FP+FN+TN)

IJARSE
ISSN 2319 - 8354

c. **Specificity** – It is the accurately negative entitled by the program to all who are healthy in reality.

Specificity = TN/ (TN+FP)

The performance of the designed system is calculated by using parameters mentioned above and attached in further section. The actual methodology of implementation is explained further in the next section which explains workflow organization, data base preparation and platform on which our proposed work is implemented.

IV RESULT ANALYSIS (FIGURES & TABLES)

The overall result of 4 steps of image preprocessing on healthy as well s COVID-19 positive x-ray is as shown in fig. 4.1.

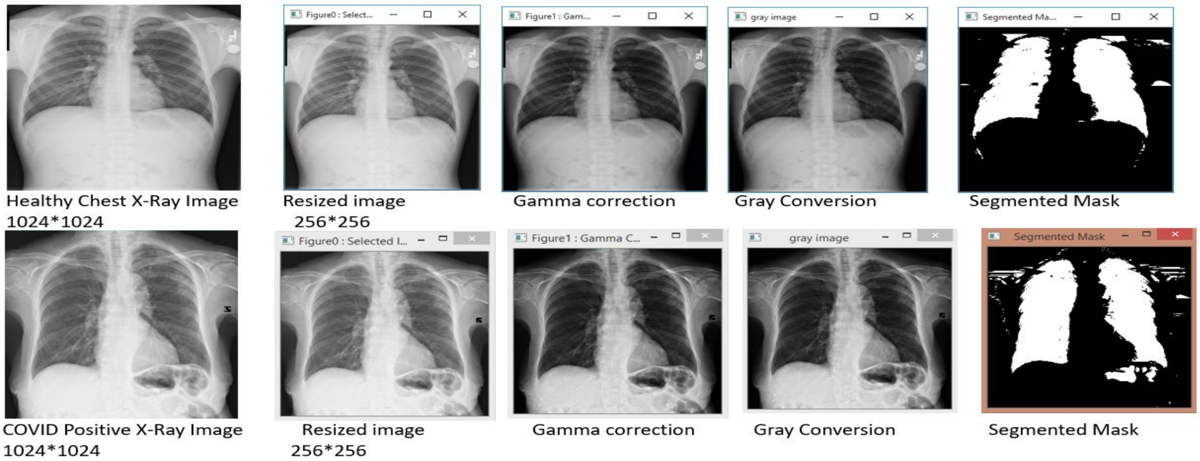


Fig. 4.1: Image pre-processing Results

Preprocessed X-Ray images are then subjected for detection of region of interest in next step.

A region of interest (ROI) in the mask image, pixels that belong to the ROI are set to 1 and pixels outside the ROI are set to 0. The segmented mask generation result image is masked with grey converted image. The results obtained are as shown in the Fig. 4.2 where healthy chest X-Ray & COVID positive chest X-Ray images are masked respectively.

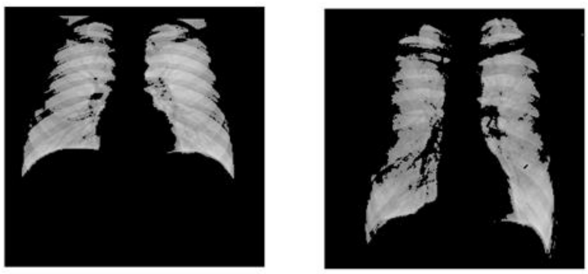


Fig. 4.2: Results after ROI finding for Healthy and COVID-19 Positive case

The preprocessed image is subjected to CNN for Result findings.

We used LeNet Architecture for Implementation of the CNN. The input to the LeNet is preprocessed images ,the Implemented CNN contains 2 max pooling layer, 2, Convolution layers. The flowchart for CNN Implementation is as shon in Fig. 5.18. The dtset is divided into two parts consisting of image 60% images for training & remaining 40% images for testing.

Flowchart for CNN Implementation:

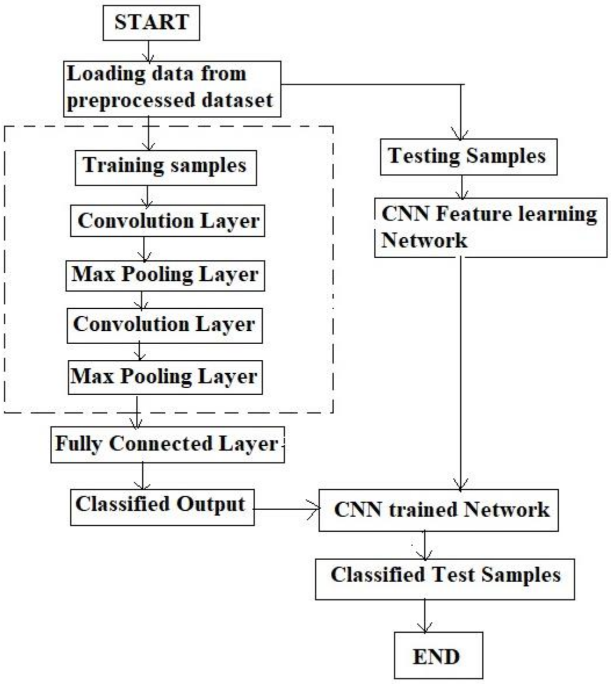


Fig. 4.3 : Flowchart for CNN Implementation

The two sets of CNN functions applied on chest X-Ray images that helps in extraction of useful feature in the X-Ray image fully connected layer for classification. Using the CNN trained network the test X-Rat images are tested.

CNN Configuration:

CNN Configuration for COVID-19 chest X-Ray diagnosis using CNN based deep learning technique is as further,

i. Trained network choosen – LeNet
ii. No. of Epoch set – 100
iii. Error set - 1e-3 (0.001)
iv. Strides set – 2
v. Pooling -Max pooling used, of size 2*2
vi. No. of CNN layers – 2 (Each convolution layer has convolution layer, Max pooling layer and output layer)
vii. Output function used - Sigmoid

Result & Discussion on CNN Implementation:

The division of the dataset into training & testing images is as shown in Table 5.2.

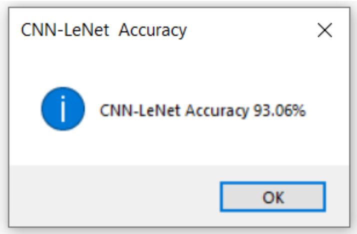
Table 4.1 : Data set division

 IJARSE
ISSN 2319 - 8354

Dataset / Total Image	No. of samples	
	Training	**Testing**
1	**54**	**36**
2	**54**	**36**
3	**131**	**72**

a. CNN Classifier result for Dataset 1,2:

The figure 5.19 shows the accuracy of the implemented CNN testing containing Images form Github& Kaggle. Fig. 5.20 shows confusion matrix for dataset 1,2. And Fig. 5.21 shows the ROC Curve of testing for the same dataset.



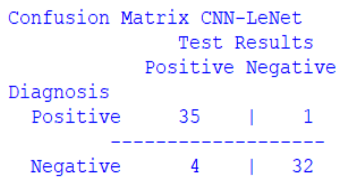


Fig. 4.4 CNN Accuracy for dataset 1&2 4.5 CNNConfusion matrix for dataset 1,2.

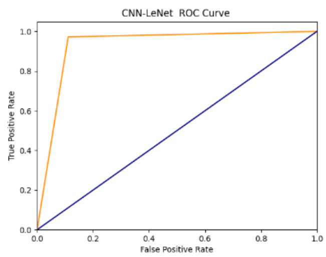
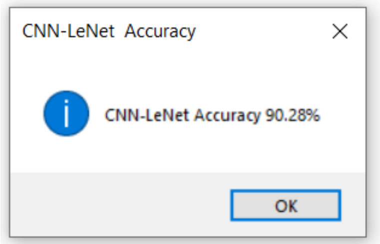


Fig: 4.6 ROC Curve for Dataset 1&2

The Accuracy Sensitivity & Specificity of testing for COVID-19 chest X-Ray image is calculated by reffering the equations for accuracy sensitivity & specificity from Section 3.5 of Chapter 3 and got resuts for Accuracy, sensitivity & Specificity as 93.06%, 0.97 and 0.89 respectively for datset 1,2.

b. CNN Classifier result for Dataset 3:

The figure 5.22 shows the testing accuracy of the implemented CNN containing Images form Vedh Diagnostic & Research Centre, Sangli for Indian Scenario. Fig. 5.23 shows the CNN matrix for dataset 3 and Fig. 5.24 shows ROC Curve for the same.



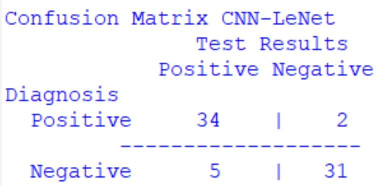


Fig. 4.7 CNN testing Accuracy for dataset 3 Fig. 4.8 Confusion matrix for dataset 3

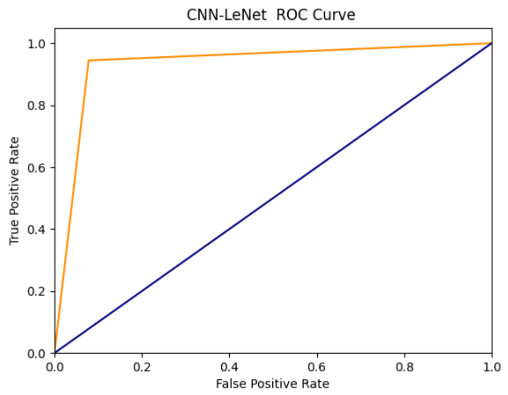


Fig: 4.9 ROC Curve for Dataset 3

The Accuracy Sensitivity & Specificity of testing for COVID-19 chest X-Ray image is calculated by reffering the equations for accuracy sensitivity & specificity from Section 3.5 of Chapter 3 and got resuts for Accuracy, sensitivity & Specificity as 90.28%, 0.94 and 0.86 respectively for datset 3.

The result analysis for finding the best suited trining parameters is as described in Section 5.6 of the dissertation.

Result Analysis:

Table4.2 : Testing Result of CNN Implementation by varying batch size

Sr. No.	**Epoch**	**Batch Size**	**Number of images**	**Accuracy**
1	50	1	180	91.34%
2	50	32	180	91.07%
3	**100**	**1**	**180**	**93.06%**
4	100	32	180	90.28%
5	150	20	180	92.41%
6	200	20	180	92.36%
7	500	32	180	92.89%

It is found from CNN experimentation The designed CNN Based DL For COVID-19 Chest X-Ray Diagnosis for Finding abnormality have testing accuracy ranges between 90.28% to 93.06%. To study the performance of the testing CNN various parameters of CNN training are varied such as batch size, Epoch as well as no. of Images and the Results obtained are mentioned in the Table no. 4.2. We are getting maximum accuracy as 93.06% for Epoch-100, batch Size -1, & No. of Images 180.

V CONCLUSION

CNN's detection and diagnosis of COVID-19 at an initial stage The basic measures in avoiding disease and pandemic progression are to use evidence-based DL approaches with the least expense and complications. By applying the SVM Classifier and convolutional neural network (CNN) along with the Result comparison, this work built and developed an intelligent system for the COVID-19 identification with high accuracy and minimal complexity. The accuracy obtained for the designed SVM and CNN for Dataset Image base is 86.11% & 93.06% respectively. The accuracy of classification for the dataset collected (from Vedh Diagnostics & Research Centre,sangli) dataset 3, is having 84.34% accuracy for SVM whereas 90.28% accuracy for CNN.

REFERENCES

[1] Yujin Oh, Sangjoon Park, and Jong Chul Ye, "Deep Learning COVID-19 Features on CXR Using Limited Training Data sets,"IEEE transactions on medical imaging, vol. 39, no. 8, August 2020.

[2] Rubin, G. D. et al "The role of chest imaging in patient management during the COVID-19 pandemic,", fleischner society of Radiology, April2020.

[3] I. D. Apostolopoulos and T. A. Mpesiana, "Covid-19: Automatic detection from X-ray images utilizing transfer learning with convolutional neural networks," Phys. Eng. Sci. Med., Apr. 2020.

[4] L. Wang and A. Wong, "COVID-net: A tailored deep convolutional neural network design for detection of COVID-19 cases from chest X-ray images," May2020

[5] A. Narin, C. Kaya, and Z. Pamuk, "Automatic detection of coronavirus disease (COVID-19) using X-ray images and deep convolutional neural networks," arXiv: 2003.10849.

[6] P. K. Sethy, S. K. Behera, "Detection of Coronavirus Disease (COVID-19) Based on Deep Features," no. 2020030300, 2020.