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Detection Covid-19 Based on Chest X-ray Images Using Convolution Neural Networks

Sufyan Othman Zaben[1], Akbas Ezaldeen Ali[2]

[1,2]Department of Computer Science, University of Technology, Baghdad, Iraq

[1]cs.19.38@grad.uotechnology.edu.iq, [2]110034@uotechnology.edu.iq

Abstract **---** *Covid-19 is a deadly virus that has spread worldwide, causing millions of deaths. Chest X-ray is one of the most common methods of diagnosing the infection of Covid - 19. Therefore, this paper has presented an efficient method to detect Covid-19 through X-rays of the chest area through a Neural convolution network (CNN). the proposed system has used a convolution neural network to classify the extracted features. Since CNN needs a set of data defined for training and testing, the proposed method used a public dataset of 350 pneumonia x-ray images, 300 viral images, and 350 normal images for evaluation. Besides, the proposed work achieved a satisfactory accuracy of 95% based on the X-ray image.*

Index Terms-- *Covid-19, chest X-ray, Neural convolution network, deep learning.*

I. INTRODUCTION

Many health authorities have recently indicated an interest in various issues, including Healthcare, the Internet of Medical Things [1-4], medical image cryptography, and medical image recognition. Coronavirus infection (COVID-19) pandemic has altered how health care was given, impacting many of the health care system's structural difficulties. Currently, everyone's attention is focused on these issues [5 -9]. The covid-19 virus was discovered in Wuhan, China. The World Health Organization (WHO) declared that the coronavirus disease (covid-19) is pandemic in February 2019. However, in March 2021, more than 127 million cases of COVID-19 had been registered in more than 223 countries, resulting from a round of 2,796,000 deaths. [10-13]. The rapid spread of the pandemic has triggered an alarm in all countries throughout the world, encouraging all scientists and researchers to go on high alert to develop acceptable measures to control the spread of this disease [10-14].

The virus is spread primarily through small droplets formed by people nearby talking, coughing, and sneezing. The droplets do not fly long detachments through the air, landing on surfaces or ground. There was no proof of airborne virus in a sample of thousands of cases in China. But by touching a contaminated surface or object and then touching the face, a person may become infected. The virus can spear even still no signs are present. A deep learning framework has been used to implement the characteristics of minimal pattern and low-variance features from real-valued time series, resulting in image power featuring. The convolutional neural network (CNN) was used as one of the Deep Learning (DL) architectures. Because of its powerful feature extraction illustration, the CNN was commonly used in the medicinal lawn. [15-17].

The paper was planned in sections where section 2 gives related work; section 3 shows the proposed system performance. Section 4 evaluates the proposed system's results, while Section 5 presents the best conclusions.

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II. RELATED WORK

Several researchers have focused on Covid- 19. Pneumonia causes a study Bhandary [18] AlexNet over individual two sets of normal and covid-19 done accurateness 93 percent has offered two different methods for organizing lung pneumonia, and tumor chest images In other work J. Zhang [19], intelligent deep learning was provided for categorizing X-Ray images across only double classes. Normal and covid-19 since 70 instances through 94 % accurateness. K. Hammoudi's [20] dense-Net-based CNN was intended to check chest imageries in 13,645 tasteless suitcases for individuals with an accuracy of 92%. In another study Mahdi, and Mohammed Salih [21] proposed a convolutional neural network (CNN) ("sars, covid-19, mers, ards, normal") are five modules. The practical outcomes for estimating the testing set indicate the advised Scheme of the CNN classifier through an accurateness of 98%. Wang, L [22]. Deep learning" based approaches have been applied to the study of changed forms of lung disease, including deep learning for detecting pneumonia instead of doing something new, select to use Chex-NG, which achieved 93.3%, T. Ozturk [23] proposed over recent years for medical image classification. Specifically, the procedure called transfer learning was adopted. With transfer learning, Harshvardhan gm [24] employs convolutional neural networks (CNNs) of varying configurations on a machine learning-based binary classification task with a given dataset of chest X-rays that depicts affected and unaffected cases of pneumonia.

III. RESEARCH AND METHODOLOGY PROPOSED SYSTEM

The system's primary aim is to discover the normal representations of the variations that can be presented in a group of medical images with an abnormal condition as their origin.

A. Convolutional Neural Network (CNN)

An artificial neuron is known as a purpose that accepts performs with vectors as inputs, nonlinear changes on them, and outputs a value. After every neuron in the previous layer has been connected to every neuron in the current layer, a Deep Neural Network is constructed by stacking these neurons collected hierarchically. This architecture works fine with level data but is inappropriate for computer vision problems involving images. Because the computational total and memory requirements skyrocket as the image size grows, this method is not scalable. The most widely used Deep Neural Networks for computer vision tasks are Convolutional Neural Networks (CNNs). Images are fed into CNNs, which sieves them using convolutional operations to produce the last vector that encapsulates everything in the image's information stimulating features. The vector determination is fed into a sequence of Fully Connected Layers for classification. There are only 280 parameters in a layer of ten 3x3x3 filters. This number remains constant as the input image grows, allowing for the training of more profound and more significant networks [25-29]. *Fig. 1* shows CNN architectures.

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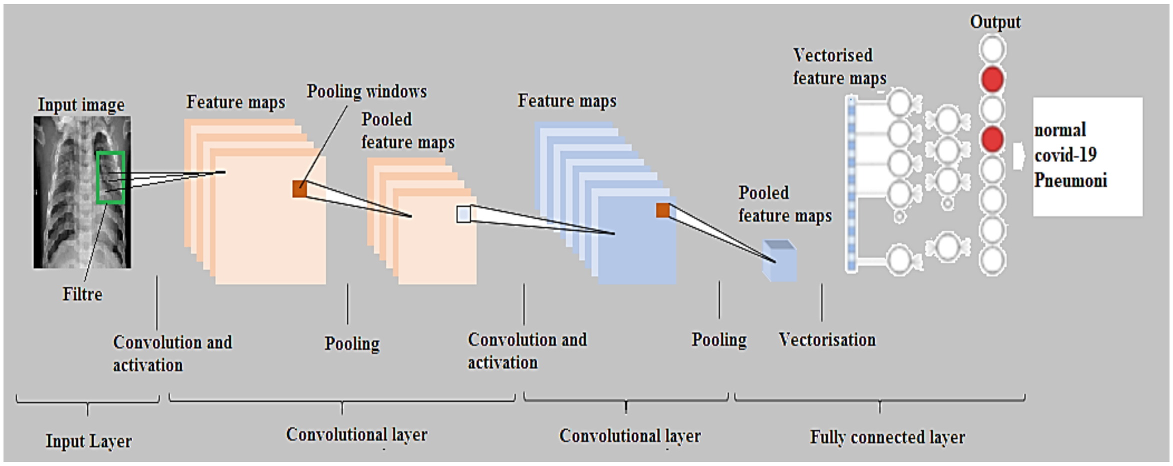

FIG. 1. CNN ARCHITECTURES

The proposed starting point CNN has the following architecture:

- Input layer: X-ray images are one of the sources of data. As parameters, the image dimensions (512*512) are used
- Convolutional layers: In the operation of expansion, a set of weights is applied to the input, with one weight on each side of the chain, resulting in no but linearity. It's meant for two-dimensional data input. This is equivalent to multiplying the filters' weighting and volume data volume values. The proposed architecture has three layers with a filter that has 3x3 block dimensions and no extra space between them
- Pooling Layers: It is responsible for dropping the image size and saving the essential features
- ReLU layers: 4 ReLU layers are used for each convolutional layer
- fully connected layers: In this model, the input data is treated as an easy vector, and the output is treated as an odd vector with one inner-product layer. The most recent, with SoftMax activation, is a fully connected output layer

B. Proposed System Analysis

In this stage, the steps of the proposed system will be explained. *Fig. 2* shows the block diagram.

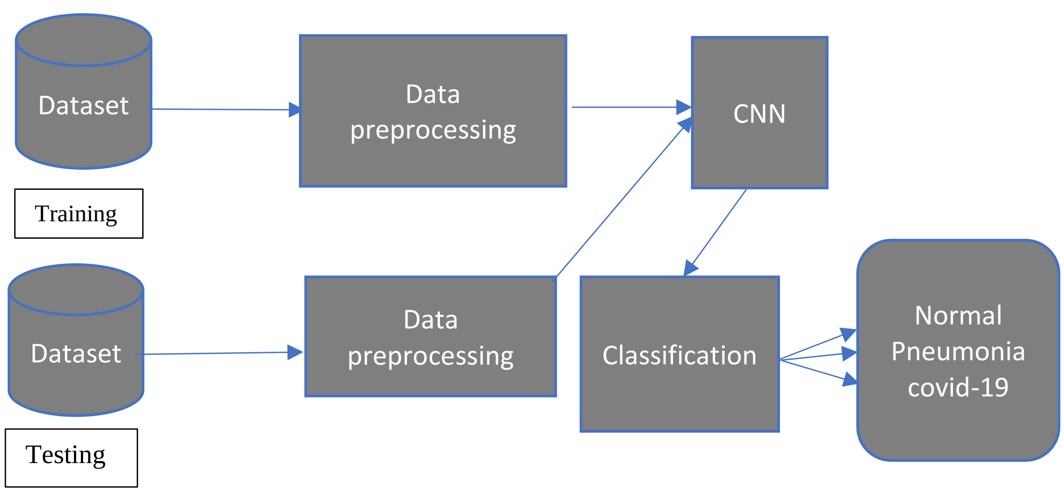

FIG. 2. BLOCK DIAGRAM PROPOSED SYSTEM

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B1. Dataset

The current database used in this study was created by cohen / Covid-19 X-Ray_ detection. [30]. The dataset 550 images have two types of images (225 normal and 225 pneumonias, covid-19) and images of various sizes 1024*1024, as shown in *Fig. 3*.

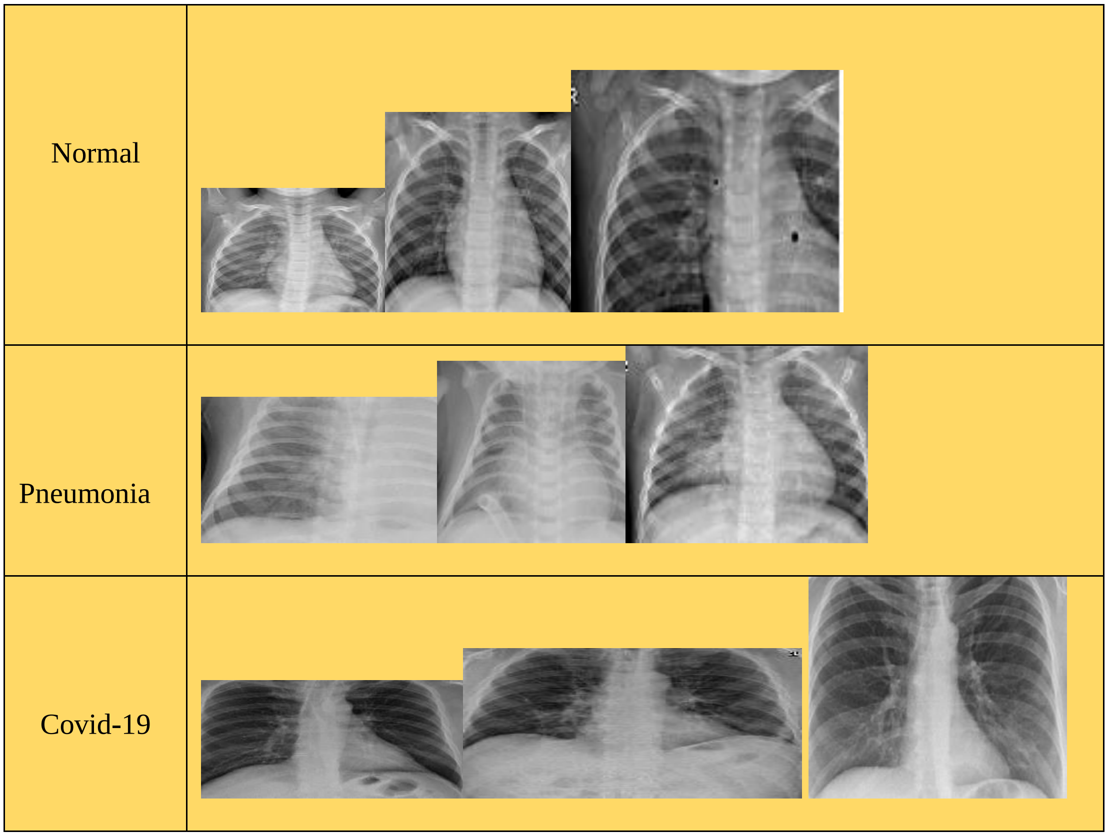

FIG. 3. DATASET

The dataset was divided into two groups according to each image, as shown in the following Table I.

TABLE I. DIVISION DATASET

Type	Normal	Pneumonia	Covid-19
Training	225	225	200
Testing	125	125	100

B2. Data Preprocessing

These two conversions and resizing (512*512) processes are required to work with this data set, but they are essential to overall model improvement because they are involved in converting and re-and-the

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data. Converting the image to grayscale, the work from 3-band to 1-band converts from 24-bit pixels per channel to 1 bit per channel. Reduce step for enlarging, increase step for reducing. The images will be expanded by a factor of two and then shifted from 0 to 255 times their original resolution to prepare them for the convolution neural network

B3. Classification Convolution Neural Network

After data preprocessing, the size of the training dataset is ready to move on to the feature extraction stage through the proposed models in command to extract the suitable and related features. The extracted features from apiece to create the vectorized feature maps and the proposed model were flattened simultaneously. The feature vector that was created was approved. A perceptron with multiple layers organizes each image into correspondent classes. Lastly, the performance of the proposed process was evaluated on test images using a trained model. Features from the convolution neural network stayed trained, where priority was given to each class to pneumonia, either normal or covid-19. The result was used to get the class-specific probabilities with values (0,1,2). It's a mathematical function that converts a set of numbers into a set of probabilities, with the probabilities of a value proportional to the vector's size. As a result, the covid-19 class will have a probability. If there was a normal in the image, it was given a probability (0). If it is not, then it takes a probability (1), and the probability of the image is pneumonia also probability (2) if covid-19 image. Table II shows the proposed architecture of CNN.

TABLE II. LAYERS OF PROPOSED SYSTEM

Layer (type)	Output shape (No. of filters)
Input (Input Layer)	(None, 128, 128)
conv2d (conv2d)	(None, 126, 126, 32)
Maxpooling2d (maxpooling2d)	(None, 63, 63, 32)
conv2d-1 (conv2d)	(None, 61, 61, 64)
maxpooling2d-1 (maxpooling2d)	(None, 30, 30, 64)
flatten (flatten)	(None, 57600)
dense (dense)	(None, 512)
dropout (dropout)	(None, 512)
Dense-1 (dense)	(None, 3)

IV. EVALUATION RESULTS

The proposed plan uses Python 3.9 on a 64-bit operating system and 8RAMG under it. *Fig. 4* illustrates the change between network training and testing performance measurements or accuracy. In contrast, as an example, *Fig. 5* shows the loss of measures for the network between training and testing concerning deep learning. It is accurate 95% or more of the time while learning and testing, after which it has expanded and approached the unknown sample size to match the training data. A performance

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calculation for proposed convolution neural network schemes on train 650 images and test pixel-transformed 350 images has been calculated.

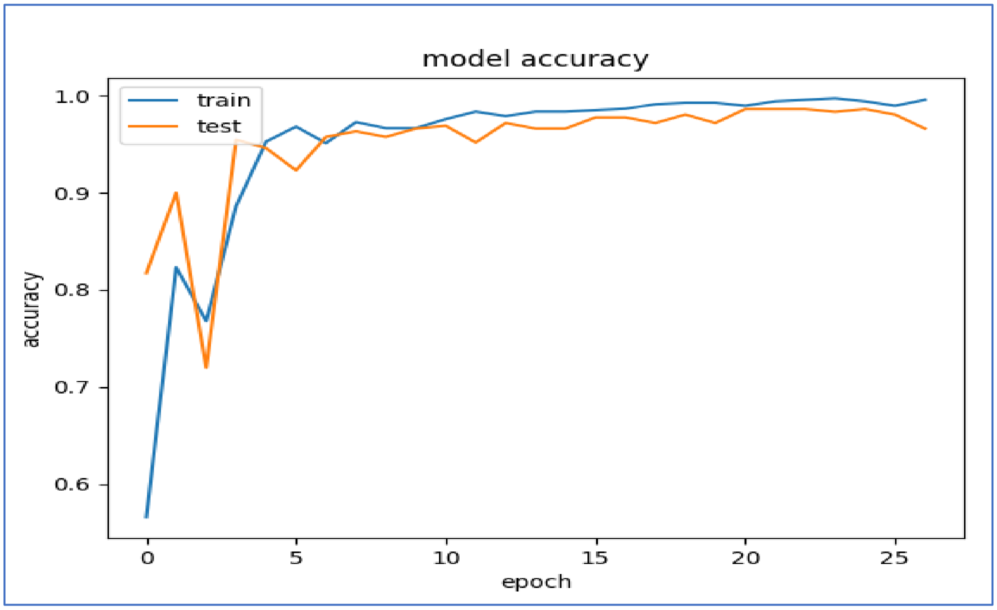

FIG. 4. ACCURACY CURVE

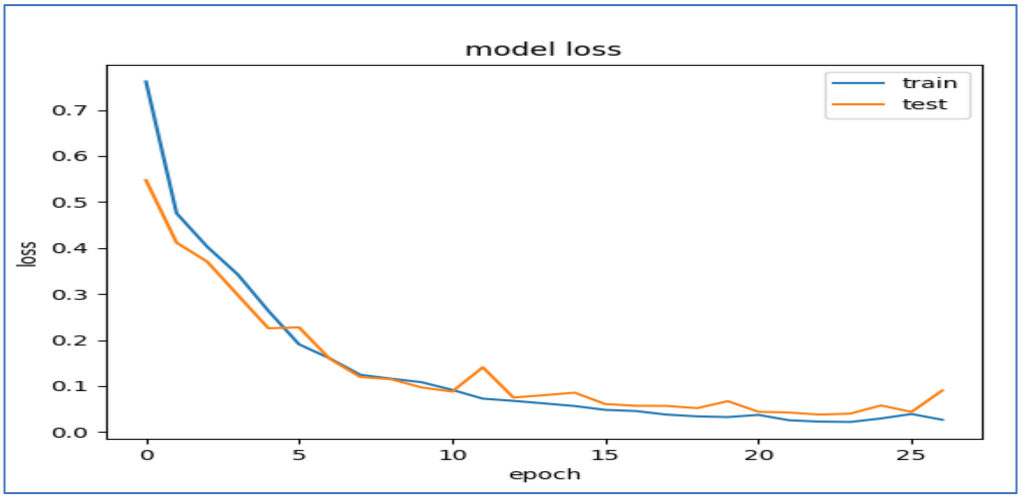

FIG. 5. LOSS CURVE

Confusion matrix used to describe dataset testing 350 images as shown in *Fig. 6*. It showed 125 images from the class, and the prediction for the type was normal, while 124 images from the class and the prediction for the type of pneumonia appeared, while 90 images of the kind Covid -19 were all correct. Only four images remained from the row, and the prediction was incorrect.

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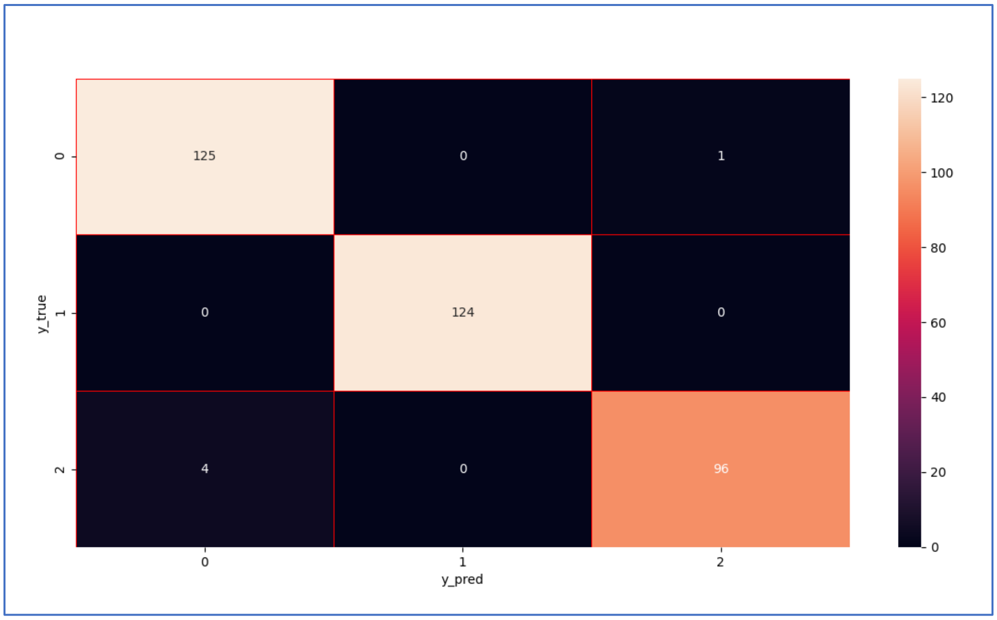

FIG. 6. CONFUSION MATRIX

The classification metrics accuracy (Acc) and F-score were executed. The proposed system architecture has reached the best presentation with a typical classification accuracy and f-Score

$$Accuracy=\frac{TP+TN}{Total\ Numbers\ Samples}*100 \quad (1)$$

$$F1\ score=2*\frac{Precision*Recall}{Precision*Recall} \quad (2)$$

$$Precision=\frac{Tp}{Tp+Fp} \quad (3)$$

$$Recall=\frac{Tp}{Tp+FN} \quad (4)$$

Whereas:

•TP denotes the number of images for which a correct prediction for a specific class has been made.
•TN is the number of images that correctly disallowed sure class prediction.
•FP represents the number of images with incorrectly known predictions for a specific class.
•FN denotes the number of incorrectly disallowed predictions for a specific class.

The result of applying Eqs. (1-4)

Accuracy== 95%, F1 score==0.96%, Precision==0.95%, Recall==0.94%

Table III below shows a comparison between the previous works referred to with the proposal in terms of technology and accuracy

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TABLE III. COMPARISON METHODS

No	Ref	Technical	Accuracy	Type of classification
1	*18*	*Deep learning with Alex net*	*93%*	*Normal Covid-19*
2	*19*	*Deep learning with Res-net*	*94%*	*Normal Covid-19*
3	*20*	*CNN based on dense-net*	*95%*	*Normal Covid-19*
4	*21*	*CNN*	*98%*	*Normal Covid-19*
5	*22*	*Deep learning with Chex-NG*	*93.3%*	*Normal Covid-19*
6	*23*	*Transfer learning with CNN*	*97.8%*	*Normal Covid-19*
7	*24*	used (CNNs) of varying configurations on a machine learning-based binary classification	*95%*	*Normal Covid-19*
6		*Proposed*	*95%*	*Normal Pneumonia Covid-19*

VI. CONCLUSION

For improving the diagnosis of COVID-19 disease, a CNN classifier is created for classifying chest X-ray images from the COVID-19 dataset into three different classes (COVID-19, pneumonia, and normal), and for evaluating the testing set, the practical outcomes show that the CNN classifier has a 95% accuracy. In the future, the proposed CNN Schema should be used with a large dataset and/or another feature fusion technique.

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