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A Survey on Machine Learning Model for Diagnosis of Pneumonia and Bronchitis

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ABSTRACT: Pneumonia is a respiratory disease has a significant negative influence on universal health and is the leading infectious source of mortality in children worldwide. The automatic identification of pneumonia has attracted a lot of attention in recent years thanks to machine learning (ML) and deep learning techniques. The major goal of this study is to construct a machine learning model that is practical-based and interpretable, using readily identifiable symptoms and indicators as forecaster. Using ML model, it is simple and quick to classify patients suffering from bronchitis or pneumonia. It compares the performance of Naive Bayes and decision trees classifier on the basis of accuracy, precision and execution time for disease prediction.

KEYWORDS*:* Pneumonia, Bronchitis, Machine learning, Deep learning.

I. INTRODUCTION

Pneumonia is a respiratory infection (acute) which affects the lungs. For a healthy person small sacs called alveoli in lungs are filled with air. When an individual suffering from disease pneumonia, the small sacs are filled with fluid and pus, which leads difficulty in breathing and lower oxygen level. Based on the germ causing the symptoms of infection can vary from mild to severe. Pneumonia signs and symptoms in aged person include nausea vomiting dyspnoea, chest pain, fever, sweating loss of appetite, fatigue and confusion. Bronchitis is also a lung infection of airways called bronchi, which causes inflammation of lung. The main symptom is a cough that produces yellow-grey mucus, shortness of breath, shortness of breath, sore throat and wheezing. Bronchitis can be acute or chronic. Acute bronchitis is very common which results in infection, and contagious.[10]

In order to mimic how people learn, machine learning, a subfield of artificial intelligence and computer science, enables systems to self-learn from training data. In order to produce their own predictions and gradually increase their accuracy, machine learning algorithms are able to recognise patterns in data and learn from them. A branch of machine learning called deep learning studies algorithms that are modelled after the structure and operation of the human brain. A subset of machine learning, which is a component of artificial intelligence, is deep learning (AI). The ability of a machine to mimic intelligent human behaviour is known as artificial intelligence.

Following the confirmation of pneumonia, the subject is introduced to hospital for further investigations such as a scan and arterial blood tests. Instrumental diagnosis includes blood tests, sputum tests, X-rays, and pulse oximetry. When resources and knowledge are scarce, overlapping symptoms present a substantial obstacle to the early detection and diagnosis of pneumonia patients.

Patients who have bronchitis or pneumonia may experience many of the same symptoms. Although bronchitis is defined as an acute infection of the trachea and bronchi, pneumonia is existence of fluid in the air sac. As viral infections are typically the cause of bronchitis, antibiotic treatment is typically ineffective. In contrast, antibiotic treatment is typically beneficial for pneumonia, which is a significant incentive for accurate referrals.

Using ML algorithm, symptoms predictors, and laboratory test results several studies results showed decent response in the identification of pneumonia and other respiratory diseases, which also include Chronic Obstructive Pulmonary Disease, Unfortunately, there hasn't been much study done on models that only use symptoms and indications as

forecaster, which has the disadvantages on community medical management, emphasises a lack of research in this area. Additionally, it is clear that there are a number of problems in the field: reports frequently lack a solid evidence base for their models, ML reporting is not always clear, and the literature does not specifically address how to distinguish pneumonia from other respiratory diseases with similar clinical presentations.[6]

As a result, the goal of this work was to develop an interpretable, evidence-based ML model that could identify between individuals with bronchitis and pneumonia using readily recognisable symptoms and indicators as predictors. Such algorithm is appropriate for inclusion in a diagnostic tool for the community's physical examination for pneumonia with the goal of enhancing referral and treatment options.

II. LITERATURE REVIEW

A. *Pneumonia Detection Using Deep Learning Methods*
Chest X-rays can reveal pneumonia, a respiratory infection that damages the lungs and impairs breathing. Several deep learning approaches are being utilised in medical imaging to detect and diagnose pneumonia in order to diagnose the disease at an early stage. CNN is frequently used to identify and categorise illnesses. The functionality was pre-trained in CNN models, which were then used as feature-extractors by various classifiers.[1]

The chest X-ray datasets are gathered and trained on various deep learning models, including ANN and CNN. The system will be created so that hospitals and clinics can quickly access a device for the identification of pneumonia.

B. *Detection of Pneumonia using ML & DL in Python*
An acute respiratory illness is pneumonia. The chest radiology is a crucial method in the treatment of pneumonia, and it influences many of the doctor's decisions. This method involves sorting chest radiographs into pneumonia and those without pneumonia and utilising a convolutional neural network to detect pneumonia on a chest radiographs. The most used radiography technique has flaws. As a result, this model was developed using CNN and batch normalisation, and accuracy was calculated using a confusion matrix utilising the open source programming languages Python and OpenCV.[2]

In places where there is a dearth of personnel knowledgeable in procedures like radiography, disease detection with the help of Machine and Deep learning algorithms approaches is particularly advantageous. Such tools are very affordable, require few instruments, and are therefore simple to use in rural regions. Also, these techniques will be highly useful in automatically determining who needs immediate medical attention and who can wait.

C. *Pneumonia Diagnosis on Chest X-rays with Machine Learning*
This research describes a method that uses machine learning to identify the problem with pneumonia detection. To improve classification performance and lessen the challenges of the training process, the method uses feature extraction and dimensionality reduction techniques. Several widely used deep neural networks are used in the evaluation trials to realise the diagnosis of pneumonia.[3]

The input photos are first processed to extract feature points. The feature vector of the input photos is then created using the proposed mechanism for feature clustering is generated by feature vectors are then fed into the classifier using proposed boosting method to do the classification of pneumonia. precisely which class the input image belongs to. The BOVW model and enhanced k-means algorithm have been implemented.

D. *A Deep Feature Learning Model for Pneumonia Detection Applying a Combination of mRMR Feature Selection and Machine Learning Models*

One of the illnesses that people can contract at any time is pneumonia. Pneumonia accounts for about 18% of infectious illnesses. The illness could be fatal. Lung X-ray images are routinely reviewed by the subject specialists in the medical context to determine the presence of pneumonia as a medical illness.[8]

As a feature extractor, a convolutional neural network and a few existing models of the network were used. Finally, for each deep model, the lowest redundancy maximum relevance approach was used to lower the total number of deep features. This feature set was fed into the decision tree, k-nearest neighbours, linear discriminant analysis, linear regression, and support vector machine learning models in this step of the experiment. Eventually, while all models produced encouraging results, linear discriminant analysis produced the best outcomes with a 99.41% accuracy rate.

E. *A machine learning model for supporting symptom based referral and diagnosis of bronchitis and pneumonia in limited resource settings*

It can be quite difficult to distinguish pneumonia from other respiratory illnesses just on analysis of symptoms. The challenges of diagnosing pneumonia have showed promise for machine learning algorithm. Support vector machines, Logistic regression and decision trees were put to the test and contrasted. Models were created, then tested, trained, and validated. Due to low symptom specificity, a dearth of widely accessible diagnostic testing, and variations in clinical presentation among subpopulations, pneumonia diagnosis and referral are difficult. [9]

A decision tree was the most effective model for utilising signs and symptoms to identify bronchitis from pneumonia. Compared to previously published models that relied mostly on various instrumental tests conducted and radiographs, the strong proof based design and capability to make use of symptoms to discriminate pneumonia from other respiratory condition which is similar to pneumonia offers benefit for implementation in LMICs. Machine learning models that support disease examination, early prediction, diagnosis, and proper referral must give thorough the reports of methodology , performance and place an attention on features that are simple to evaluate, like the presence of clinical signs and symptoms, in order to be most useful in resource-constrained settings.

F. *Deep Learning Techniques for the Real Time Detection of Covid19 and Pneumonia using Chest Radiographs*

Disease Covid19 is spread by the recently discovered virus, also known as a coronavirus. Given that it has infected millions of individuals worldwide, the World Health Organization has declared this virus to be a global pandemic. Humans' respiratory systems are severely damaged by an infection brought on by the Covid19 sickness, and in the worst cases, organ failures or death result.[7]
In this technique, different deeplearning CNN architectures were fed chest radiographs as input in order to extract features. When the features were extracted, the feature extracted images were given to various machine learning classifying algorithms such as kNN, Tree, SVM, RF, Naive Bayes, and AdaBoost, to identify whether the images were Covid19-infected, normal, or infected with pneumonia.

G. *Development of Pneumonia Disease Detection Model Based on Deep Learning Algorithm*

A bacterial or viral lung inflammation in people results in the life-threatening and fatal condition known as pneumonia. The earlier pneumonia is diagnosed, the more likely it is to respond favourably to treatment. Recent advances in deep learning have produced the best results across a variety of fields, particularly in the naming and categorization of human diseases. These methods use multiple zones of processing to understand the different criteria of data representation.[10]

Thus, it is necessary to construct automatic algorithm using deep learning algorithm which has power to diagnose chest radiology pictures and to provide ease of identification of pneumonia in order to increase the system performance for identifying pneumonia disease. In this paper, a convolutional neural network model for diagnosing pneumonia using chest radiographs is constructed. The two primary steps of the suggested framework are image preprocessing, feature extraction and image classification. It exceeds the most recent models described in the literature. Hence, the proposed CNN model-based pneumonia detection method's significant efficacy across all performance metrics can offer efficient patient care while lowering death rates.

H. *A classification framework for identifying bronchitis and pneumonia in children based on a small-scale cough sounds dataset*
The two most prevalent respiratory illnesses are pneumonia and bronchitis. Pneumonia is the primary reason of death in paediatrics globally and places a significant burden on healthcare systems. This study examines cough impression to categorise childhood pneumonia and bronchitis. To recognise bronchitis and pneumonia in paediatrics, a categorization framework based on cough sounds (CFCS) has been proposed. Cough noises are part of the dataset.[4]

Few cough impression include disease information, an aggregation operation was adopted to get individuals' disease characteristics. Due to the modest size of our dataset, Support Vector Machine (SVM) was used in our framework's classification stage to categorise the disorders. Also, used data augmentation to extend the amount of features in our data before classifying with a Long ShortTerm Memory Network

I. Pneumonia detection in chest X-ray images using an ensemble of deep learning model

Pneumonia is a respiratory infection caused on by bacteria or viruses that affects a lot of people particularly in emerging and poor nations includes more pollution, unhygienic living, and overcrowding, as well as a lack of adequate medical infrastructure. Pleural effusion, a condition in which fluids fill the lung and complicate breathing, is brought on by pneumonia. [11]

For successful treatment to be accessible and to enhance survival rates, early detection of pneumonia is crucial. Chest X-ray photography is the method most commonly used to diagnose pneumonia. Yet, examining chest X-rays is a Radiograph interpretation is a challenging undertaking due to uncertainty. developed a computer-aided diagnosis method in this work that uses chest X-ray radiographs to easily determine pneumonia. To address the lack of available data, we used deep transfer learning and created an ensemble of three convolutional neural network models.

Although different varieties of pneumonia can appear strikingly similar on CT scans, even skilled medical professionals may make mistakes while diagnosing the illness. In the area of machine learning, the LDA-SVM (Linear Discriminate Analysis - Support Vector Machine) classification technique is presented to deal with the problems of inefficiency, coarse granularity, and low accuracy in the face of huge data. LDA is used to extract the properties of the images, and SVM classifier is used to classify the sub-datasets with strong fusion features.

J. *Automatic Bronchitis Classification in Children Based on Cough Recordings*

Cough is a typical symptom of paediatric respiratory infections and may indicate other serious conditions as well. The conclusion made based on a cough during a routine consultation session is typically subjective judgement and heavily dependent on the experience of professionals.[5]

Based on cough recordings, made automatic classification of paediatric respiratory disorders. Employed Mel-frequency cepstral coefficients, which have been demonstrated to be effective in capturing the short-term power spectrum of speech signals in automatic speech recognition, to characterise cough aspects. Also employed support vector machines (SVMs) to classify bronchitis after feature selection on disease.

III. CONCLUSION

Due to low symptom specificity, a limitation of widely accessible diagnostic testing, and variations in clinical presentation among subpopulations, pneumonia diagnosis and referral remain challenging. In this study, Survey done on machine learning algorithms to analyse data on the characteristics of the subject population, their symptoms, and the outcomes of laboratory tests. Also studied various papers on predictors of pneumonia in dataset according to feature selection. A decision tree had the best performance when it came to separating bronchitis from pneumonia using signs and symptoms, achieving an average performance of the solid, proof based design and capability to identify bronchitis from pneumonia.

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