

Detection of Pneumonia in Chest X-ray Using Inception Google Net Classification.

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Abstract—the most vital organ in any living is the lung, which is responsible for the continuous breathing and respiration. Pneumonia patient leads to the rapid development of pus in a person's lungs caused by various factors especially most common respiratory viruses, which could lead to severe fatigue. It is very clear from the various campaigns and studies conducted by several agencies pneumonias are found to span from the young to the elderly; it is commonly attributed to lack of hygiene. The most usual method used by medical practices is utilizing the chest X-ray scans for the purpose of medical diagnosis of pneumonia patient. This practice does not give accurate diagnosis in a patient would need to consult doctor. There are several cases of clinical errors leading to false diagnosis of the disease, leading to life threatening situations. In this research, we have developed a system leveraging the deep learning architecture, Inception Google net to efficiently perform diagnosis using the chest X-rays scans of a patient to detect if the patient is affected from pneumonia, if affected also the severity of the disease in the patient is also identified, thus providing a good insight on the treatment required by the patient. The system could achieve very high accuracy in the prediction and also could be very helpful and enable patients to explore state of the art medical diagnosis systems.

Index Terms—Lung abnormality, Pneumonia disease, Deep Learning, Convolutional Neural Network, Inception Google net.

INTRODUCTION

Pneumonia is a disease that targets the lungs of a patient resulting in severe fatigue caused due to the disruption of normal respiration in the patient due to the development of mucus fluids such as sputum and phlegm. The patient is left unattended for the disease to lead to other severe lung infections thus complicating this severity of the pneumonia disease. Pneumonia is a negatively phenomenal fever that has perished the lives of several children and elderly across the globe disrupting all stages of life. It is concluded that pneumonia is responsible for the deaths of close to 13 around the globe especially in countries where hygiene is insufficient. Multiple agencies have recommended symptoms and signs that disrupt the ordinary way of life that could point to the pneumonia disease: 1) Severe pain and fatigue in the chest 2) Severe vomiting caused by the phlegm and mucus 3) Uncontrollable cough and cold 4) Severe fever and chills during the night.

RELATED WORKS

There are many papers and journals published in the field of diagnosis of pneumonia and other diseases that have been taken as reference for this research. The following are the list of all papers used for their search of medical diagnosis of pneumonia. A. Pneumonia Detection Using Deep Learning Based on Convolutional Neural Network, 2021. In the field of computer science, artificial intelligence has given rise to multiple solutions that require human intervention which is often doubted to be accurate. Artificial intelligence provides solutions to problems that require good decision making. In the field of medical research artificial intelligence has opened a vast number of opportunities to explore solutions. Especially in the medical diagnosis of disease that handle digital images such as CT scans and X-rays. For the purpose of better accuracy machine learning is used to provide an application. This paper helps in better and accurate diagnosis of pneumonia disease using lung scan images with the use of machine learning. This model is responsible for consistent diagnosis of the pneumonia disease using the lung scan images. B. A Deep Convolutional Neural Network Based Framework for Pneumonia Detection, 2021. Pneumonia is a very daring disease that has claimed the lives of 14 disease can be cured very easily. For medical diagnosis lung X-rays scans have been effectively utilized, but require a medical professional such as a radiologist for the diagnosis using the X-ray scans. There is a large demand for modern technological solutions to automate the prediction of the disease, earlier it was not cost-effective using machine learning algorithms. More than the machine learning architectures it has been understood Convolutional neural networks provide better results. In this research an algorithm using the Alex net and SVM are leveraged combined.

C. Pneumonia Detection: An Efficient Approach Using Deep Learning, 2020

Across the world pneumonia is found to be a very deadly disease. Africa is found to be the most affected from pneumonia, especially in the elder generation and newborn bringing grief to families. The WHO has recognized a pandemic for the pneumonia disease outbreak in Wuhan, China. Using the X-rays of patients, the main objective of this study is to detect pneumonia disease in patients. Medical diagnosis of pneumonia involves very heavy effort from the medical field. Deep learning architecture is used to solve this problem for doctors. In the project, an effective solution to the medical diagnosis of pneumonia is understood by comparing their search of a previous forum. D. Deep learning Enables Accurate Diagnosis of Novel Corona

virus(COVID-19)withCTimages”,2015 A pneumonia outbreak across the world has been delivered by the COVID-19 pandemic. For the purpose of diagnosis, CT scans have been used for diagnosing COVID-19. Using CT scans there is large demand for automatic systems to detect the presence of COVID-19. For comparison and modelling, CT scans of 86 healthy patients have been collected along with 88 patients affected from pneumonia and another 90 patients affected from COVID-19 have been collected. Patients affected from the COVID-19 were effectively diagnosed rightly using the deep-learning diagnosis system developed from this research paper. The results achieved from the model was found to be AUC of 0.95, recall (sensitivity) of 0.96, and precision of 0.79 in detecting COVID-19 patients, differentiating them from patients affected from pneumonia bacteria. The ground-glass opacity (GGO) has been extracted as a feature using the model achieved from this research.

E. A 3D Probabilistic Deep Learning System for Detection and Diagnosis of Lung Cancer Using Low-Dose CT Scans, 2018
Meaningful assessment has been achieved from this project using a diagnosis system for lung cancer with CT scans of lung. Coupling between detection and diagnosis component has been one considering no dual detection systems. For comparison and modeling, CT scans of 86 healthy patients have been collected along with 88 patients affected from pneumonia and another 90 patients affected from COVID-19 have been collected.

F. Automated Detection and Classification of Oral Lesions using Deep Learning for Early Detection of Oral Cancer, 2019.
The lowest of the societies are the ones most vulnerable to the wrath of oral cancer, accounting about 20 population. A synthesis of large dataset is collected. Excellent labels are being developed using annotating tools by various medical experts as part of the Me MoSA® (Mobile Mouth Screening Anywhere) project. For the task of developing the automatic system deep neural networks have been employed. Resnet-101 and Faster R-CNN as object detection algorithm have been used combined for developing the automatic system for oral cancer. From the model F1 score of 88 identification of images that contained oral cancer and 79 were normal images. The research paper proves that this difficult task can be solved by deep learning technology.

G. Spatial Pyramid Pooling with 3D Convolution Improves Lung Cancer Detection, 2020
The major proportion of cancer deaths can be attributed to lung cancer. Due to false diagnosis necessary complication has been met by multiple patients resulting in people not trusting the medical diagnosis system to identify lung cancer. The accuracy of medical diagnosis method has been improved thanks to the advent of deep learning technology. From the lung scan of a potential patient the diagnosis for lung cancer can be carried forward using the algorithm used in this project. In the future with the rise of deep learning technology the accuracy of the project can be improved significantly.

H. Patient-Specific Models for Lung Nodule Detection and Surveillance in CT Images
The goal from this research paper is to identify lung nodules from the CT images using deep learning technology. The project provides an excellent solution that could potentially prevent the patient from being exposed to the CT scans. From the lung scan of a potential patient the diagnosis for lung cancer can be carried forward using the algorithm used in this project. In the future with the rise of deep learning technology the accuracy of the project can be improved significantly.

I. FissureNet: A Deep Learning Approach for Pulmonary Fissure Detection in CT Images
The pulmonary fissure detection is a very vital solution to the rising problem of smoking. By this research paper we propose a slick solution to for the detection mechanism by effective and efficient classification and feature extraction. The provided framework is a result of twining of two different CNNs. By this way any drawback or challenges are nullified and averaged for example feature extraction from image voxels. The clinical trial of the project was carried forward with a close to thirty subjects and the dataset collected from 5000 subjects. The proposed system exhibited better results than deep learning architecture U-net architecture.

J. Quantitative Biomarkers for Cancer Detection Using Contrast-Free Ultrasound High-Definition Microvessel Imaging: Fractal Dimension, Murray's Deviation, Bifurcation Angle and Spatial Vascularity Pattern
Microvascular networks are found to be in close correlation to tumors as suggested by studies. Superior differentiation and detection can be obtained from malignant and benign tumors using this project guidelines. The objective is to achieve good insight on the microvascular networks. For this project an effective technology HDMI is used. There are multiple factors that contribute to this project outcome.

K. Variational PET/CT Tumor Co-segmentation Integrated with PET Restoration
Oncology is the study of cancer where CT and PET imaging plays a very important role. It's very easy to differentiate between PET and CT imaging based on their resolution and contrast. There is a very vast demand to effectively identify if PET or CT imaging is best for detection of cancer. The PET and CT imaging are two very different mechanisms, they can be differentiated easily by resolution and contrast. The proposed system has put forth a study to effectively identify if PET and CT which is best suited and accurate.

L. Detecting Brain Tumor in Magnetic Resonance Images Using Hidden Markov Random Fields and Threshold Techniques
Brain tumor is a very deadly disease caused by development of brain cells. The effective treatment of tumors first begins with identifying the part of the brain affected from tumor and the size of it. It's always best to keep in mind the time duration within which the medical diagnosis is to be completed. In image processing the most difficult concept is that of brain tumor detection. Utilizing the HMRF and threshold methods, this research paper proposes and advances a method for brain tumor detection.

M. Multi-label classification of brain tumor mass spectrometry data

There are multiple three hold methods to effectively identify data points that support in the effective detection and identification of boundary in brain tumors. From the lung scan of a potential patient the diagnosis for lung cancer can be carried forward using the algorithm used in this project. In the future with the rise of deep learning technology the accuracy of the project can be improved significantly.

N. An Intelligent System for Early Assessment and Classification of Brain Tumor

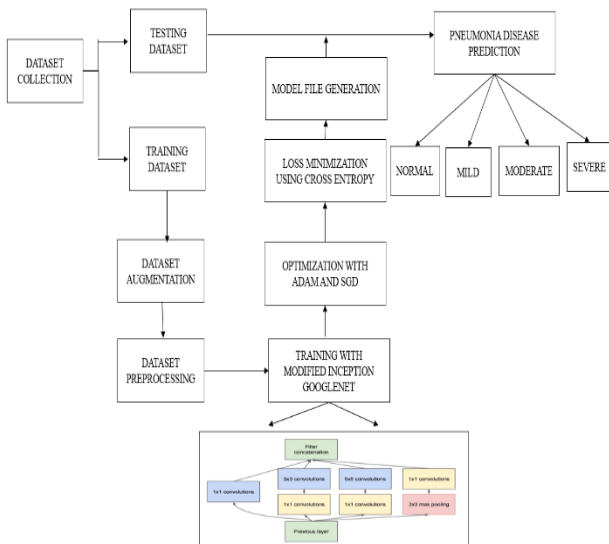
In the modern medical research, due to the advent of data mining, it has been attributed solving decision making, early diagnosis and treatment, identifying patterns in large medical data sets. This paper contributes to diagnosis of tumor in the brain using segmentation and distortion of data set. In this project, the SVM (Support Vector Machine) algorithm is utilized to effectively detect the occurrence of brain tumor in a patient at a very high success rate. The project also recommends the degree of the brain tumor.

O. Early Cancer Detection in Blood Vessels Using Mobile Nanosensors

By the vast scientific advances in the medical field especially in the field of oncology, cancer cells in a patient can be effectively identified using sensors called the nano sensor. There search closely studies the efficiency of nano sensors that are deployed to the patient, to identify the cancer cells in cardiovascular systems. Then a nano sensor if near the blood cell can efficiently identify the cancer. Using the nano sensor that are subjected to the patient's blood stream the cancer cells are effectively identified.

PROPOSED SYSTEM

The most vital organ in any animal is the lung, which is responsible for the continuous breathing and respiration. Pneumonia in a patient leads to the rapid development of pus in a person's lungs caused by various factors especially most common respiratory viruses, which could lead to severe fatigue. It is very clear from the various campaigns and studies conducted by several agencies pneumonia is found to span from the young to the elderly, it is commonly attributed to lack of hygiene. The most usual method used by medical practitioners utilizing the chest X-ray scans for the purpose of medical diagnosis of pneumonia in a patient. This practice does not give accurate diagnosis in a patient who would need to consult a doctor. There are several cases of clinical errors leading to false diagnosis of the disease, leading to life-threatening situations. In this research, we have developed a system leveraging the deep learning architecture, Inception GoogleNet to efficiently perform diagnosis using the chest X-rays scan of a patient to detect if the patient is affected from pneumonia, if affected also the severity of the disease in the patient is also identified, thus providing a good insight on the treatment required by the patient. The system could achieve very high accuracy in the prediction and also could be very helpful and enable patients to explore the state-of-the-art medical diagnosis systems.



I. MATERIALS AND METHODS

A. DATASET COLLECTION

For the purpose of medical diagnosis the data set collected is that of chest X-ray of a patient affected from pneumonia based on the severity of the disease. There are various means from which this dataset can be procured. 1) Dataset procurement from web 2) Dataset procurement from hospitals and clinics are the two most common methods used for dataset collection in this project.

1) *Data collection from the web:* The image dataset for

this project required is that of chest X-ray scans that can be collected by manually scrapping the web for the appropriate images. It is a very challenging task to collect the appropriate image dataset manually from the web. The label required from this dataset can be extracted from various annotation tools. The following are the list of accredited sites for downloading the image dataset: 1) www.kaggle.com 2) www.dataworld.com. Hospitals and clinics In the case of collecting real time image data set from the hospitals and clinics, one must visit the medical facility and obtain records of the specific case in this project we could collect the chest scans of patients affected from pneumonia according to the degree of severity of disease in the patient.

B. DATA AUGMENTATION

Dataset augmentation is a mechanism to effectively elaborate the image dataset ,by effectively altering the resolution, orientation and view of the image data set. Due to the heterogeneous nature of the image dataset collected the data set is not uniform any of the aspects beater solution, size and orientation. This disparity could lead to very poor accuracy achieved by the deep learning model. The data set preprocessing method is responsible for the effective

Standardization of the dataset in terms of resolution, size and a spectratio. The data set preprocessing is effective einreducing the noise in an image.

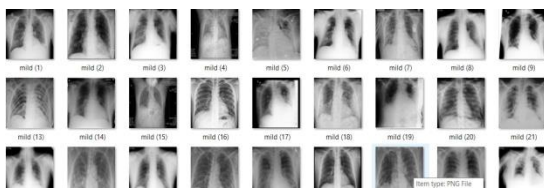
C. PNEUMONIA DETECTION USING THE INCEPTION GOOGLE NET ARCHITECTURE

In this project ,in caption googl enter is used as the deep learning architecture to achieve an automatic system for the diagnosis of pneumonia, based on the severity of the disease in the patient with the chest X-ray scans. The inception google net consist of 9 inception modules and 22 Convolutional layers. One of the major positive of this inception google net is that the model aims to reduce the input image size but retains the accuracy of the model.

The height and width of the input image can be minimized by the max-pooling layer, for which it is used. This is a very efficient method to minimize burden on the processing unit by effective making the input image less complicated by reducing various aspects such as aspect ratio and resolution using these layers.

results

The project consists of data set collected from various sources of four classes 1) Normal 2) Mild 3) Moderate 4) Severe pneumonia as describe by the image below:



The following step would be of dataset augmentation to improve the represent ability of the acquired image dataset:

Fig.3. BEFORE DATA AUGMENTATION

The below figure 4 shows the dataset after data augmentation

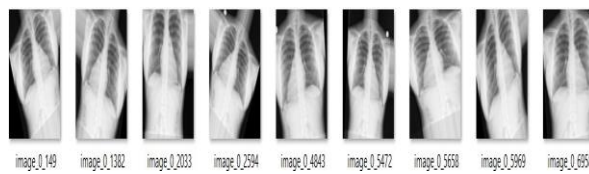


Fig.4. AFTER DATA AUGMENTATION



Fig.5.BEFORE DATAPREPROCESSING

The following step would be that of before dataset pre-processing which is to bring uniformity to the image dataset collected in Fig.1. DATA COLLECTED

The following step would be of dataset separation into the four different classes as described in the image below:

mild	17-06-2022 09:21	File folder
moderate	17-06-2022 09:21	File folder
normal	17-06-2022 09:21	File folder
severe	17-06-2022 09:21	File folder

Fig.2.DATASEPARATION

Fig.6.AFTER DATAPREPROCESSING



The following step would be to generate a model file by training the dataset with deep learning architecture inception-googlenet and obtain excellent accuracy:

```
[INFO] evaluating after fine-tuning...
```

	precision	recall	f1-score	support
mild	0.99	0.64	0.78	159
moderate	0.71	0.92	0.80	144
normal	0.77	0.94	0.85	155
severe	0.98	0.85	0.91	142
accuracy			0.83	600
macro avg	0.87	0.84	0.84	600
weighted avg	0.87	0.83	0.83	600

Fig.7.EFFICIENCY OF MODEL OBTAINED

The graph plotted for the number of epochs run can be seen in the following figure 8 below:

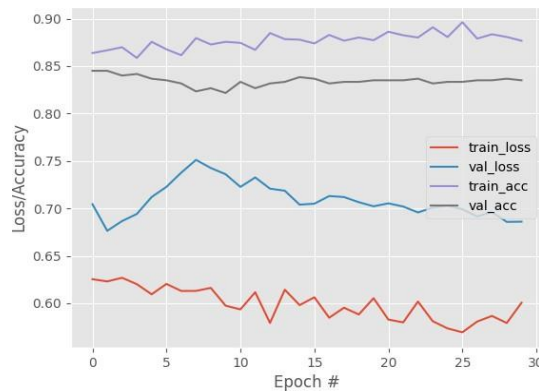


Fig.8.GRAPH PLOT OBTAINED FROM THE TRAINING PROCESS

On upload of a chest X-ray scan the severity of the pneumonia disease of a patient can be realized as shown in the image below:

Fig.9.NORMALLUNGSCANDETECTED



On uploading of a chest X-ray scan the severity of the pneumonia disease of a patient is to be found which means the patient is not affected from pneumonia: The below image displays the detection of mild lung x-ray

Fig.10.MILDLUNGSCANDETECTED

The below image displays the moderate lung x-ray:



Fig.11.MODERATE LUNGSCANDETECTED

The below image displays the severe lung x-ray:

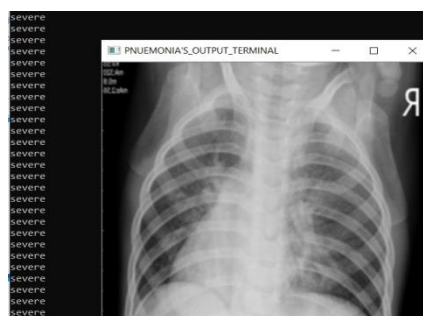


Fig.12.SEVERELUNGSCANDETECTED

CONCLUSION AND FUTUREWORK

This project provides an automatic system for efficient diagnosis of pneumonia in a patient based on the severity of the disease. The system utilizes the inception Google net to achieve the prediction model based on four classes of severity of the disease. The system provides a cost-efficient and time efficient solution to people who don't have access to adequate equality health care facility. The system is also proven to be very reliable for very high accuracy of 83% achieved using deep learning. The project has very vast potential when it comes to be developed as a benchmark for diagnosis systems using the deep learning technology. The prototype can be enhanced to be utilized a fully-fledged product in the field of health care providing affordable healthcare for the general public. The system could enlighten and encourage future enhancements in the field of deep learning appreciating the medical health care field.

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