CNN ALGORITHM BASED PNEUMONIA RECOGNITION WITH REAL-TIME PATIENT STATUS MONITORING

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ABSTRACT

Pneumonia is a prevalent and potentially severe lung infection that primarily targets the respiratory system. This condition is marked by the inflammation and infection of the air sacs within the lungs, occurring in either one or both. This results in the manifestation of symptoms like coughing, elevated body temperature, labored breathing, and chest discomfort. Pneumonia continues to pose a significant worldwide public health challenge, leading to significant levels of illness and death. Therefore, it is imperative to identify pneumonia swiftly and precisely to ensure effective patient care and enhance overall results. Moreover, for every disease the process of detecting that disease at the very early stage is crucial with accurate technology. pneumonia detection is necessary not only for individual patient well-being but also for public health, epidemiological tracking, and healthcare resource management. So we propose a comprehensive solution for pneumonia detection using Convolutional Neural Networks (CNNs) and an integrated website for real-time patient status monitoring. In addition to pneumonia detection, we have developed a user-friendly website that allows healthcare providers to access patient information and X-ray results with a simple button press. This web-based platform provides real-time updates on patient status, streamlining communication and decision-making within healthcare facilities. It augments collaboration among medical staff, reduces response times, and ultimately improves the quality of care delivered to pneumonia patients. Our CNN-based algorithm leverages Deep Learning techniques to analyze chest X-ray images with high accuracy and speed. By training the model on a diverse dataset of X-ray images, it can effectively identify signs of pneumonia, providing quick and reliable results. This automated approach significantly enhances the diagnostic process, enabling healthcare professionals to make timely decisions and improve patient outcomes.

Keyword: - *Pneumonia, pneumonia detection, CCN-Convolutional Neural Network, Chest X-ray, real-time patient status monitoring, deep learning techniques*

1. INTRODUCTION

In recent years, the use of Convolutional Neural Networks (CNNs) has revolutionized the field of medical diagnostics, particularly in the early detection of pneumonia from chest X-ray images. This comprehensive overview explores various studies and research papers that leverage deep learning techniques, transfer learning, and CNN architectures to develop robust pneumonia detection models. These advancements not only enhance diagnostic accuracy but also have the potential to reduce mortality rates associated with pneumonia. Furthermore, the

integration of real-time patient status monitoring through web-based platforms demonstrates the transformative power of technology in healthcare, offering efficient communication, collaboration among medical professionals, and ultimately improving the quality of care for pneumonia patients. Such monitoring provides information streaming at zero or low latency, so there is minimal delay between data collection and analysis. It enables quick detection of anomalies, performance issues and critical events. The fusion of deep learning technology with healthcare offers a promising path towards more effective disease management by developing an intelligent patient monitoring system that automatically collects and transmits patient's biological data via sensors and IoT networks to provide real-time health condition monitoring additionally serving as a beacon of innovation in the field of medicine.

2. MILESTONES

In 2019, The paper titled "Detection of pneumonia from Chest x-rays using a convolutional neural network architecture" [1] was published by Sabyasachi Chakraborty, Satyabrata Aich, Jong Seong Sim and Hee-Cheol Kim. In this article, it describes that accurate and timely diagnosis of pneumonia is of paramount importance for both children and adults, as pneumonia claims approximately 50,000 lives annually worldwide. Ensuring effective treatment and a cure for this disease is imperative to prevent unnecessary fatalities. Traditionally, healthcare professionals have relied on chest X-rays to detect and diagnose pneumonia, as they offer a quick and cost-effective means of identifying the illness. In a recent study, a convolutional neural network (CNN) was developed to enhance the diagnostic process by analyzing chest X-rays. This CNN was designed to pinpoint the specific spatial locations of activations that contributed to the detection of pneumonia within the X-rays. The model's performance in this research was impressive, boasting an accuracy rate of 95.62%. Additionally, the model achieved an average precision of 96% and a recall rate of 95%, further demonstrating its effectiveness in diagnosing pneumonia. This breakthrough in utilizing advanced technology to improve pneumonia diagnosis not only enhances the speed and accuracy of detection but also holds significant promise for reducing mortality rates associated with this deadly disease. By harnessing the power of machine learning and convolutional neural networks, healthcare professionals can better equip themselves to save lives through early and precise pneumonia diagnosis and treatment.

The paper named "Predictive Analysis on Multimodal Medicare Application" [2] by Ritik Sharma, Sugandhi Midha and Amit Semwal was released in October 2022.This paper will mostly discuss the use of predictive analytics in healthcare and various prediction models that may be employed to address issues with such catastrophic illnesses.In order to provide reliable insights into prediction, predictive analysis today focuses on predicting future occurrences that are impacted by previous actions and behavior. It does this by using principles from machine learning, deep learning artificial intelligence, statistics, data analytics, and mathematical modelling. Financial, retail manufacturing, and marketing are just a few of the industries that tools are suggested on. Predictive analysis, however, has shown to have a higher influence on doctors and patients in the healthcare industry for analyzing health conditions, procedures, and therapies that reduce possible dangers associated with identifying the underlying causes of patients' ailments. It sought to enhance medical treatments by using cutting-edge technology to deliver better services and diagnoses. For improved medical practices, predictive analysis offers specialized and automated techniques to search for illnesses in a bigger data set that includes historical patient test volumes and their diagnostic histories. With benefits such as appointments, routine checkups, disease prevention, fraud detection, and resource savings, combining current tools used in the healthcare sector with advanced tools can also help in the prevention of future diseases in patients by reducing potential risk of abnormality in them.

The article titled "CheXNet: Radiologist-level pneumonia detection on chest x-rays with deep learning" [3] inscribed by Pranav Rajpurkar, Jeremy Irvin, Kaylie Zhu, Brandon Yang, Hershel Mehta, Tony Duan, Daisy Ding was published in 2017.The paper instigates that of creating an algorithm that is capable of detecting pneumonia from chest X-rays at a level higher than radiologists in practice. With over 100,000 frontal-view X-ray scans of patients with 14 disorders, ChestX-ray14 is now the biggest publicly accessible chest X-ray dataset. Our system, CheXNet, is a 121-layer convolutional neural network trained on this dataset. On a test set that included annotations from four active academic radiologists, we compare CheXNet's performance to that of radiologists. On the F1 measure, we discover that CheXNet performs better than the typical radiologist. To identify all 14 diseases in ChestX-ray14, we expand CheXNet and obtain cutting-edge findings for all 14 diseases.

The article entitled "Understanding of a convolutional neural network" [4] composed by Saad Albawi, Tareq Abed Mohammed and Saad Al-Zawi was released in 2017.This paper brings forth Artificial neural networks (ANN) with

several layers referred to as deep neural networks or deep learning and assumes that the readers are familiar with artificial neural networks and machine learning. The components of CNN, their functions, and all other significant problems will be discussed in detail in this paper. It will also list the factors that affect CNN effectiveness. It has been regarded as one of the most potent tools over the last several decades and has gained a lot of popularity in the literature due to its ability to handle enormous amounts of data. Deeper hidden layers are now starting to outperform traditional approaches in a variety of applications, including pattern recognition. Convolutional Neural Networks (CNN) are among the most often used deep neural networks. Convolution is a mathematical linear action between matrices that gave rise to the term. Convolutional, non-linear, pooling, and fully connected layers are among the many layers that make up CNN. Pooling and non-linearity layers lack parameters, but convolutional and fully connected layers do. In machine learning issues, the CNN performs quite well. Particularly the image-related applications, such as the biggest image classification data set (Image Net), computer vision, and natural language processing (NLP), and the outcomes attained were truly astounding.

"Feature extraction and classification of chest x-ray images using cnn to detect pneumonia" [5] was a paper published in 2020 by Harsh Sharma, Jai Sethia Jain, Priti Bansal and Sumit Gupta. The study reveals that when left untreated, pneumonia is an illness that inflames the lungs and can be fatal. Chest X-rays are frequently used to diagnose pneumonia, but they must be carefully examined by a professional. An expert must spend more time and be less accurate when diagnosing pneumonia using chest X-ray pictures. In this study, we present several deep convolution neural network (CNN) architectures to extract characteristics from chest X-ray pictures and categorize the images to determine if a patient has pneumonia The outcomes of our study were subsequently published, shedding light on the effectiveness of various CNN architectures in pneumonia detection and the significance of dataset size in enhancing the accuracy of these models. This research contributes to the advancement of pneumonia diagnosis methods, potentially leading to more timely and accurate detection, which can be crucial in saving lives.

In December 2020, Rachna Jain, Preeti Nagrath, Gaurav Kataria, V. Sirish Kaushik and D. Jude Hemanth written and published a paper entitled "Pneumonia detection in chest Xray images using convolutional neural networks and transfer learning" [6]. This paper outlines that every year, pneumonia claims the lives of a significant number of youngsters globally. Up to five-year-old children had an estimated 1.2 million bouts of pneumonia, of which 880,000 resulted in fatalities in 2016. As a result, pneumonia is a leading cause of death in children, with South Asia and Sub-Saharan Africa having high incidence rates. Pneumonia is one among the top 10 killers, even in a sophisticated nation like the United States. In nations with a high frequency, early diagnosis and treatment of pneumonia can considerably lower child death rates. As a result, this article provides convolutional neural network models for x-ray image-based pneumonia detection. By adjusting different parameters, hyperparameters, and the number of convolutional layers, many convolutional neural networks were trained to categorize x-ray pictures into two groups, namely pneumonia and non-pneumonia. The report makes mention of six models. The first and second models, respectively, include two and three convolutional layers. The remaining four models—VGG16, VGG19, ResNet50, and Inception-v3—are pre-trained models. The validation accuracy for the first and second models is 85.26% and 92.31%, respectively. ResNet50, VGG16, VGG19, and Inception-v3 are each 87.28%, 88.46%, 77.56%, and 70.99% accurate, respectively.

The paper titled "Transfer learning with deep convolutional neural network (CNN) for pneumonia detection using chest X-ray" [7] by Tawsifur Rahman, Muhammad EH Chowdhury, Amith Khandakar, Khandaker R. Islam, Khandaker F. Islam, Zaid B. Mahbub was published in 2020.This focuses of a bacterial or viral infection that can produce the potentially fatal illness pneumonia, which affects the lungs. Early pneumonia diagnosis is crucial since it can be life-threatening if treated improperly. The purpose of the article is to use digital x-ray pictures to automatically identify viral and bacterial pneumonia. Following a thorough description of improvements in the accurate identification of pneumonia, the approach used by the authors is presented. Transfer learning was carried out using four distinct pre-trained deep convolutional neural networks (CNNs): AlexNet, ResNet18, DenseNet201, and SqueezeNet. For the transfer learning-based classification task, a total of 5247 chest X-ray pictures, including bacterial, viral, and regular chest x-ray images, were preprocessed and trained. The authors of this study have presented three categorization schemes: normal pneumonia vs viral pneumonia, bacterial pneumonia versus viral pneumonia, and normal, bacterial, and viral pneumonia. Normal and pneumonia pictures, bacterial and viral pneumonia images, and normal, bacterial, and viral pneumonia images all had classification accuracy of 98%, 95%, and 93.3%, respectively. This is the greatest accuracy among those reported in the literature, in any scheme. As a result, the suggested study may aid in the faster diagnosis of pneumonia by the radiologist and in the speedy screening of pneumonia patients at airports.

In 2022, the paper named "Deep Learning applications to detect pneumonia on chest X-ray: A systematic study" [8] was formulated and issued by Neenu Sebastian and B. Ankayarkanni. The paper mainly suggests the effect of pneumonia in air sacs of our lungs and other parts of our body. Our ability to breathe depends on the function of our air sacs. These air sacs fill with pus or fluid when the lungs get infected by bacteria or viruses. As a result, this infection results in a fever, a cough, and pneumonia, a hazardous medical disease. This illness can range in intensity from moderate to severe. For newborns, young children, and the elderly, it becomes a life-threatening scenario. Chest X-rays are used by the doctors to confirm the infection. It takes time for the doctors to visually examine the chest x-rays and determine whether the patient has pneumonia. Doctors are assisted by computer-aided diagnostics in the quicker and more precise recognition of pneumonia infection on chest X-rays. For the confirmation of pneumonia, computer-aided diagnosis employs CNN models, which have outperformed humans in performance.

"Deep learning for automatic pneumonia detection" [9] was a paper published in 2020 by Tatiana Gabruseva, Dmytro Poplavskiy and Alexandr Kalinin. The paper illustrates that one of the primary causes of mortality worldwide and among young children is pneumonia. By carefully examining a chest X-Ray radiograph, highly trained physicians can typically diagnose pneumonia. This tiresome process frequently results in a dispute amongst radiologists. Systems for computer-aided diagnostics had the potential to increase diagnostic precision. In this study, we offer a computational method based on single-shot detectors, squeeze-and-extinction deep convolution neural networks, augmentations, and multi-task learning for detecting pneumonia areas. The suggested method was tested as part of the Radiological Society of North America's Pneumonia Detection Challenge, and it produced one of the challenge's top outcomes.

The publication entitled "Detection of pediatric pneumonia from chest X-ray images using CNN and transfer learning" [10] was published in 2020 by Gaurav Labhane, Rutuja Pansare, Saumil Maheshwari, Ritu Tiwari and Anupam Shukla. One of the most lethal diseases affecting the lungs is pneumonia. A chest x-ray that is read by a radiologist is used to make the diagnosis. An automated technique for the identification of pneumonia using x-rays is required because human aided diagnosis has constraints of its own, such as cost, availability of an expert, etc. In this study, neural network models were created to analyze chest x-ray pictures and identify pneumonia. Four models were created using transfer learning and CNN, including a simple convolutional neural network (CNN), VGG16, VGG19, and InceptionV3. The models were then trained using a dataset of paediatric pneumonia that included 2992 pneumonia cases and 2972 healthy chest x-rays. After that, the models were tested using 854 photos of pneumonia and 849 photographs of normal people, and all models demonstrated an accuracy of more than 97 percent.

In June 2020, the paper named "Chest X-ray pneumonia detection based on convolutional neural networks" [11] was issued by Zebin Jiang. This paper portrays of an overview of Chest X-ray pictures that make it challenging for non-experts to determine whether the patient has pneumonia. The efficiency of diagnosing pneumonia will increase and the burden of the doctors will decrease if the convolutional neural network is utilized to do this task. This study is therefore extremely important. Chest X-ray pneumonia diagnosis tasks are handled by several convolutional neural network variations, including InceptionResNetV2, Xception, DenseNet201, and VGG19. Additionally, the entire procedure is presented, including dataset selection, dataset processing, and chest X-ray pneumonia identification. Convolutional neural network-based chest X-ray pneumonia detection can increase training speed and detection accuracy, with the maximum accuracy reaching 94.20%, according to experimental data.

Vikash Chouhan, Sanjay Kumar Singh, Aditya Khamparia, Deepak Gupta, Prayag Tiwari, Catarina Moreira, formulated and published a publication titled "A novel transfer learning based approach for pneumonia detection in chest X-ray images" [12] in 2020.This publication proclaims that one of the leading illnesses that lead to the majority of fatalities worldwide is pneumonia. Pneumonia can be brought on by a virus, bacterium, or fungus. However, a chest X-ray alone cannot accurately diagnose pneumonia. The purpose of this study is to make pneumonia identification easier for both specialists and beginners. Utilizing the idea of transfer learning, we propose a novel deep learning framework for the diagnosis of pneumonia. Using several neural network models that have been trained on ImageNet, features from pictures are retrieved in this method and put into a classifier for prediction. Five distinct models were created, and their performance was evaluated. To get the best performance in pneumonia recognition, there is a suggestion of an ensemble model that incorporates the outputs from all pretrained models. This model surpassed individual models. On unseen data from the Guangzhou Women and Children's Medical Centre dataset, our ensemble model achieved an accuracy of 96.4% with a recall of 99.62%.

An article was issued in December 2019, titled, "Pneumonia detection using CNN based feature extraction" [13] formulated by Dimpy Varshni, Kartik Thakral, Lucky Agarwal, Rahul Nijhawan and Ankush Mittal. The study depicts of humans who have pneumonia, a potentially fatal bacterial condition affecting one or both lungs, are frequently infected with the Streptococcus pneumoniae bacterium. According to the World Health Organisation (WHO), pneumonia is to blame for one in three fatalities in India. Radiotherapists with advanced training are required to evaluate chest X-rays used to diagnose pneumonia. Therefore, creating an automated method for diagnosing pneumonia might help treat the illness quickly, especially in distant places. Convolutional Neural Networks (CNNs) have attracted a lot of attention for illness categorization as a result of deep learning algorithms' effectiveness in analysing medical imagery. Additionally, pre-trained CNN models' features from huge datasets are quite helpful in picture classification applications. In this study, the evaluation is done on the basis of how well pre-trained CNN models perform when used as feature-extractors, followed by various classifiers, to categorize abnormal and normal chest X-rays. We use analysis to choose the most effective CNN model. According to statistical findings, using pretrained CNN models and supervised classifier algorithms to analyze chest X-ray pictures, especially to identify pneumonia, can be highly helpful.

In 2020, Mohammad Farukh Hashmi, Satyarth Katiyar, Avinash G. Keskar, Neeraj Dhanraj Bokde and Zong Woo Geem formulated and published a paper named "Efficient pneumonia detection in chest xray images using deep transfer learning" [14]. The 7% of the world's population is afflicted with pneumonia, which claims the lives of almost 700,000 kids every year. The main method for diagnosing this illness is chest X-rays. Examining chest X-rays is a difficult undertaking, even for a qualified radiologist. The accuracy of diagnosis has to be increased. The radiologists' decision-making process may be aided by the effective model for the identification of pneumonia that is developed in this study and trained on digital chest X-ray pictures. We offer a unique weighted classifier-based methodology that optimally integrates the weighted predictions from cutting-edge deep learning models including ResNet18, Xception, InceptionV3, DenseNet121, and MobileNetV3. This strategy is an aspect of guided learning in which the network forecasts the outcome based on the calibre of the training dataset. To improve the deep learning models' training and validation accuracy, transfer learning is applied. Techniques for partial data augmentation are used to evenly expand the training dataset. All the individual models can be outperformed by the suggested weighted classifier. Finally, the model is assessed based on the AUC score as well as test accuracy. On the unseen data from the pneumonia dataset from the Guangzhou Women and Children's Medical Centre, the final claimed weighted classifier model can obtain a test accuracy of 98.43% and an AUC score of 99.76. As a result, the suggested model may be applied to provide a prompt diagnosis of pneumonia and can help radiology professionals make the diagnosis.

"Pneumonia detection using convolutional neural networks" [15] was paper published in 2020 by Shanay Shah, Heeket Mehta and Pankaj Sonawane. This paper gives an overview of Pneumonia which is a deadly illness that primarily affects the elderly and occasionally poses a threat to life. Pneumonia identification at an early stage is crucial for saving many lives. This study tries to identify and characterize people with pneumonia based on their chest X-rays. The above diagnosis is made using a convolutional neural network, which is built from scratch and produces incredibly accurate findings. When issued patient X-rays, deep learning models streamline the procedure and guarantee prompt, skillful, and qualified outcomes. After the image is fed through several convolutional and max pooling layers that are triggered by using the ReLU activation function, which is then fed into the neurons present in the dense layers, and finally, the output neuron is woken up by the sigmoidal function, classification takes place. As the model learns and reduces loss concurrently, the accuracy rises. Implementing data augmentation prior to training the model helps avoid overfitting. In order categorize chest X-rays for the detection of pneumonia, the suggested deep learning models produce reliable and appealing results.

3. CONCLUSIONS

In accordance with the research, it demonstrates of the potential of CNN algorithms in automating the detection of pneumonia from chest X-ray images. It can serve as a valuable tool to aid healthcare professionals in their diagnostic process. Through the utilization of Convolutional Neural Networks (CNNs) and the integration of real-time patient status monitoring, we thus create a comprehensive solution that offers numerous benefits to both healthcare professionals and patients alike. Thus exemplifies the potential of combining cutting-edge deep learning technology with web-based platforms to revolutionize healthcare delivery. By addressing the challenges of pneumonia detection and patient monitoring comprehensively, we aspire to make a meaningful impact on the management and treatment of this critical respiratory condition, setting a precedent for the integration of innovative solutions in healthcare. Our work underscores the importance of leveraging technology to enhance patient care, reduce healthcare disparities,

and ultimately save lives. By addressing the challenges of pneumonia detection and patient monitoring comprehensively, we aspire to make a meaningful impact on the management and treatment of this critical respiratory condition, setting a precedent for the integration of innovative solutions in healthcare.

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