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PNEUMONIA DETECTION USING CHEST X-RAY IMAGES THROUGH CNN

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Abstract. Pneumonia is a respiratory infection caused by bacteria or viruses. It is a condition in which fluids fill the lung, causing respiratory difficulty. It can be life threatening for people with weak immune systems. It is important to diagnose pneumonia at an early stage which helps in curing it and it increases the survival rate of the patient. Generally Chest X-ray imaging method is used for diagnosing pneumonia. But the examination of chest X-rays is a challenging task and is prone to subjective variability. In this system, we developed a computer-aided diagnosis system for automatic pneumonia detection using chest X-ray images. Various deep learning techniques are integrated into this system to improve their ability to detect the disease from their X-ray images and produce the result faster and efficiently. With the growing technological advancements we have in this day and age, it is possible to use tools based on deep learning frameworks to detect pneumonia based on chest x-ray images. The challenge here would be to aid the diagnosis process which allows for expedited treatment and better clinical outcomes. The proposed system is evaluated on two publicly available pneumonia X-ray datasets. This dataset(Kermany dataset)consists of 5856 chest X-ray images from a large population of both adults and children, unevenly distributed among the classes “Pneumonia” and “Normal”. Which obtained an accuracy rate of 0.8958%.

Keywords:

Pneumonia, CNN, Deep Learning, Chest X-ray images.

1. Introduction

1.1 About Project

In recent years, a tremendous amount of enthusiasm for deep learning, a

subfield of Machine Learning,

where the algorithms are inspired by the working of the human brain, has emerged among students,researchers and technologists from every different strata like medical science.

All deep learning models use some form of Convolutional Neural Network as their base algorithm. A Convolutional Neural Network(CNN) takes in data, trains themselves to recognize the patterns in data and predicts the output for a new set of similar data. CNN models exhibit a complex set of interconnections between inputs and outputs in order to perform a variety of tasks such as image recognition, natural language processing, music generation, even medical diagnosis and procedures.

Pneumonia is a severe acute respiratory disease which is caused when the air sacks(alveoli) in lungs are infected by some bacteria, virus or fungi to which the patient's body has weak resistance. As a result the alveoli in lungs gets filled with pus and are unable to provide oxygen to the patient's blood. Although it can be treated by medical care and vaccinations , still it's one of the major causes of death worldwide. For most radiologists, determining whether a patient is suffering from pneumonia by analyzing an x-ray image alone can be very difficult given that an x-ray can often be affected by noise generated by radiation scattering, source leakage, sensor errors, electronic devices and implantation. Therefore, building a deep learning model by training a convolutional neural network with thousands of x-ray images to determine whether a patient has pneumonia with high accuracy while taking all the noise generated into the account can be an effective solution to this problem.

1.2 Purpose

The purpose of this project is to study and construct a convolutional neural network model from scratch to extract features from a given chest X-ray image and classify it to determine if a person is infected with pneumonia. This model could help mitigate the reliability and interpretability challenges often faced when dealing with medicine. imagery.

1.3 Objectives of the Project

Our first objective of the proposed approach is to deliver a system that automates the detection of pneumonia with the help of artificial neural networks. In addition to it our approach can be used to achieve accuracy of more than average

radiologists. Moreover, it is to be helpful to those areas/populations which have inadequate access to diagnostic radiologists and to improve costs to predict pneumonia.Developing a reliable diagnostic tool for detecting Pneumonia. Helpful for both doctors and patients.

1.3 Scope of the Project

For the treatment of pneumonia it is essential to detect it early stage because it increases the survival rate. For that chest x-ray imaging method is used to diagnose. But the examination of chest X-rays is a challenging task and is prone to subjective variability.

The purpose of this project is to study and construct a convolutional neural network model from scratch to extract features from a given chest X-ray image and classify it to determine if a person is infected with pneumonia. This model could help mitigate the reliability and interpretability challenges often faced when dealing with medical. imagery.

2. Literature Survey

2.1 Existing System

A paper primarily focuses on putting forth the performances of different simple CNN architectures and selecting the best architecture based on optimum corresponding minimum loss and maximum accuracy which can serve as a viable tool for physicians and the medicine community to correctly identify and diagnose viral, bacterial, fungal-caused and community acquired pneumonia given only the chest X-ray of the patient a detailed report on advances in accurate detection of pneumonia and then presents the methodology adopted by the authors. Four different pre-trained deep Convolutional Neural Network (CNN): AlexNet, ResNet18, DenseNet201, and SqueezeNet were used for transfer learning. A total of 5247 chest X-ray images consisting of bacterial, viral, and normal chest x-rays images were preprocessed and trained for the transfer learning-based classification task.

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2.2 Proposed System

In this project we are using supervised and classification algorithms for detecting whether a person is affected with Covid-19 or not. Firstly, we will train a machine with two types of datasets. One dataset contains positive X-Ray images and another dataset contains negative X-Ray images. In this project we have used Deep Learning algorithms like CNN for classification.

3. Proposed Architecture

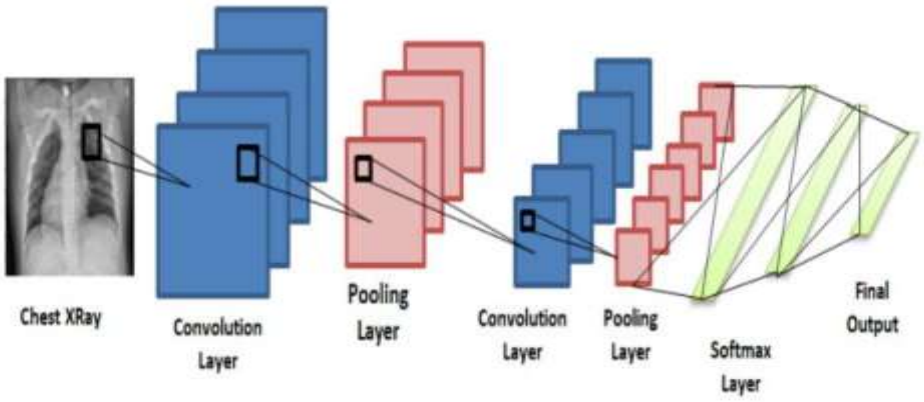

Fig: 1 Architecture

System Methodology

The main aim of our model is to predict the class of an input image with highest accuracy possible. In order to achieve that objective we need to build a custom CNN (Convolutional Neural Network). Our model's convolutional neural network mainly consists four components:

1. Convolutional Layer(Cov2D)

This layer performs a blend of linear and non-linear operations essential to perform feature extraction. Our model consists of 5 convolutionally interconnected layers which uses two dimensional kernel of size 3*3 and the 'Relu' activation function. The first cov2d layer is the input layer which provides input data to the system to be processed further by the consecutive layers of neurons. The input shape of our training data is 150 pixels in height, 150 pixels in width and color gamut value as 1 for gray scale (for RGB color gamut the value is 3), represented as 'input_shape=(150,150,1)*.

2.Pooling Layer

A pooling layer provides a typical downsampling operation which reduces the in-plane dimensionality of the feature maps in order to introduce a translation invariance to small shifts and distortions, and decrease the number of subsequent learnable parameters. It is of note that there is no learnable parameter in any of the pooling layers, whereas filter size, stride, and padding are hyperparameters in pooling operations, similar to convolution operations. This layer typically reduces the dimensionality of the features and decreases the number of trainable parameters[10] to avoid over-fitting. Our model consists of 5 max-pooling layers, each of filter size 2*2.

3. Dense Layer

The feature maps[10] are converted into a 1D array after being extracted from the last convolutional or pooling layer, this process is also called flattening.After the flattening process the output are connected to a fully connected layer called the dense layer which also uses "Relu' as activation function.

4. Output Layer

This layer is the last dense layer of our model .It gives only one output at a time and uses 'sigmoid function as activation function which gives a probability score from 0 to 1 to the output of the previous layer. The output with the highest probability score is produced by the output layer.

4. Implementation

4.1 Algorithm

Deep learning algorithms run data through several “layers” of neural network algorithms, each

of which passes a simplified representation of the data to the next layer.

1. Collecting Data:

As you know, machines initially learn from the data that you give them. It is of the utmost importance to collect reliable data so that your machine learning model can find the correct patterns

2. Preparing the Data:

After you have your data, you have to prepare it. You can do this by :

Putting together all the data you have and randomizing it.

Cleaning the data to remove unwanted data, missing values, rows, and columns, duplicate values, data type conversion, etc.

Visualize the data to understand how it is structured and understand the relationship between various variables and classes present.

Splitting the cleaned data into two sets - a training set and a testing set. The training set is the set your model learns from. A testing set is used to check the accuracy of your model after training.

3. Choosing a Model:

A machine learning model determines the output you get after running a machine learning algorithm on the collected data. It is important to choose a model which is relevant to the task at hand.

4. Training the Model:

Training is the most important step in machine learning. In training, you pass the prepared data to your machine learning model to find patterns and make predictions.

5. Evaluating the Model:

After training your model, you have to check to see how it's performing. This is done by testing the performance of the model on previously unseen data. The unseen data used is the testing set that you split our data into earlier. If testing was done on the same data which is used for training, you will not get an accurate measure, as the model is already used to the data, and finds the same patterns in it, as it previously did. This will give you disproportionately high accuracy.

6. Parameter Tuning:

Once you have created and evaluated your model, see if its accuracy can be improved in any way. This is done by tuning the parameters present in your model.

7. Making Predictions:

In the end, you can use your model on unseen data to make predictions accurately.

4.2 Code Implementation

Dataset Distribution

The dataset was collected from kaggle website and The dataset is organized into 3 folders (train, test, val) and contains subfolders for each image category (Pneumonia/Normal). There are 5,863 X-Ray images (JPEG) and 2 categories (Pneumonia/Normal).

Chest X-ray images (anterior-posterior) were selected from retrospective cohorts of pediatric patients of one to five years old from Guangzhou Women and Children's Medical Center, Guangzhou. All chest X-ray imaging was performed as part of patients' routine clinical care.

For the analysis of chest x-ray images, all chest radiographs were initially screened for quality control by removing all low quality or unreadable scans. The diagnoses for the images were then graded by two expert physicians before being cleared for training the AI system. In order to account for any grading errors, the evaluation set was also checked by a third expert.

Data preprocessing and augmentation

Data preprocessing can refer to manipulation or dropping of data before it is used in order to ensure or enhance performance, and is an important step in the data mining process. The phrase "garbage in, garbage out" is particularly applicable to data mining and machine learning projects. Data augmentation in data analysis are techniques used to increase the amount of data by adding slightly modified copies of already existing data or newly created synthetic data from existing data. It acts as a regularizer and helps reduce overfitting when training a machine learning mode

Rotation Range - The rotation range denotes the range in which the images were randomly rotated during training. For example: 40 degrees.

Width Shift - Width shift is the horizontal translation of the image.

Height Shift - Height shift is the vertical translation of the image.

Zoom Range - Zoom range is the difference in magnification from one end of the

Feature extraction

Feature extraction is a process of dimensionality reduction by which an initial set of raw data is reduced to more manageable groups for processing. A characteristic of these large data sets is a large number of variables that require a lot of computing resources to process. The process of feature extraction is useful when you need to reduce the number of resources needed for processing without losing important or relevant information. Feature extraction can also reduce the amount of redundant data for a given analysis. Also, the reduction of the data and the machine's efforts in building variable combinations (features) facilitate the speed of learning and generalization steps in the machine learning process.

Convolution is a specialized type of linear operation used for feature extraction, where a small array of numbers, called a kernel, is applied across the input, which is an array of numbers, called a tensor. An element-wise product between each element of the kernel and the input tensor is calculated at each location of the tensor and summed to obtain the output value in the corresponding position of the output tensor, called a feature map .

Classification

Classification is a process of categorizing a given set of data into classes, it can be performed on both structured or unstructured data. The process starts with predicting the class of given data points. The classes are often referred to as target, label or categories.

5. Result

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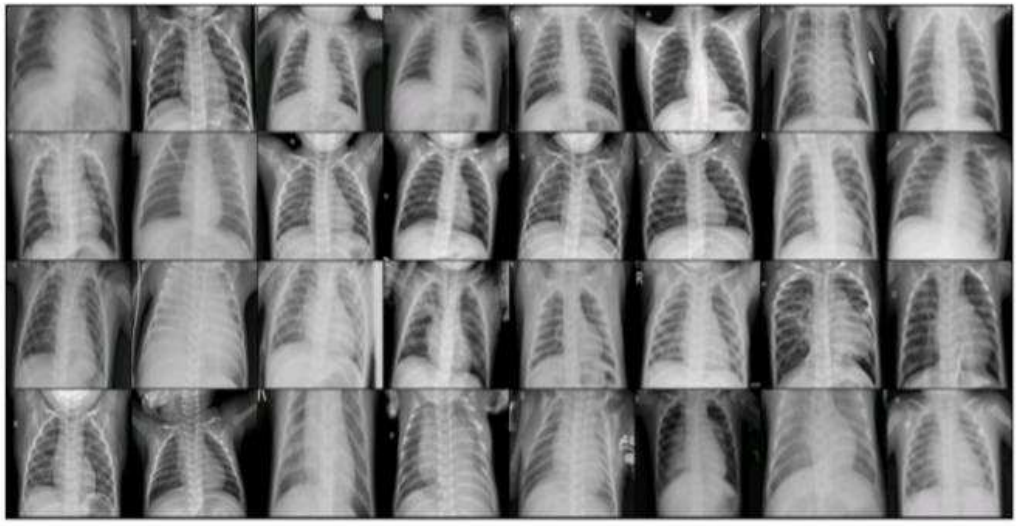


Fig 5.1.1 OUTPUT FOR PNEUMONIA CASE

The above data is considered for validation. Each Xray is studied and then validated. The validated Xray is executed with a voice output. While considering dataset from kaggle, the XRay images are divided as per the algorithm process, then if the particular person has pneumonia then an output of voice message confirms the person has pneumonia.

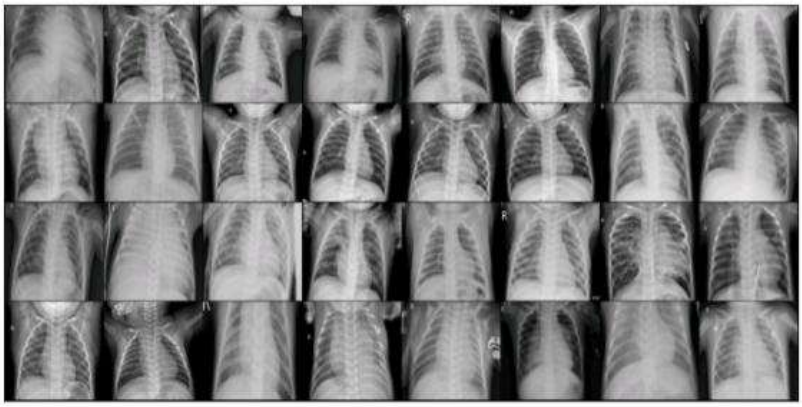
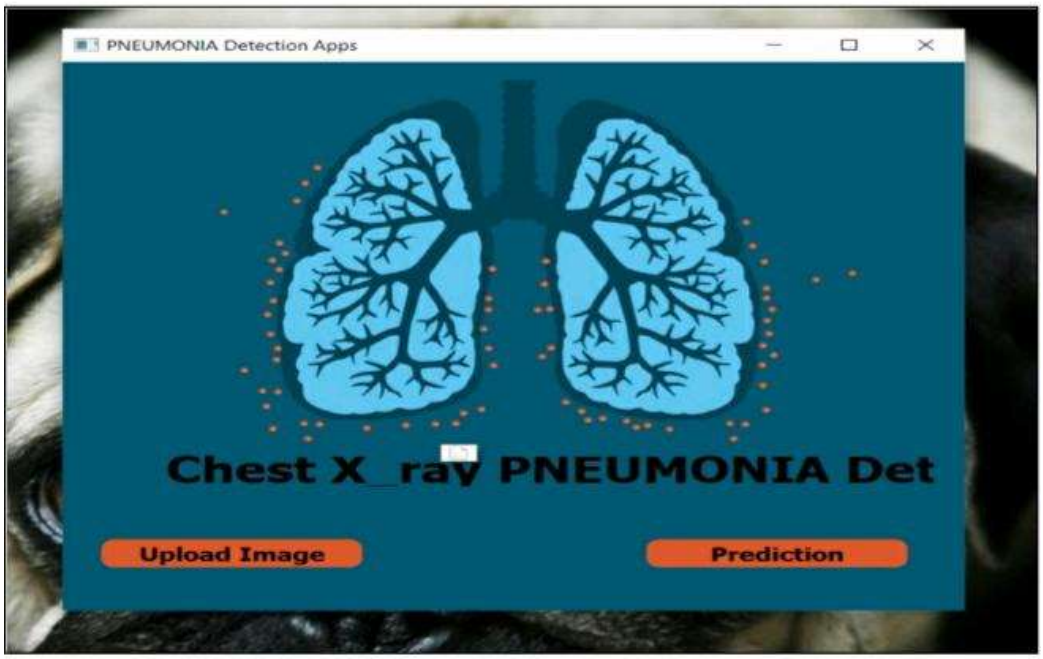


FIG NO. 5.1.2 OUTPUT FOR NORMAL CASE

And if observed that the person has no pneumonia then the voice message confirms

he has no pneumonia.



6. Conclusion

Pneumonia is a life-threatening infectious disease. For patients over 75 years, the mortality rate of pneumonia is 24.8% . In this study, an algorithm which can further support computer-aided diagnosis of pneumonia has been proposed. The deep residual network, proposed in the study, has a more complex structure but fewer parameters and higher accuracy.

Early detection of pneumonia is crucial for determining the appropriate treatment of the disease and preventing it from threatening the patient's life. Chest radiographs are the most widely used tool for diagnosing pneumonia; however, they are subject to inter-class variability and the diagnosis depends on the clinicians' expertise in detecting early pneumonia traces. To assist medical practitioners, an automated CAD system was developed in this study, which uses deep

transfer learning-based classification to classify chest X-ray images into two classes "Pneumonia" and "Normal."

While this Pneumonia detector is not a fully deployable product that can change the world, it is clear that it is easy to get started with it. It is great to witness the growth and accuracy of deep learning in such real-world scenarios. This model is robust as it can work on any of the datasets that conform to the size of the image that is required for this model. The accuracy of the system is 0.8958.

7. Future Scope

We have demonstrated how to classify positive and negative pneumonia data from a collection of X-ray images. In the future, this work will be extended to detect and classify X-ray images consisting of lung cancer and pneumonia. Distinguishing X-ray images that contain lung cancer and pneumonia has been a big issue in recent times, and our next approach will tackle this problem. And in future the system can achieve 100 percent accuracy. This would be base for more upcoming medical technology more technologies can be tested for more complicated diseases would be a step towards engagement of medical sciences and machine learning technologies which is very evident now with the growing technology.

8. References

1. RAY HARSHVARDHAN GM, MAHENDRA KUMAR GOURISARIA, SIDDHARTH SWARUP RAUTARAY*, MANJUSHA PANDEY PNEUMONIA DETECTION USING CNN THROUGH CHEST X-RAY,2021[1,4]

2. TAWSIFUR RAHMAN,AMITH KHANDAKAR,KHANDAKER R. ISLAM TRANSFER LEARNING WITH DEEP CONVOLUTIONAL NEURAL NETWORK (CNN) FOR PNEUMONIA DETECTION USING CHEST X-RAY, 2020[2,5]

3. MRIDUL MAZUMDER PNEUMONIA DETECTION, 2020[3]

4. XIANGYU, SHUI-HUAWANG, YU-DONGZHANG CGNET: A GRAPH-KNOWLEDGE EMBEDDED CONVOLUTIONAL NEURAL NETWORK FOR DETECTION OF PNEUMONIA,2021[6]
5. PRANAV RAJPURKAR JEREMY IRVIN, KAYLIE ZHU CHEXNET: RADIOLOGIST-LEVEL PNEUMONIA DETECTION ON CHEST X-RAYS WITH DEEP LEARNING [7]

6. ROHIT KUNDUID1 , RACHETA DASY2 , ZONG WOO GEEMID3 PNEUMONIA DETECTION IN CHEST X-RAY IMAGES USING AN ENSEMBLE OF DEEP LEARNING MODELS, 2020[8]

7. LUKA RAČIĆ, TOMO POPOVIĆ, SENIOR MEMBER, IEEE, STEVAN ČAKIĆ, STEVAN ŠANDI PNEUMONIA DETECTION USING DEEP LEARNING BASED ON CONVOLUTIONAL NEURAL NETWORK,2021 [9]
8. DIMPY VARSHNI , RAHUL NIJHAWAN , KARTIK THAKRAL COLLEGE PNEUMONIA DETECTION USING CNN BASED FEATURE EXTRACTION,2021 [10]