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Machine Learning Framework To Detect Corona Virus - A Study With CT Scan Image Of Suspected Individuals

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Abstract- The recently discovered Corona-virus pneumonia, dubbed COVID-19, is extremely transmissible as well as pathogenic. For the treatment, currently there is no licensed antiviral medication or any vaccination. COVID-19 is characterized by a fever, sore throat, dry cough and headaches. Pulmonary edoema, multi-organ failure, acute respiratory distress syndrome can occur if symptoms progress to a severe type of pneumonia with significant consequences. The COVID-19 contamination is growing at a speedy rate, with the supply of restricted wide variety of checking out kits. As a result, the progress of COVID-19 checking out kits is even now a work in progress. Recent studies shows that chest CT pictures may be used for COVID-19 testing because chest CT images show a bilateral extrade in COVID-19 inflamed individual. However, estimating the bilateral extrade in COVID-19 suffers from CT images is considered as an ill-posed task. As a result, COVID-19 inflamed sufferers are classified using a mastering strategy in this study.

Keywords* — *COVID-19, Classification, Chest CT image, Convolutional Neural Network, Disease, Virus.

I. INTRODUCTION

COVID-19 is phylogenetically related to SARS-like bat viruses, according to genomic research. As a result, bats could be a source of viral replication [1]. Pangolins have also been identified as a possible COVID-19 intermediate host [3]. SARS-CoV, avian influenza, MERS-CoV, and other prevalent respiratory viruses are pathogenically similar to this recently discovered virus, but it is highly transmittable. Concerning COVID-19, the WHO declared the outbreak of the novel Corona-virus as a Public Health Emergency of International Concern (PHEIC) on 30 January, 2020 [4]. On 11 March, 2020, a global pandemic was announced due to the disease's rapid global expansion. COVID-19 suffers have symptoms that are comparable to those of other viral respiratory infections such bacterial pneumonia, respiratory syncytial virus (RSV), influenza, etc. Fever, dry cough, myalgia, dyspnea, bilateral lung infiltrates, sore throat, diarrhoea, shortness of breath are the most common presenting symptoms, which can be seen on clinical imaging such as a chest X-ray. Headache, rhinorrhea, pleurisy, sneezing, nasal congestion, and vomiting are some of the other symptoms.

Acute Respiratory Distress Syndrome (ARDS), pulmonary edoema, septic shock, acute renal injury, cardiac injury and even Multi-Organ Failure (MOF) have all been reported in patients with more severe COVID-19 [4] [5]. There is currently no antiviral medication or vaccine that has been clinically licensed to treat COVID-19. The replication number (R0) is reported to be 3.77 [6] [7], which would be defined as the expected number of susceptible cases directly generated by one contagious case of COVID-19 illness.

Despite the international attempts to reduce travel restrictions and isolation, the global incidence of new COVID-19 is growing, at over 1.6 million cases reported and over 100,000 mortality as of this writing [8]. As of April 2020, 211 nations had reported significant new COVID-19 instances, including significant reported cases in France, Japan, South Korea, Germany, Iran, Italy, Germany [9]. The early distribution of novel COVID-19 cases was linked to recent travel to China, but community transmission is now widespread over the world. Close interpersonal transmission (about 6 feet) by respiratory droplets is responsible for the majority of new infections [5]. Infected surfaces can also cause contamination when they come into touch with the mouth, nose, or eyes. To fight the Coronavirus, it is necessary to fully understand its genetic properties. Corona-virus is a single-stranded RNA virus having particle sizes ranging from 65 to 125 nanometers in diameter and a genome size of roughly 27 to 32 kb [1]. In mild of this, it is clear that early COVID-19 discovery is required to end the cycle of COVID-19 and avoid the risks by isolating patients, tracing and quarantining close connections. The proper monitoring of progression of the disease in individuals with COVID-19 is an important component of illness management.

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Medical imaging techniques such as chest X-ray and Computerized Tomography (CT) play a significant role in verifying the diagnosis of positive COVID-19 infection as well as monitoring the spread of the disease progression in Canada, even though they are not indicated for initial assessment of COVID-19. These photos reveal the amount of asymmetrical ground-glass opacities that develop quickly following the onset of COVID-19 symptoms. During days 6-11 of the disease, these anomalies peaked. During days 12-17 of the disease, the second most frequent pattern of lung opacity anomalies peaks [12].

Computer-Aided Diagnosis (CAD) systems that combine X-ray and Computed tomography image processing methods with deep learning algorithms should help physicians diagnose COVID-19 and gain a better understanding of the disease's course. The creation of COVID-19 test kits is still a work in progress; with insufficient test kits, it is hard to screen each individual with a respiratory ailment using traditional means (RT-PCR). In addition, the tests have a high turnaround time and low sensitivity. While results of the tests are pending, detecting suspected COVID-19 infections on a chest X-ray may assist confine high-risk individuals.

Figure 1: CT-Scan images of COVID-19 sufferers.

II. Related Work

COVIDX-Net, a deep learning framework created by Hemdan et al. [13], was used to diagnose COVID19 in X-Ray photos. The authors present a comparison of various deep learning architectures, including ResNet V2, Xception, Inception V3, MobileNet V2, Inception ResNet V2, DenseNet 201, and VGG19. Dr. Joseph [14] and Dr. Adrian [15] donated the accessible X-ray picture dataset. The dataset includes 50 X-ray pictures, which were separated into two groups: normal cases and COVID-19 positive cases. Hemdan's findings showed that DenseNet201 and the VGG19 models outperformed their counterparts at accuracy of 90.00 %.

For COVID-19 categorization from CT scans, Barstugan et al. [16] suggested a machine learning approach. From 150 Image data, patches of various sizes (16×16, 32×32, 48×48, 64×64) have all been extracted. The Discrete Wavelet Transform (DWT), Local Directional Pattern (LDP), Grey Level Size Zone Matrix (GLSZM), Grey Level Run Length Matrix (GLRLM), Gray - level Co-occurrence Matrix (GLCM) techniques were among the hand-crafted features used. Two-fold, five-fold, and ten-fold cross-validations have been used to feed the collected attributes into a Support Vector Machine [17] classifier. GLSZM feature extractor using 10-fold cross-validation had the best accuracy of 98.77 percent.

COVID-Net, a customized deep learning-based network created by Wang and Wong [18], was intended for COVID-19 identification using chest X-ray photos. To create a deeper structure and avoid the gradient disappearing problem the COVID-Net framework was built using a composite of 1×1 convolutions, depth-wise convolution and also residual module. The proposed dataset consisted of a multi-class categorization of regular, bacterial infection, viral infection, and COVID-19 inflammation using a mix of Dr. Joseph Cohen's COVID chest X-ray dataset [14] and Kaggle's chest X-ray pictures dataset [19]. This study had an accuracy rate of 83.5 percent.

Maghdid et al. [20] used a deep learning based technique and a transfer learning strategy for quick-service of COVID-19 infection in a study. The suggested design is a hybrid of a simple CNN architecture i.e. 1-convolutional layer with 16 filters, batch normalization, ReLU, and 2-fully-connected layers along with a modified AlexNet [21] design along with transfer learning capability. The proposed updated design achieved a 94.00 percent accuracy.

The diagnostic uncertainties and interpretabilities of deep learning-based approaches for COVID-19 identification in X-ray pictures were explored by Ghoshal and Tucker [22]. Bayesian-CNN based on dropweights were utilised to evaluate uncertainties in deep learning systems and also provide a degree of trust for a computer-based treatment in a valued clinician scenario

To evaluate the relation between accuracy and uncertainties, Kaggle's Chest X-Ray Pictures dataset [19] was used to balance 70 posterior-anterior-lung X-ray pictures of COVID-19 sufferes from Dr. Joseph Cohen's public dataset [14]. All photos were shrunk to 512×512 pixels in order to develop the dataset.

To overcome the dataset's low size, a supervised learning method and real world data augmentation methodologies were used. Using the VGG16 deep learning method, the suggested Bayesian inference strategy achieved a detection accuracy of 92.86 percent on X-ray pictures. Hall et al. [23] employed a VGG16 design and a transfer learning technique with ten-fold cross-validation on Dr. Cohen's dataset [14]. To enhance the size of the dataset, all photos were resized to 224×224 pixels and a data augmentation approach was used. On the presented dataset, the proposed method has an accuracy results of 96.1 percent and an overall AUC of 99.70 percent.

COVID-ResNet is a fine-tuned and pre-trained ResNet-50 design presented by Farooq and Hafeez [24] for COVID-19

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pneumonia screening. Different data augmentation strategies, such as vertical flips, randomized rotation (at a 15-degree angle), and model regularisation, were applied to increase the generalization of the training phase. On a multi-elegance class classification dataset of regular, bacterial contamination, non-COVID-19 viral infection, and COVID-19 contamination, the suggested technique attained an accuracy of 96.23 percent.

III. Proposed Methodology

The goal is to enhance classification performance by using CNN to distinguish COVID-19 patients from non-COVID-19 patients in chest X-ray and CT scan. A Deep Neural Network is used, which is a complex neural network that uses filters to retrieve features from an image with maintaining pixel position data. Applying a convolution on a matrix is a mathematical procedure. This matrix represents the image in pixels and integers. The convolution method is used to extract and preserves the image's attributes and spatial features. The goal is to improve classification accuracy by differentiating COVID-19 individuals from non-COVID-19 individuals using chest X-ray and CT scan images.

During this phase,

1. The learning model is utilized to classify COVID-19 infected individuals based on their chest CT scans.
2. To improve the outcomes even more, the cost sensitive smooth loss function is used.
3. A dataset of chest CT images is used to train the training model.

The proposed methodology for detecting COVID-19 victims will be implemented in the following steps:

Training Phase:

Step 1: Upload images and add labels to it with two classes: positive and negative.

Step 2: Resize each image to 64 x 64 pixels.

Step 3: Follow the steps below to train pictures using the CNN algorithm. A loss graph and model summary will be generated once the training is complete.

Step i: Set your Neural-Network options.

Step ii: Initialize your Neural-Network.

Step iii: Prepare the data for normalization and train the CNN model.

Step iv: Classify the data using the trained model.

Testing Phase:

Step 4: To test, upload test photographs and resize each one to 64 x 64 pixels.

Step 5: If the model is tested using testing images, the confusion matrix, accuracy, precision, and recall of the pre-trained model will be returned. The stages of the CNN algorithm will be followed in the testing model.

Step i: Load the pre-trained model, weights, and metadata.

Step ii: Write a function to deal with the classification outcomes.

Step 6: A single image prediction will be performed in the output model. The output model will perform the steps of the CNN algorithm.

Step i: Load the pre-trained model, weights, and metadata.

Step ii: Write a function to deal with the classification outcomes.

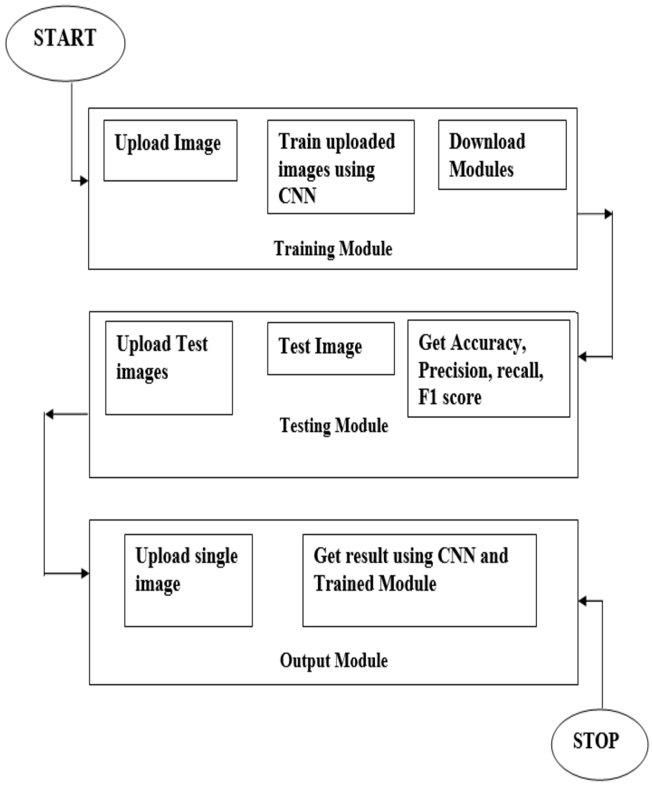

Figure 2: Flow of Proposed Methodology

IV. Conclusion

Because of the disease's relatively high contamination rate, the ongoing COVID-19 epidemic has also been declared a global health emergency. As of this writing, there is no clinically approved therapy medicine or immunization for COVID-19. To avoid public transmission and assure patient care, COVID-19 must be discovered early. Isolating and quarantining suspicious patients is currently the most fruitful method of preventing COVID-19 transmission. Diagnostic procedures such as chest X-ray and CT play a crucial role in monitoring the disease's course and intensity in COVID-19 positive individuals. This study proposes a features extractor-based DL and ML classifier strategy for computer-aided detection of COVID-19 infection. Various

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machine learning methods were trained on extracted features using well-known Classification algorithms to discover the best collaboration of attributes and learners.Because image data has such a good visual complexity, properly extracting deep features is a critical step in building deep CNN networks.

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