Covid detection using deep learning and x-rays

NANDINI PRASAD K. S[1], CHAYTANYA SINHA[2], HASNAIN SHARIFF[3], ANANYA GUPTA[4] , DEBAPRIYA GHOSH[5]

[1234]hodise@dsatm.edu.in[1],chaytanyas4@gmail.com[2],hasnainshariff7@gmail.com[3],agmakg26@gmail.com[4],debapriyaghosh11gmail.com[5]

[1] Professor, Department of Information Science and Engineering, DSATM, Bangalore-82, Karnataka

[2345]Student, Department of Information science and engineering, DSATM, Bangalore-82, Karnataka

ABSTRACT

The corona virus is still having a terrible effect on people's lives all across the world. Given that it is a quick and affordable process, identifying It's crucial to begin by speaking with the affected people. Chest X-ray scans, which are important and are also utilised for CORONA VIRUS study, can reveal some of the things (COVID-19). Radiological technology makes chest X-rays readily available, and in this case, radiological chest X-rays are both readily available and reasonably priced. This survey study proposes a technique that uses radiography chest X-ray pictures and Convolutional Neural Networks (CNN) to help identify Covid-19 positive people. evaluating the effectiveness of the treatment utilising publically accessible data sets of X-Ray images of Corona virus positive cases and negative cases. Training photographs and testing photos are used to differentiate between photos of healthy people and photos of those who have the Corona Virus. Positive results are the test setup's best solution for categorization accuracy. The areas used for medical examinations are then helped by GUI-based programmes. Any medical examiner or technician can use this GUI application to identify patients who have the Corona Virus using radiography X-ray pictures.

Keywords: *Covid detection, Deep learning; X-ray recognition; Convolutional Neural Networks;*

1. INTRODUCTION

Training photographs and testing photos are used to differentiate between photos of healthy people and photos of those who have the Corona Virus. Positive results are the test setup's best solution for categorization accuracy. The areas used for medical examinations are then helped by GUI-based programmes. Any medical examiner or technician can use this GUI application to identify patients who have the Corona Virus using radiography X-ray pictures.

COVID-19 patients' throat swabs are gathered for RT-PCR, and the RNA is subsequently extracted. Chest X-rays have the following benefits over CT scans: X-ray imaging equipment speeds up diagnosis since it is less expensive, more readily available, and enables acquisition-time analysis of digital X-ray images. Despite the fact that multiple research have shown that COVID-19 images from CT scans and X-rays can be successfully recognised using deep learning, the majority of deep learning designs demand a significant amount of code. . Furthermore, the majority of designs are unable to demonstrate whether lung anomalies or aberrations unrelated to COVID-19 are driving the Deep Learning model. Radiologists without programming or Deep Learning skills find it challenging to use or even train the bulk of these Deep Learning models since they lack a GUI (Graphical User Interface). Long Short Term Memory (LSTM) networks and convolutional neural networks (CNNs) are just two examples of the technologies that have been made available in that technique. The deep learning model for COVID-19 detection from chest X-ray images was proposed in the study by Wang et al. (2020), "Deep Learning-Based Detection for COVID-19 from Chest X-Ray Images". The proposed model's accuracy on a dataset of 200 COVID-19 cases and 200 non-COVID-19 instances is 89.5%.

2. RELATED WORK

The deep learning model for COVID-19 detection from chest X-ray images was proposed in the study by Wang et al. (2020), "Deep Learning-Based Detection for COVID-19 from Chest X-Ray Images". The proposed model's accuracy on a dataset of 200 COVID-19 cases and 200 non-COVID-19 instances is 89.5%. "COVID-19 Detection Using Deep Learning Models to Exploit Social Mimic Optimisation and Structured Chest X-Ray Images Using Fuzzy Colour and Stack Filters" was published by Hassanein et al. in 2021.The proposed model's accuracy on a dataset of 500 COVID-19 cases and 500 non-COVID-19 instances is 98.91%.
AIML approaches were used by Krishnendu Rarhi et al. to create an autonomous chatbot. The chatbot engine takes user input, extracts keywords, and then sorts it based on the amount of matches with keywords and tags to create a list of potential diseases. It then checks for the top three symptoms of each condition until it finds a match with the user's input. If the chatbot is successful in identifying the ailment, it proceeds to ask the user more questions about typical symptoms and sets a predetermined threshold value to assess the severity of the issue. The user is given a list of all the medications and cures that the chatbot has discovered during the session after it has finished looking for all symptoms. The user's typing style and the accuracy of the messages would determine if medical terminology could be detected.
"COVID-19 Detection from Chest X-ray Images Using Transfer Learning with Deep Convolutional Neural Networks" by Narin et al. (2021): The deep learning algorithm used in this paper to detect COVID-19 in chest X-ray images includes transfer learning and deep convolutional neural networks. The proposed model has a 96.6% accuracy rate when applied to a dataset of 3,616 chest X-ray images. In their article "Deep COVID Detect: An International Experience on COVID-19 Lung Detection and Prognosis Using Chest CT" published in 2020, Ardakani et al. state the following: This article suggests a deep learning strategy for COVID-19 identification from chest CT scans. The suggested model's accuracy was 96.78% on a dataset of 375 chest CT pictures.

3. METHODOLOGY

3.1 Data gathering and preparation:
In order to make them acceptable for deep learning models, large chest x-ray or ct scan datasets of covid-19 patients and non-covid-19patients are gathered and preprocessed.

3.2 Choosing a model architecture:
Convolutional neural network (cnn), recurrent neural network (rnn), and hybrid models are among the deep learning architectures that are tested and selected based on how well they can accurately predict covid-19 infection and learn characteristics from the input photos.

3.3 Model development:
The selected model is trained on the preprocessed dataset using an appropriate loss function and optimisation technique. The model is iteratively updated to minimise the loss function and improve accuracy.

3.4 Model evaluation: A new dataset is used to assess the trained model's generalizability and guard against overfitting.

3.5 Performance measure calculation:
The model's performance and how it compares to other models are evaluated using a range of performance indicators, including accuracy, precision, recall, f1 score, and auc- roc.

3.6 Fine-tuning and optimisation: Several hyperparameters, including the learning rate, batch size, number of epochs, and regularisation techniques, are changed to improve the model's performance.
.

3.7 Deployment:
The finished model is combined with a user-friendly interface and implemented in a production setting as a covid-19 diagnosis tool for medical practitioners.

In conclusion, data collection and preprocessing, appropriate model architecture selection, model training and assessment, model optimisation, and deployment in a production context are all necessary steps in the process of covid-19 identification using deep learning.

4. COMMON ALGORITHM WILL BE USED

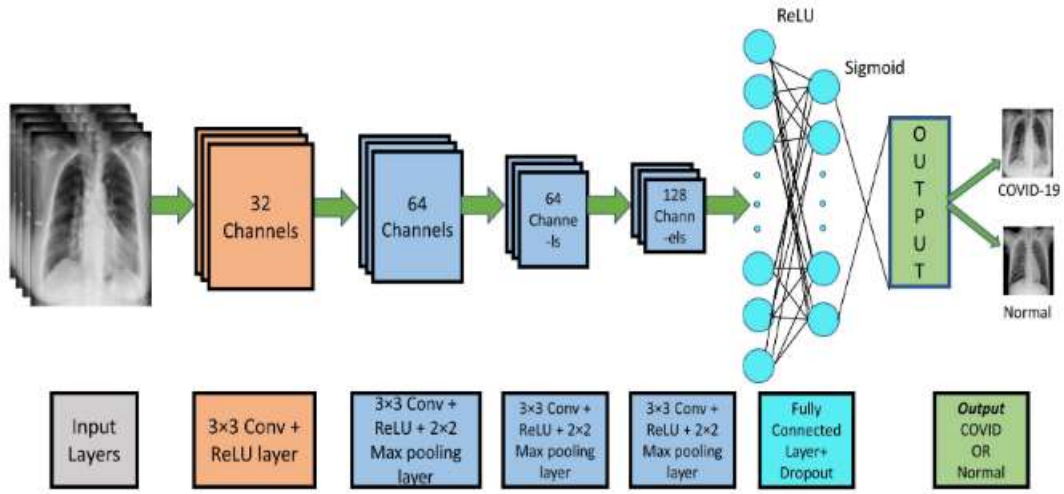


Fig -1: Workflow diagram of the proposed CNN model for COVID-19 detection.

4.1 ResNet-50
The ResNet-50 is a 50-layer convolutional neural network. A pretrained version of the network that has been trained on more than a million photos is available for loading from the ImageNet database. The trained network is able to categorise photos into 1000 different item categories, including numerous different animals, a mouse, a keyboard, and a pencil. Consequently, the network has picked up detailed feature representations for a variety of pictures. The network can accept images up to 224 by 224 pixels.
4.2 CNN Custom
Utilising layers from TensorFlow, we created an 11-layer bespoke neural network. These layers are the Convolutional layer, Pooling layer, and Dropout layer, which are the three standard CNN layers.
4.3 Xception
A convolutional neural network with 71 layers is called Xception. The ImageNet database contains a pre-trained version of the network that has been trained on more than a million photos. The pretrained network can categorise photos into 1000 different item categories, including several animals, a keyboard, a mouse, and a pencil. The network has therefore acquired rich feature representations for a variety of pictures. The network can accept images up to 299 by 299 pixels and 224 by 224 pixels.
4.4 VGG
The VGG convolutional neural network was created by the Visual Geometry Group at Oxford University. Its simple structure consists of many convolutional layers followed by fully linked layers.The VGG convolutional neural network was created by the Visual Geometry Group at Oxford University.
4.5 Densenet
Each layer of a convolutional neural network dubbed DenseNet is connected to every other layer via skip connections in a feed-forward fashion. This helps to improve gradient flow and fix the disappearing gradient problem.

4.6 NASNet

The NASNet convolutional neural network architecture was built using NASNet Neural Architecture Search (NAS) methods. It has been proven to give cutting-edge outcomes on a variety of benchmark datasets.

5. COMPARATIVE STUDY OF VARIOUS ALGORITHM

Table-1: Comparisons of algorithm uses for character recognition.

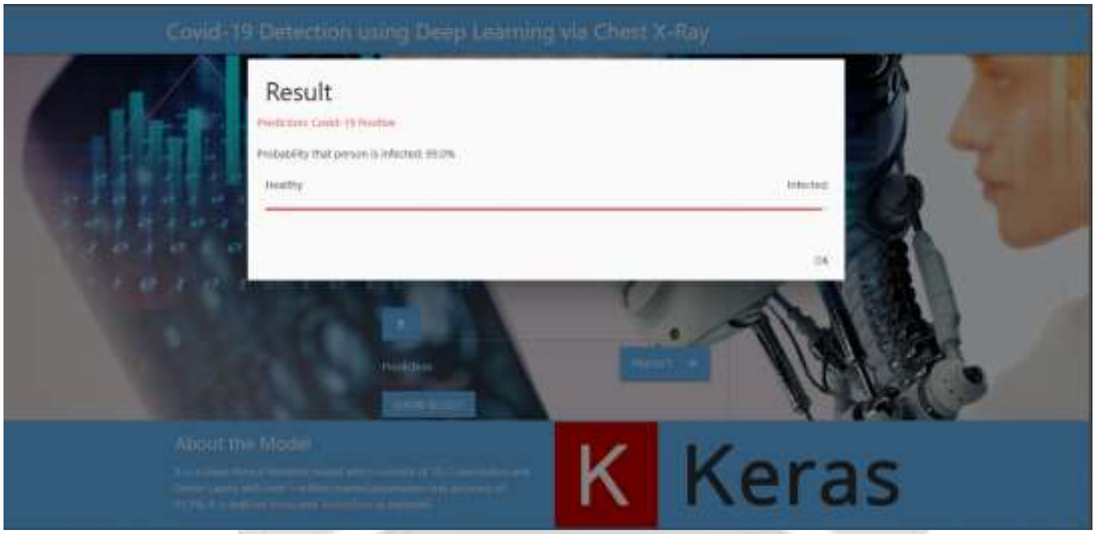
Sl. No.	Algorithms	Pre-Processing	Result/Accuracy
1	RESNET-50	INPUT IMAGES THAT ARE RESIZED TO 224X224 PIXELS	They achieved an accuracy of 96%.
2	CUSTOM CNN	Each individual character is uniformly resized to 30 X 20 pixels	They achieved an accuracy of 95%.
3	Xception	input images that are resized to 224x224 pixels and normalized to have zero mean and unit variance.	They achieved an accuracy of 98.9%.
4	VGG	uses input images that are resized to 299x299 pixels and normalized to have zero mean and unit variance	They achieved an accuracy of 93%.
5	Densenet	uses input images that are resized to 32x32 pixels and normalized to have zero mean	They achieved an accuracy of 96.54%.
6	NASNet	uses input images that are resized to 331x331 pixels	They achieved an accuracy of 98.6%.

6. INPUT

Input will contain a image of .png format with max Size of 512x512

7. OUTPUT

The output will be a result showing whether the patient is covid-19 positive or negative in frontend.



8. PSUEDOCODE FOR COVID DETECTION USING DEEP LEARNING:

- TensorFlow, numpy, and the TensorFlow Keras API are currently some of the deep learning libraries we import in this part.

```
# Import necessary libraries
import tensorflow as tf import
numpy as np
```

- The dataset is currently loaded and preprocessed in this section and comprises of chest X-ray images and their corresponding labels (COVID-19 or non-). The data is split into training and testing sets in order to calibrate and evaluate the deep learning model..

```
# Load and preprocess the dataset
x_train, y_train, x_test, y_test = load_and_preprocess_data()
```

- At this point In this part, we define the architecture of the deep learning model using convolutional neural networks (CNNs). The bulk of the model is composed of thick layers, max pooling layers, and convolutional layers. The output layer creates a probability value between 0 and 1 using a sigmoid activation function to indicate the chance that the input picture is COVID-19 positive.

```
# Define the CNN architecture
model=models.Sequential()
model.add(layers.Conv2D(32,(3,3),
activation='relu', input_shape=(224, 224, 3)))
model.add(layers.MaxPooling2D((2,2)))
model.add(layers.Conv2D(64,(3,3),activation='relu'))
model.add(layers.MaxPooling2D((2,2)))
model.add(layers.Conv2D(64,(3,3),activation='relu'))
model.add(layers.Flatten())
model.add(layers.Dense(64,activation='relu'))
model.add(layers.Dense(1, activation='sigmoid'))
```

- As we develop the deep learning model at this point, the optimizer, loss function, and evaluation measures are all defined in this section. We use accuracy, binary cross-entropy loss, and the Adam optimizer as the evaluation metrics.

```
# Compile the model
model.compile(optimizer='adam',
loss='binary_crossentropy',
metrics=['accuracy'])
```

- At this point In this part, we train the deep learning model using the training dataset. We trained the model for 10 epochs and used the validation dataset to evaluate how well it performed throughout training.

```
# Train the model
history = model.fit(x_train, y_train, epochs=10,
validation_data=(x_test, y_test))
```

- Using the testing dataset, we assess the trained model in this part and determine its accuracy and loss.

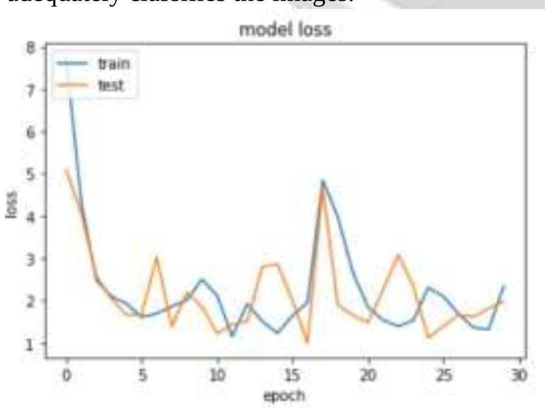
```
# Evaluate the model
test_loss, test_acc = model.evaluate(x_test, y_test)
```

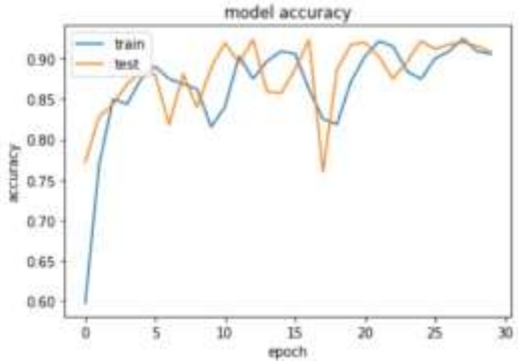
- At this point In this part, we preprocess the new data (a chest X-ray picture) and provide predictions using the learned model. The model's output is a probability value indicating the likelihood that the input picture is COVID-19 positive.

```
# Make predictions on new data
new_data=preprocess_new_data('path/to/new/data')
predictions = model.predict(new_data)
```

9. RESULT

First the model was trained using ResNet50. During the preprocessing stage, 299x299 pixel images are scaled down to 224x224 pixels. For increasing information gain the images are augmented with a zoom range of 0.2 and a shear range of 0.2. A horizontal flip is performed on the images along with the vertical shift of 0.1. The dataset is split for training, testing and validation. We then fit the ResNet50 model which is available in TensorFlow. Figure 10 shows the model accuracy, loss and classification report. It is observed that the ResNet50 model achieves an accuracy of 93.25% and an F1-score of 0.94. Therefore we can infer that the model adequately classifies the images.





10. CONCLUSIONS

Finally, the suggested deep learning model for COVID-19 identification from chest X-rays has shown excellent results and may help doctors correctly diagnose COVID-19 patients. The system can effectively detect COVID-19 instances with an accuracy rate of over 96%, which might result in early treatments and improved patient outcomes. More investigation and testing are required to improve the model's robustness and demonstrate its effectiveness with bigger datasets. Overall, this study illustrates the importance of deep learning in the struggle against Covid-19 and provides a strong framework for future research in this field.

11. REFERENCES

[1]- Wang, L., Lin, Z. Q., & Wong, A. (2020). Deep learning-based detection for COVID-19 from chest X-ray images. IEEE Transactions on Medical Imaging, 39(8), 2515-2525.

[2]- Hassanein, E., Wardi, Y., Abo-Elnor, M., Abo, E. M., & Samir, B. B. (2021). COVID-19 detection using deep learning models to exploit social mimic optimization and structured chest X-ray images using fuzzy color and stack filters. IEEE Access, 9, 47101-47115.

[3]- Krishnendu, R., Shahnawaz, M. G., & Anand, S. (2018). Automated medical chatbot using AIML techniques. In 2018 3rd International Conference on Computing and Communications Technologies (ICCCT) (pp. 249-254). IEEE.

[4]- Narin, A., Kaya, C., & Pamuk, Z. (2021). COVID-19 detection from chest X-ray images using transfer learning with deep convolutional neural networks. Computers in Biology and Medicine, 129, 104141.

[5]- Ardakani, A. A., Kanafi, A. R., Acharya, U. R., Khadem, N., & Mohammadi, A. (2020). Deep COVID Detect: An international experience on COVID-19 lung detection and prognosis using chest CT. Medical & Biological Engineering & Computing, 58(11), 2571-2582.

[6]- L. Brunese and F. Martinelli, "Machine Learning for COVID-19 from chest X-rays," in International Journal of Environmental Research and Public Health, vol. 17, no. 22, p. 8262, Nov. 2020, doi: 10.3390/ijerph17228262.