

Chapter 5

A Convolutional Neural Network (CNN)–Based Pneumonia Detection Using Chest X–Ray Images

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ABSTRACT

Pneumonia is a fatal illness; an infection that occurs in one or both human lungs. It is caused by either bacterial or viral infection. Pneumonia impacts mostly elders, as well as children under five. Thus, the early diagnosis of pneumonia can help the patient. So, an image classifier may help to diagnose patients with pneumonia in an automated and fast way. Chest X-rays (CXR) are frequently used to diagnose pneumonia and make many clinical decisions. Deep learning enhancements, especially impressive performances in picture categorization, have been demonstrated by convolutional neural networks (CNNs). In this chapter, the authors primarily concentrated on the capability of deep CNN, feature extraction approaches, and various machine learning classifiers for detecting pneumonia using X-ray image datasets. It also discusses various measures for calculating the performance of the model like accuracy, precision, recall, and f1 scores.

1 INTRODUCTION

A common communicable disease is a pneumonia, which is the result of microbes, virus, or fungi. Pneumonia is a respiratory infection that results in long-term lung damage. When a healthy individual inhale, he or she exhales slowly and deeply. Alveoli are little sacs that fill with air. The lungs are in the

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process of being formed. A patient who suffers from pneumonia experiences difficulty breathing and low oxygen levels because their lungs become filled with pus and fluid. This bacterium is extremely harmful for youngsters under the age of five, as well as those in their declining years (Rahman et al., 2020). Various signs, such as bodily weakness, old age, disease, inadequate nutrition, and a weaker immune system, are linked to the prevalence of bacterial pneumonia. It is dangerous for persons of different ages, and it is higher risk for smokers, drinkers, recent surgical patients, asthmatics, people with a weaker inflammatory response, and people who have just had surgery. and people with a feeble immune system. Fortunately; antibiotics and antiviral medicines are often effective in treating pneumonia. X-rays indicate pneumonia by showing an abnormal area known as lung opacity, which appears opaque compared to the surrounding tissues as the light attenuates in the lung (Al Mamlook et al., 2020; Yee & Raymond, 2020). Early identification and treatment of pneumonia, on the other hand, are critical in preventing death. Pneumonia can be diagnosed using a variety of techniques, including chest X-rays, CT scans, chest ultrasounds, and chest MRIs. In modern medicine, the most common type of radiography is a chest x-ray and well-known method of detecting pneumonia. More than 850,000 individuals died of pneumonia in 2017. In South Asia and Sub-Saharan Africa, pneumonia is a leading cause of death. According to a survey published in 2017, the fatality rate from childhood pneumonia was more than half in five countries, namely Pakistan, India, Ethiopia, Nigeria, and the Republic of Congo, and was dubbed the “ultimate illness of poverty.” This demonstrates that pneumonia mortality has a substantial relationship with a country’s income.

In rare circumstances, pneumonia appears indistinct on chest x-ray pictures and is mistaken for another disease. When it involves diagnosing pneumonia, those variations ended in a variety of subjective judgments and versions among radiologists. As a result, a computerized internet is needed to help radiologists with inside the avoidance of x-ray-precipitated pneumonia. Using deep learning approaches, Convolutional Neural Networks (CNNs) have achieved excellent results in image categorization and segmentation. The use of data analysis, machine learning, and deep learning algorithms in 21st-century healthcare has assisted complex explaining relationships and developing clinical prediction models (Liang & Zheng, 2020; Muhammad et al., 2021; Sirazitdinov et al., 2019). Deep learning techniques are currently being employed in medical applications to identify images using convolutional neural networks (CNNs). Deep Learning techniques like Convolutional Neural Network (CNN) have lately been used for picture classification tasks as a result of their success in other domains, particularly in medical applications. On the basis of X-ray scans, machine learning techniques are used to predict Pneumonia. Clinical personnel would be able to view real-time information on a patient’s condition and risk level, which would allow for the quick addition of diagnostic tests. To that end, the use of investigative methods and predictive methods, such as Machine Learning algorithms, is essential for clinical decision-making and for assisting radiologists and doctors in avoiding misdiagnosis (Militante et al., 2020). The aim of this study is to discover if chest X-rays can be used to detect pneumonia using Machine Learning. This chapter compares and contrasts three contemporary machine learning classifiers. Support Vector Machine (SVM), Logistic Regression, and AdaBoost Classifier are three of the most used machine learning algorithms, To investigate and test the accuracy of machine learning techniques and convolutional neural networks (CNNs) for classifying Pneumonia using Chest X-ray pictures, on chest X-ray pictures to prevent pneumonia, and the suggested framework’s performance is evaluated using metrics such as accuracy, specificity, sensitivity, and F1-score are used to evaluate the performance of the system. This study was focused on being able to classify this disease with high accuracy. The bellow Figure 1(a) and (b) shows the comparison between Normal X-ray and Pneumonia X-ray respectively.

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