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Comparative Analysis of Pneumonia Detection from Chest X-Ray Images Using CNN And Transfer Learning

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Abstract

A widespread bacterial or viral infection of the respiratory tract, pneumonia affects many people**.** particularly in developing and impoverished countries where pollution, unsanitary living conditions, and overcrowding are all too common, as well as a lack of medical infrastructure. Pneumonia produces pleural effusion, which is a condition in which fluids fill the lungs and create breathing problems. Early detection of pneumonia is critical for ensuring a cure and improving survival rates. The most common method for detecting pneumonia is chest X-ray imaging. As opposed to that, examining chest X-rays can be challenging and vulnerable to subjective fluctuation. A computer-aided diagnosis method for automatic pneumonia detection utilizing This research includes the creation of chest Images from X-rays. To evaluate which model is superior, an experiment was conducted utilizing a publicly accessible database on all three models. A Convolutional Neural Network (CNN) model was developed to address the lack of readily available data. together using transfer learning strategies like Mobile Net and VCG. On a dataset of accessible pneumonia X-rays, the method was tested. This research shows which neural network algorithm is optimal for detecting pneumonia, and how medical practitioners might use it in the actual world. Keywords: Pneumonia, Chest X-ray, Deep Learning, Convolutional Neural Network (CNN), Mobile Net, VCG, ReLU, Max pooling.

Keywords

Pneumonia Detection, CNN, Mobile Net, VCG, ReLU, X-rays

Introduction

Pneumonia is a lung inflammatory disease affecting the alveoli or small air sacs. Coughing, whether productive or not, chest pain, fever, and breathing problems are all common symptoms. The most frequent source of pneumonia is infection with viruses or bacteria, as well as other microorganisms. It's not always easy to figure out which illness is to blame. A diagnosis is typically made based on symptoms and a physical examination. To confirm the diagnosis, chest X-rays, blood tests, and sputum culture may be employed. One or both of the lungs are affected by pneumonia, a lung infection. A virus, bacteria,

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fungus, or other microorganisms can cause it. Whenever someone breathes in germ-laden air, the sickness is generally discovered. Patients with pneumonia may have the following symptoms: Cough that produces phlegm or sometimes blood, Fever, Shortness of breath, or difficulty breathing. Cold or tremors, Fatigue, Sweating, Chest or muscle pain.

Young children and people over the age of 65 are most at risk of developing pneumonia. People who already have health issues are also more vulnerable. The following risks and conditions may increase a person's risk of developing pneumonia: diseases such as emphysema, HIV/AIDS, or other lung diseases, immune system conditions with the flu, exposure, and inhalation of various chemicals, smoking or heavy drinking, long hospital stay or intensive care, recent surgery, recent injuries.

Pneumonia can sometimes cause serious problems, such as respiratory failure, the spread of infection, fluid in the lungs, abscesses, or uncontrolled. A medical condition of the whole body (sepsis). This condition can be fatal, so it is important to seek medical help immediately if you have these symptoms (Neuman,.M.I., et.al.2012). Pneumonia is a lung infection that mostly affects the tiny air sacs known as alveoli. Symptoms usually include a combination of productive or dry cough, chest pain, fever, and difficulty breathing. The severity of the condition varies. Pneumonia is usually caused by a viral or bacterial infection, and it is not uncommon for other viruses. Diagnosing HIV can be difficult. Diagnosis is usually based on symptoms and physical examination. Chest X-ray, blood tests, and sputum culture can help confirm the diagnosis. The disease can be classified according to where it is diagnosed, such as community-acquired pneumonia or hospital or associated health care.

Pneumonia danger signs include cystic fibrosis, asthma, diabetes, heart failure, sickle cell disease, chronic obstruction pulmonary disease (COPD), history of smoking, coughing (such as having a stroke), and a weakened immune system. vaccinations against specific forms of pneumonia (such as those caused by the Streptococcus pneumoniae virus, linked to the flu, or linked to COVID-19) are available. Other 2 prevention methods include hand washing to prevent infection, smoking, and social isolation. Treatment is determined by the underlying cause. Antibiotics are used to treat pneumonia which is thought to be caused by bacteria. If the pneumonia is severe, the patient is usually hospitalized. When oxygen levels are low, oxygen therapy can be used. Each year, pneumonia affects an estimated 450 million people worldwide (7% of the population) and results in an estimated four million deaths. Survival rates have increased dramatically since the introduction of antimicrobials and vaccines in the twentieth century. Nonetheless, pneumonia continues to be a leading cause of death in developing countries

In recent years, several papers have been published regarding pneumonia, (Lal S et al., 2021) Here, a framework that provides protection from adversarial training, an adversarial speckle-noise attack, and a feature fusion technique that upholds the classification with precise labelling is provided. During this article, the diabetic eye disease Recognition Problem is appraised and investigated together with simultaneous assaults and countermeasures on retinal fundus images, which is recognized as a state-of-the-art endeavor.

The most recent deep learning algorithms are used in this study to estimate the pandemic intensity for the near future incorporating Gated Recurrent Units (GRU), Recurrent Neural Networks (RNN), and Long Short-Term Memory (LSTM) networks, the time variable, and the data's nonlinearity while employing neural networks (Rauf H et al., 2023). To predict the number of COVID-19 cases during the next 10 days, the important elements of each model have been evaluated. As of July 1, 2020, more than 90% of the predictions generated using the employed deep learning models were accurate, proving the correctness of the proposed study.

This research provides a significant contribution to the healthcare industry and the research community by proposing a synthetic data augmentation in three deep Convolutional Neural Networks (CNNs) architectures for the detection of 14 chest-related diseases (Albahli, S., et.al, 2021). The employed models are DenseNet121, InceptionResNetV2, and ResNet152V2; after training and validation, an average ROC-AUC score of 0.80 was obtained competitively as compared to the previous models that were trained for multi-class classification to detect anomalies in x-ray images.

To determine the accuracy of a neural network model, the author used various neural network techniques. By including dropping out, altering learning rates, the size of the batch, the number of times, and fully connected layers in addition to adding fully connected layers, we successfully updated several stochastic gradient optimizers to adapt convolutional neural networks' parameters for the x-ray pictures (Sirish Kaushik, V., et.al., 2020) . A four-layer CNN outperformed a two-layer CNN in terms of accuracy.

Based on a deep learning approach, pneumonia localization and recognition in chest X-ray images was accomplished. The selected technique adds a new post-processing step that integrates bounding boxes from various models as well as significant changes to the training procedure (Jaiswal, A. K., et.al., 2019)

A self-supervised deep neural network was suggested. The evaluation's findings showed that the technique could improve recognition without needing a significant amount of labeled training data. For several datasets, the results were compared, but not with other deep learning model techniques (Gazda, M., et.al., 2021).

This research provides the COVID-DeepNet model was proposed as an effective deep-learning model for COVID-19 recognition. The model can accurately distinguish between pneumonia with COVID-19, pneumonia without COVID-19, and normal circumstances (Panthakkan, A., et.al. 2021). It is impossible to evaluate the model's ability to recognize pneumonia using huge datasets because it was only intended to work with short datasets.

Previous research (Wang, S. H., et.al, 2021) introduced the "Deep Fractional Max Pooling Neural Network (DFMPNN)" model, which improved pneumonia recognition accuracy by replacing the standard max pooling and average pooling methods of neural networks with a new pooling method. However, because the sample was so tiny, it was possible to try more sophisticated pooling methods. Tahir et al. [10] research Using deep convolutional neural networks, COVID-19, SARS, and MERS X-ray pictures were categorized. Finally, four highly effective algorithms—SqueezeNet, ResNet18, InceptionV3, and DenseNet201—were described. A related comparison analysis was carried out. Although the article employed a variety of datasets, none of the techniques to enlarge the dataset, such as data augmentation, were used (Tahir, A. M., et.al. 2022).

A previous article (Loey, M., et.al. 2022) suggested a convolutional neural network model for pneumonia recognition in chest X-ray images that is based on Bayesian optimization. This type is more precise and dependable in actual applications. However, this work lacked a comparison with other models in terms of computational effectiveness.

Methodology

Using Convolution Neural CNN's transfer learning techniques and CNN's deep learning network, VCG, MobileNet, we execute the classification in our suggested method to determine if the person has pneumonia or not. To guard against curative treatment and boost survival rates, pneumonia must be detected early. Therefore, accurate classification is crucial for the correct therapy, which will be made feasible by applying the method we have suggested.

Create Dataset: The dataset containing images of Chest X-ray images of pneumonia and normal patients is divided into training and test datasets, with the test size being 30%–20%.

1. **Pre-processing:** Resizing and reshaping the photos into the proper format for our model to learn from. We pre-process the data by Resizing and Reshaping the images. *Fromfkeras. Preprocessing.image import ImageDataGenerator.*

2. **Training:** The pre-processed training dataset, the CNN method, as well several transfer learning techniques, are used to train our model. Import The Picture. The collection contains 1200 photos for training and 270 for testing, and we begin by importing our images from the training directory. The desired size here is 64 by 64, which corresponds to the expected CNN that we set before in the Building the CNN section. Then there's the batch size, which is the size of the batch in which a random sample of our image will be included, as well as the number of images that CNN will examine before updating the weight. Finally, the categorical mode (class mode). In VCG the target size is 128. In Mobile Net target size is 224.

3. **Classification:** Our model's output is a display of X-ray pictures that are either pneumonia-related or not.
Classifier.add(Convolution2D(512, (3, 3), input_shape=(64, 64, 3), activation='relu',strides=(3,3)))
Here we have 512 filters. (3,3) is the kernel size It is to be noted kernel size will always be odd.

Results and Discussion

Three different algorithms are used to find pneumonia seen on chest X-rays. The dataset is trained to fit the model using the tensor flow. A graph for accuracy and loss is produced following the classification of the model using the Keras library. VCG, CNN, and the Mobile Net algorithm are employed in this analysis. Here is an example of a website where users can submit their chest X-rays and learn whether they have pneumonia or not. To determine which model produces the best results, three models are rendered on the testing page. With the aid of deep learning, the reliability of the model is displayed on the result page. It is classified as confirming the presence of pneumonia as depicted in Figure 1 and 2.

Figure1. Accuracy Graph

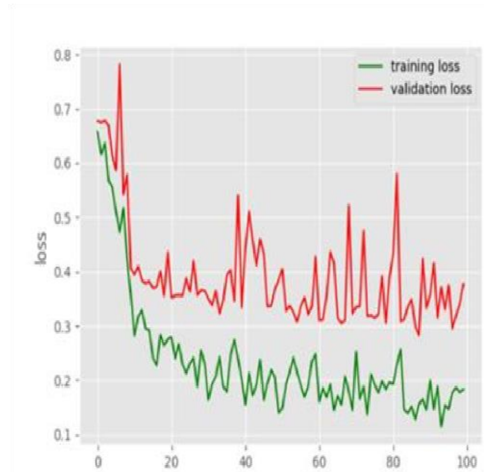

Figure 2. Loss Graphs

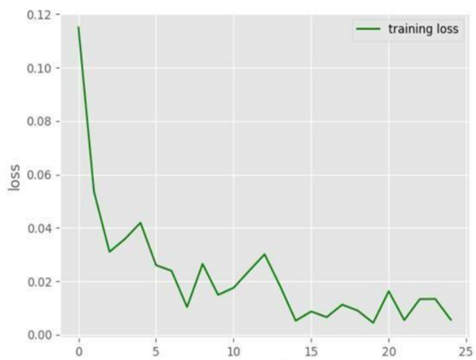

Figure 3. Mobile Net Loss Graph

Figure 4. Mobile Net Accuracy graph

Figure 5. VGG Accuracy Graph

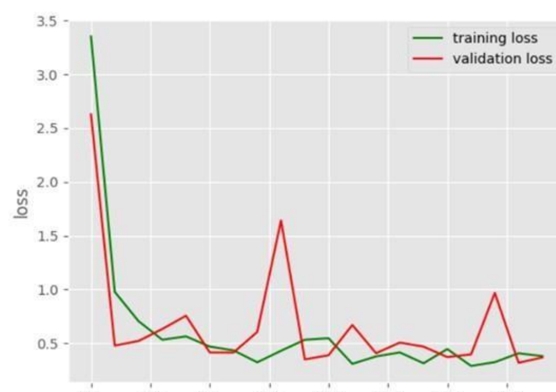

Figure 6. VGG Loss Graph

Deep learning models are used to categorize chest X-ray images of a person as normal, or pneumonia affected. To train a dataset of two different types of chest X-ray pictures (pneumonia-affected and normal), CNN and several transfer learning methods were utilized. The dataset that was obtained from a public forum is preprocessed after the model has been trained to choose the optimum algorithm. In the sphere of medical science, this algorithm is quite helpful. According to testing and training, Mobile Net can diagnose whether or not a person has pneumonia based on an x-ray. In comparison to other trained models, the validation accuracy of the CNN classifier model with two transformation models—VCG and Mobile Net—is 93.5%, 83.6%, and 98.2%, respectively as depicted in Figure 3, 4, 5 and 6.

Net has a high score. With 93.3 percent validation accuracy, the CNN classifier model with convolutional layers also comes close. Both the 98.2 percent and 93.5 percent scores appear to be good enough to allow real-time model use by medical analysts. Both variants have nearly identical performance. This model may also be used to detect covid 19 with some modifications. One of the major symptoms, if not the most significant, is pneumonia. Many clinical specialists found it difficult to identify patient disease during the epidemic, and many people were misdiagnosed.

Conclusions

The CNN classifier model with convolutional layers performs reasonably well, with a validation accuracy of 93.3 percent. The 98.2 percent and 93.5 percent scores seem to be sufficient for medical analysts to employ the model in real-time. The performance of the two variations is almost the same. With slight adjustments, this model can also be used to identify COVID-19. Pneumonia is one of the main symptoms, if not the most important one. During the pandemic, many clinical specialists had trouble diagnosing patient conditions, leading to many incorrect diagnoses. The model can be implementing this model to check covid 19. This can solve many problems that a common man faces in figuring out what has happened to him. The rural side was affected a lot with low clinical expertise to identify their issue. This model can be trained with more datasets, also on the privately available dataset. So that it can be used on real real-time basis. This project would recommend using Mobile Net out of three other neural network models.

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