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ENSEMBLE DEEP LEARNING MODEL FOR IMPROVING TB DETECTION FROM CHEST RADIOGRAPHS

J. Joy Collin mary[1], V. Mahalakshmi[2], Dr . R . Tino Merlin [3]

1, 2 (Department of IT, UG Scholar , Francis Xavier Engineering college , Tirunelveli , India)

3(Assistant Professor ,Department of IT ,Francis Xavier Engineering College, Tirunelveli, India)

Abstract

Due to relatively cheap price and easy accessibility chest X-ray (CXR) imaging is used widely for health monitoring and diagnosis of many lung diseases (pneumonia, tuberculosis, cancer, etc.). Manual analysis and detection by CXR of marks of these diseases is carried out by expert radiologists, which is a long and complicated process. Nevertheless, the modern evolution of general-purpose graphic processing cards (GPU) hardware and software for medical image analysis, especially deep learning techniques allows scientists to detect automatically many lung diseases from CXR images at a level exceeding certified radiologists. In Our Project we are going to predict the Tuberculosis from the given X-ray images by using Deep Learning. To increase the accuracy of the prediction we use ensemble Learning Technique for multiple CNN Models (ex Lenet-5, AlexNet, VGG-16)

I . INTRODUCTION

Tuberculosis (TB) is an infectious disease usually caused by Mycobacterium tuberculosis (MTB) bacteria.[1] Tuberculosis generally affects the lungs, but can also affect other parts of the body.[1] Most infections show no symptoms, in which case it is known as latent tuberculosis.[1] About 10% of latent infections progress to active disease which, if left untreated, kills about half of those affected.[1] The classic symptoms of active TB are a chronic cough with blood-containing mucus, fever, night sweats, and weight loss.[1] It was historically called consumption due to the weight loss.[8] Infection of other organs can cause a wide range of symptoms.[9] Tuberculosis is classified as the fifth leading cause of death worldwide, with about 10 million new cases and 1.5 million deaths per year. Being one of the world's biggest threats and being rather easy to cure, the World Health Organization recommends systematic and broad use of screening to extirpate the disease. Posteroanterior chest radiography, in spite its low specificity and difficult interpertation, is one of the preferred tuberculosis screening methods. Unfortunately, since TB is primarily a disease of poor countries, the clinical officers trained to interpret these chest X-Rays are often lacking.

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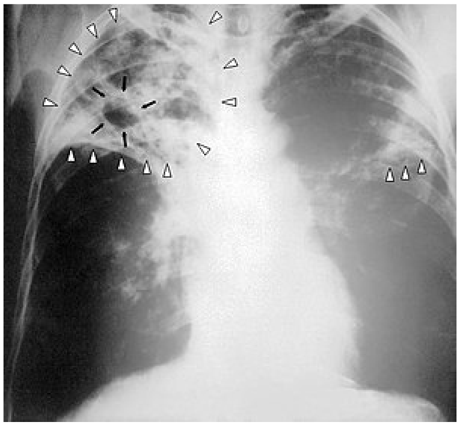

Fig.1. Chest X-Ray

As of 2018 one quarter of the world's population is thought to have latent infection with TB. New infections occur in about 1% of the population each year.[2] In 2018, there were more than 10 million cases of active TB which resulted in 1.5 million deaths. This makes it the number one cause of death from an infectious disease. As of 2018, most TB cases occurred in the regions of South-East Asia (44%), Africa (24%) and the Western Pacific (18%), with more than 50% of cases being diagnosed in eight countries: India (27%), China (9%), Indonesia (8%), the Philippines (6%), Pakistan (6%), Nigeria (4%) and Bangladesh (4%).[13] The number of new cases each year has decreased since 2000. About 80% of people in many Asian and African countries test positive while 5–10% of people in the United States population test positive by the tuberculin test. Tuberculosis has been present in humans since ancient times.

II. EXISTING SYSTEM

Data-driven deep learning (DL) algorithms such as convolutional neural networks (CNNs) self-discover hierarchical feature representations from raw data pixels and perform end-to-end feature extraction and classification with minimal expert intervention. According to the World Health Organization (WHO) report, TB remains the top infectious killer across the world, with 10 million people falling ill with 27318 the disease in 2018. People from the Asian and African sub-continents accounted for more than 60% of those suffering from the infection. In the Existing System they used CNN Models such as VGG, Inceptions etc, and they used 5 fold cross validation.

- These CNN models predicts well for Low number of validation images during training.
- But when we increase the validation images the accuracy suddenly drops down.

Pneumonia affects 7% of the global population, resulting in 2 million pediatric deaths every year. Chest X-ray (CXR) analysis is routinely performed to diagnose the disease. Computer-aided diagnostic (CADx) tools aim to supplement decision-making. These tools process the handcrafted and/or convolutional neural network (CNN) extracted image features for visual recognition. However, CNNs are perceived as black boxes since their performance lack explanations. This is a serious bottleneck in applications involving medical screening/diagnosis since poorly interpreted model behavior could adversely affect the clinical decision. In this study, we evaluate, visualize, and explain the performance of customized CNNs to detect pneumonia and further differentiate between bacterial and viral types in pediatric CXRs. We present a novel visualization strategy to localize the region of interest (ROI) that is considered relevant for model predictions across all the inputs that belong to an expected class. We statistically validate the models' performance toward the underlying tasks. We observe that the customized VGG16 model achieves 96.2% and 93.6% accuracy in detecting the disease and distinguishing between bacterial and viral pneumonia respectively. The model outperforms the state-of-the-art in all performance metrics and demonstrates reduced bias and improved generalization.

III . PROPOSED SYSTEM

- In the proposed system we used 3 CNN models such as VGG, Alexnet, and Lenet.
- We can able to get an accuracy of above 85% for all these models and hence we can able to get a average accuracy of above 85%.
- we use ensemble voting classifier for final prediction

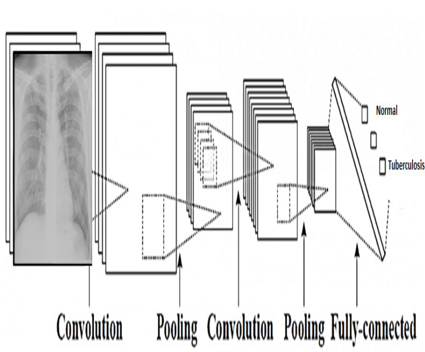

Fig.2 Convolution neural network

When programming a CNN, the input is a tensor with shape (number of images) x (image height) x (image width) x (image depth). Then after passing through a convolutional layer, the image becomes abstracted to a feature map, with shape (number of images) x (feature map height) x (feature map width) x (feature map channels). A convolutional layer within a neural network should have the following attributes:

- Convolutional kernels defined by a width and height (hyper-parameters).
- The number of input channels and output channels (hyper-parameter).
- The depth of the Convolution filter (the input channels) must be equal to the number channels (depth) of the input feature map.

Convolutional layers convolve the input and pass its result to the next layer. This is similar to the response of a neuron in the visual cortex to a specific stimulus.[10] Each convolutional neuron processes data only for its receptive field. Although fully connected feedforward neural networks can be used to learn features as well as classify data, it is not practical to apply this architecture to images. A very high number of neurons would be necessary, even in a shallow (opposite of deep) architecture, due to the very large input sizes associated with images, where each pixel is a relevant variable. For instance, a fully connected layer for a (small) image of size 100 x 100 has 10,000 weights for each neuron in the second layer. The convolution operation brings a solution to this problem as it reduces the number of free parameters, allowing the network to be deeper with fewer parameters.[3] For instance,

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regardless of image size, tiling regions of size 5 x 5, each with the same shared weights, requires only 25 learnable parameters. By using regularized weights over fewer parameters, the vanishing gradient and exploding gradient problems seen during backpropagation in traditional neural networks are avoided.[4][5]

Python applications

One of the most famous platforms where Python is extensively used is YouTube. The other places where you will find Python being extensively used are the special effects in Hollywood movies, drug evolution and discovery, traffic control systems, ERP systems, cloud hosting, e-commerce platform, CRM systems, and whatever field you can think of.

Versions

At the time of writing this book, two main versions of the Python programming language were available in the market, which are Python 2.x and Python 3.x. The stable release as of writing the book were Python 2.7.13 and Python 3.6.0.

Implementations of Python

Major implementations include CPython, Jython, IronPython, MicroPython, and PyPy.

4.1.2 Installation

Here we will look forward to the installation of Python on three different OS platforms, namely, Windows, Linux, and Mac OS. Let's begin with the Windows platform.

Installation on Windows platform

Python 2.x can be downloaded from https ://www .p y t h o n .o r g /d o w n l o a d s . The installer is simple and easy to install. Perform the following steps to install the setup:

1. Once you click on setup installer, you will get a small window on your desktop screen as shown here; click on **Next**:

Fig.3

2. Provide a suitable installation folder to install Python. If you don't provide the installation folder, then the installer will automatically create an installation folder for you, as shown in the following screenshot. Click on **Next**:

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Fig.4

3. After completion of step 2, you will get a window to customize Python as shown in the preceding screenshot. Notice that the **Add python.exe to Path** option has been marked **x**. Select this option to add it to system path variable (which will be explained later in the chapter), and click on **Next**:

Fig.6

4. Finally, click on **Finish** to complete the installation:

Fig.5

Installation on Linux platform

These days most of the Linux-based systems come preloaded with Python, so in most cases, you do not need to install it separately. However, if you do not find your desired version of Python on the Linux platform, you can download your desired version for a particular Linux platform from the site h t t p s ://w ww . p y t h o n . o r g /d o w n l o a d s /s o u r c e /. Perform the following steps:

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1. Extract the compressed file using the tar –xvzfpython_versionx.x command.

2. Browse the directory of the compressed file as shown in the screenshot:

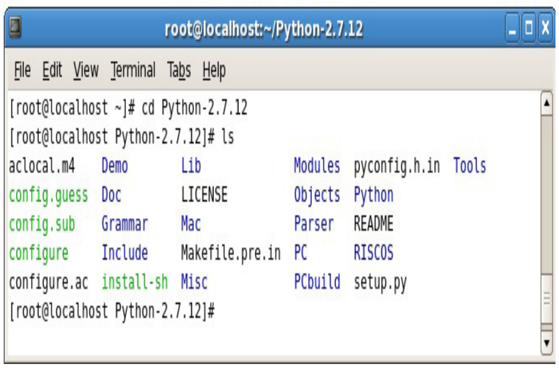

Fig.7

3. Run the following commands:

[root@localhost Python-2.7.12]# ./configure

[root@localhost Python-2.7.12]# make

[root@localhost Python-2.7.12]# make install

4. Use the command as shown in screenshot to ensure that Python is running:

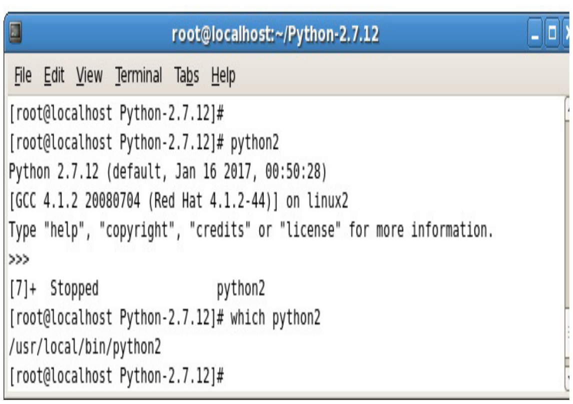

Fig.8

4.1.3 Python file formats

Every language understands a file format, for example, like the C language file extension is .c likewise java language has a file extension .java. The Python file extension is .py while bytecode file extension is .pyc.

Python interactive shell

Python interactive shell is also known as **Integrated Development Environment** (**IDLE**). With the Python installer, two interactive shells are provided: one is IDLE (Python GUI) and the other is Python (command line). Both can be used for running simple programs. For complex programs and executing large files, the windows command prompt is used, where after the system variables are set automatically, large files are recognized and executed by the system.

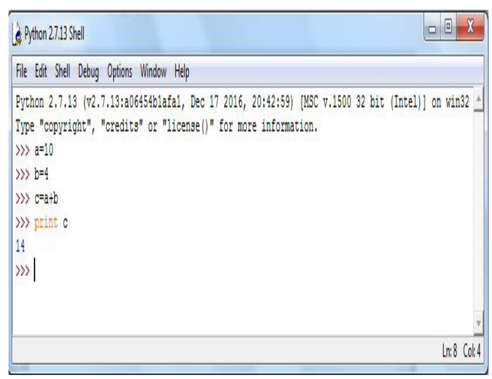

Fig.9

The preceding screenshot is what we call Python IDLE, which comes bundled with the Python installation. The next screenshot is of the command line that also comes bundled with the Python installation, or we can simply launch the Python command through the windows command line and get Python command line. For most of our programming instructions, we will be using the Python command line:

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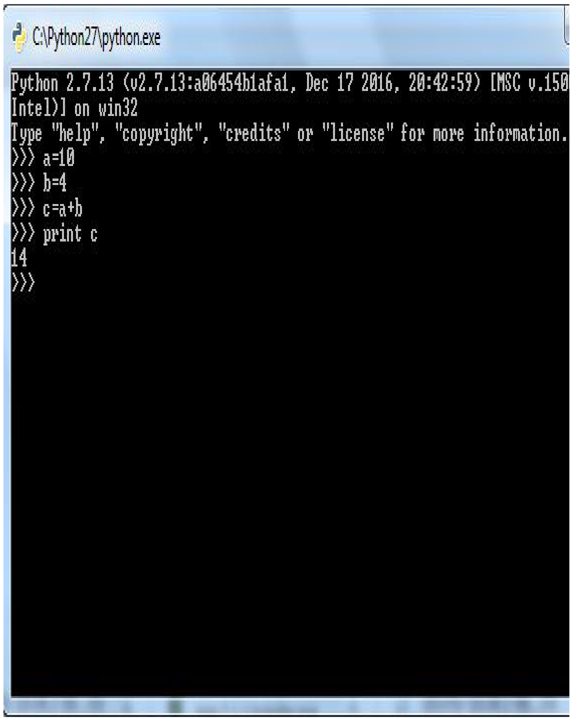

Fig.9

5 RESULT

NORMAL X-RAY

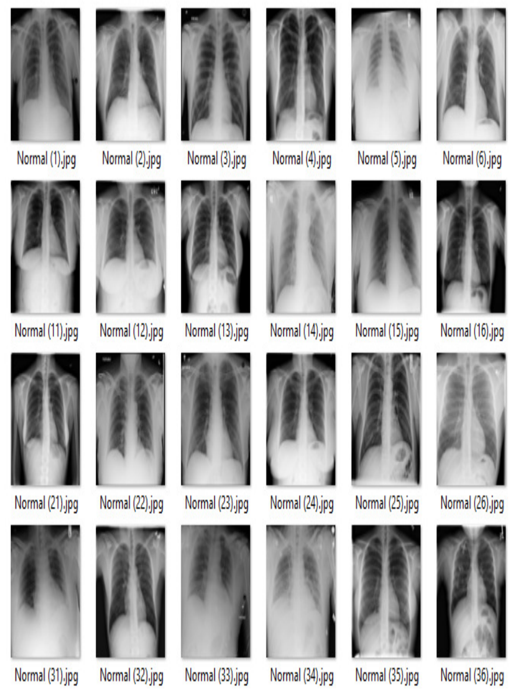

Fig.10

TB X-RAY

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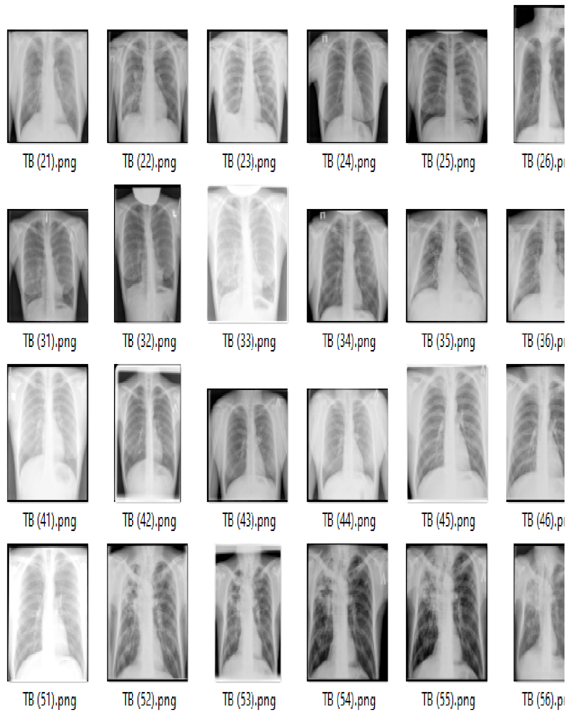
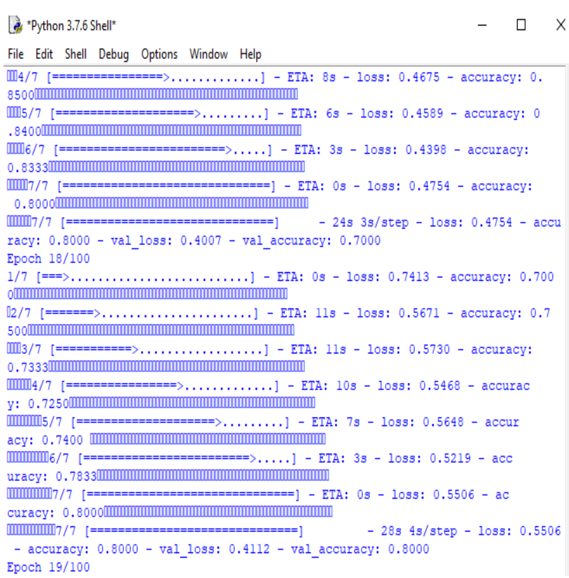


Fig.11

LENET Training



IV . CONCLUSION

Thus the project Ensemble Deep Learning For Improving TB Detection used CNN-Convolution Neural Network which utilizes an implicit reverse and explicite edge-attention to improve the identification of infected regions. Our system has great potential to be applied in assessing the diagnosis of TB, e.g., quantifying the infected regions, monitoring the longitudinal disease changes, and mass screening processing. This proposed model is able to detect the objects with low intensity contrast between infections and normaltissues.

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