Disease Detection Using Artificial Intelligence

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Abstract

Currently, artificial intelligence is widely used to aid humans in a variety of ways. One area where artificial intelligence is particularly beneficial is medical image detection where diagnostic procedures require the collection and processing of large amounts of data for particular diseases. The topics covered in this paper include Pneumonia, Lung Cancer, and Brain Tumors. Early detection and treatment are crucial when treating these types of diseases. The paper describes the use of a convolutional neural network algorithm in order to process medical images so that it can aid in decision making process and help save time. Machine learning is useful in increasing consistency and accuracy in detection. The highest accuracy that the model has achieve 94.297%.

Keywords

pneumonia detection; lung cancer; brain tumor; machine learning; image processing; artificial intelligence; convolutional neural network.

1.INTRODUCTION

Pneumonia is a disease that generally affects the human lungs. This disease can cause illness in all age groups. This disease can be caused by contagion, bacteria as well as fungi. In today's world with new advancements in medical fields we have been successful in reducing the number of deaths caused by pneumonia. Every year 1 million people have been reported to suffer from this disease by the hospital and 50,000 people die due to this disease alone. Children who are under the age group of 5 and older adults who are over the age of 65 are generally more prone to this disease. It is one of the largest causes of infectious death in children under the age of 5. Pneumonia related complications resulted in 1 million children dying in 2015. The main way to detect pneumonia is by using chest x-rays which can be a grueling task. In general, the x-rays depict increase in viscosity of the infected area which is a mixture of connection and atelectasis. Air bronchogram can be seen due to the presence of air column girdled by connection and atelectasis when the disease becomes severe. This area appears as patchy and invariant throughout the area. With significant advancements in computer vision and deep learning, effective ways have been introduced in image bracket, recognition, and segmentation.

Lung cancer, additionally regarded as lung carcinoma, have contributed about 98–99% of all lung cancers, is a malignant lung tumor characterized through uncontrolled growth in lung tissue. Lung cancers is generally the result of long-term tobacco smoking. About 10–15% of cases manifest in humans who haven't smoked. These cases are frequently caused by an aggregate of hereditary factors and vulnerability towards gases such as radon, asbestos, passive smoke and different forms of air pollution. Lung cancer is generally detected by computed tomography (CT) scans. The analysis is proven via biopsy, which is commonly carried out by using bronchoscopy or CT-guidance. 2.2 million people had reported the presence of lung cancer and 1.8 million people lost their lives due to it. This disease causes death irrespective of gender. This disease is generally prognosed at the age of 70 years. The mortality rate can be increased by early detection and treatment of the disease. The most popular and effective imaging technique (CT scanning) is used in the diagnosis as it can discover every suspected and unsuspected lung cancer nodule.

According to WHO brain tumor is the 10th leading cause of death. The survival rates in brain tumor cases vary depending upon several factors like the type of spinal cord or brain tumor. The survival rate in women is 36z% where as in men it is 34%.308,102 people had

been diagnosed with primary brain tumor. 251,329 people lost their lives due to primary cancerous brain tumors. Brain tumor is caused by the growth of abnormal cells in the brain. There are several types of brain tumor. Some are benign which means that they are noncancerous, and some are malignant that is they are cancerous. Brain tumors can originate within the brain or it can be present in other parts of the body and then spread to the brain as a secondary brain tumor. The speed at which a brain tumor grows can vary and its severity depends upon its location, size, etc.

Deep Learning methods can be deployed in medical sector for analysis and detection purpose from biomedical images. A lot of chest x-rays, MRIs and CT scans are taken daily in hospitals across the nation which in turn creates a large unexplored image dataset. Hence, we have proposed a convolutional neural network algorithm which is capable of classifying the above-mentioned diseases with the help of CT scans, MRI and x - rays.

2.RELATED WORKS: -

In this paper [1], machine learning algorithm is used to support the decision-making process so that it determines the correct diagnosis with help of chest x-rays. They have concentrated on only one disease that is pneumonia and have used a CNN algorithm to classify the chest X-ray images. Pneumonia is a disease which affects the lower part of respiratory tract. The main libraries that were used in this paper are: Keras, Matplotlib, Seaborn and NumPy. Their model had an accuracy of 88.90%.

In this paper [2], multiple variants of convolutional neural networks namely, InceptionResNetV2, DenseNet201 and VGG19 are trained using different methods of feature extraction and fine-tuning. Due to the low amount of data, a higher detection accuracy is attained on the chest X-rays pneumonia detection task. The highest accuracy of their model can reach up to 94.20%.

In this paper [3], they have created two different models which includes detection and segmentation of Brain tumor. The first model was used to segment the tumor with the help of FCM and then classify the images with the help of ML algorithms. CNN is widely used for medical image processing. They came up with an exemplary that correctly classifies tumor from the MRI images. Their paper had some drawbacks such as sparsity of connection and parameter sharing.

In this paper [4], they have used CT scan images as their input. Their methodology has various steps that is pre-processing where the noise and other disturbances present in the image are removed and the next step is image segmentation. The important during the diagnosis of this disease. They selected a Fully Convolutional Network in order to gain more accuracy. They used FCN to segment the lung nodules. Their method was able to provide 100% accuracy.

In this paper [5] they have included a CNN-based brain tumor diagnosis system which helps in detecting brain tumor. This helps in rapid treatment planning, to carry out pre-processing on images, the process of feature extraction, reduce the feature space, and lastly classify the images for diagnosis of brain tumor. They improved the performance of their model with the help of geometrical and statistic data augmentation on the images that they had acquired. Their model achieved an accuracy of 100%.

In this paper [6] consists of a computerized method for identifying the tumor region in the brain with the help of the MRI images. Firstly, they have classified the brain into healthy brain or a brain that has tumor and after that they have further classified them into benign or malignant tumor. The algorithm that they have used consists of pre-processing, feature extraction, image segmentation and classification of images. They have created a user-friendly MATLAB GUI program.

3.METHODOLOGY

2.1. Input Biomedical images: - We take CT images for lungs, Xray for pneumonia and MRI images for brain tumor detection. The main advantage of biomedical images is that they have better clarity, less noise and distortion. The mean and variance and the calculated value is very close to the original value.

2.2. Pre-processing: - Pre-processing is the first process in disease detection. It consists of steps that format the images before they can be used for the model training. It converts image data into a form that will allow machine learning algorithm to solve it. This technique improves the detection accuracy and also eliminates the background noise or disturbance. There are several techniques which are used to pre-process an image like image resizing, converting the images to grayscale images, noise reduction and image augmentation. For the dataset that we have acquired we have only resized the images.

2.3. Feature extraction: - Feature extraction is a decisive step in image processing and machine learning that uses various algorithms and techniques for detecting and isolating the required features of an image. It is a section of the dimensionality reduction process, in which, a preliminary set of the raw information is divided and reduced to extra manageable groups. So, when we choose to process it will be easier. The most important attribute of these massive datasets is that they have a vast range of variables. These variables require a lot of computing assets to process. So, feature extraction helps to get the satisfactory characteristic from those large datasets by choosing and combining variables into features, thus, efficiently lowering the amount of data. These facets are effortless to process, however nonetheless capable

to describe the real data set with accuracy and originality. Hence, we can conclude that, feature extraction in image processing and machine learning helps in increasing the accuracy and reducing the computational time which is required for the learning algorithm.

2.4. Train ML model: -Training a model is the most vital step in machine learning process. It is a process that allows a machine learning algorithm to automatically learn various patterns based on the given data. These patterns are statistically learned using either supervised learning or unsupervised learning. We first divide our dataset into two parts as training and testing dataset. While training the model, we use the training dataset which helps in the learning process of the model. Once the model is trained, we then test our model using the testing dataset to check whether the predictions made by our model are accurate. Once the model is trained, we can use save this model and use the model for future predictions.

2.5. Detection of Disease: - Once the machine learning model is trained and saved. The user can input the medical image which will be properly resized. After this the inputted image will be classified into a particular disease by the machine learning model.

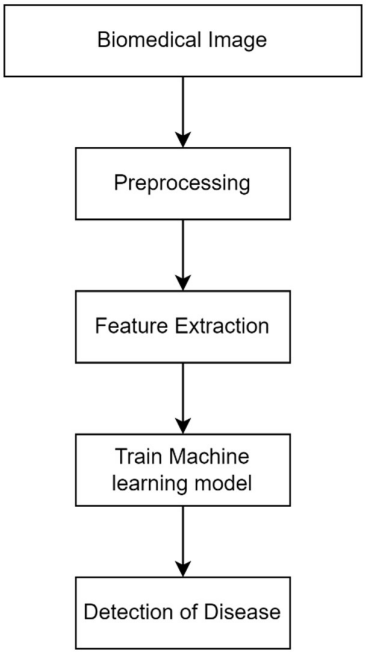

Fig.1. Steps involved in Detecting a disease

4.RESULTS AND DISCUSSION

Phase 1: - Here figure (2) represents some of the biomedical images for the particular diseases from the dataset. The images taken are a combination of Chest X-rays, MRI and CT scans. The data set contains 7182 images of lung cancer, brain tumor and pneumonia.

Phase 2: - The size of all the images is resized to a standard (100x100) dimension size with the help of resize function as all the images had different sizes.

Phase 3: - All the images were converted into an array with the help of np.array function so that the features can be extracted properly before passing on the data for training purpose.

Phase 4: - Here in table (1) represents all the parameters that we have added in order to train the machine learning model. Once all the parameters and filters have been applied the machine learning model is trained.

Phase 5: - Here in figure (4) represents all the predicted results along with the actual results.

Phase 6:- Here in table (2) shows the accuracy rate for the model that has been trained.

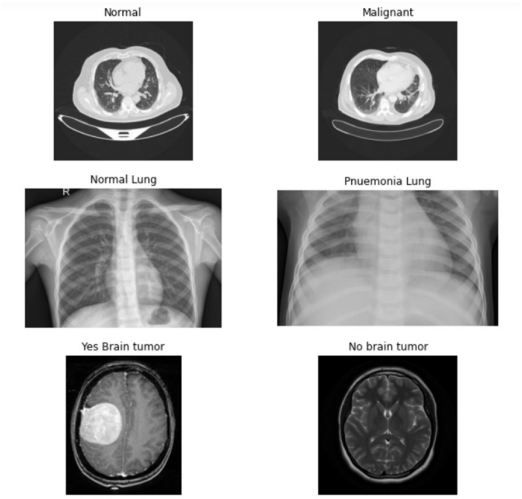

Fig.2. Images for combined Dataset (Lung Cancer, Pneumonia and Brain Tumor)

Layer(type)	Output Shape	Parameter
conv2d(Conv2D)	(None, 99, 99, 32)	416
max_pooling2d (MaxPooling2D)	(None, 49, 49, 32)	0
dropout (Dropout)	(None, 49, 49, 32)	0
conv2d_1 (Conv2D)	(None, 48, 48, 16)	2064
max_pooling2d_1 (MaxPooling2)	(None, 24, 24, 16)	0
dropout_1 (Dropout)	(None, 24, 24, 16)	0
conv2d_2 (Conv2D)	(None, 23, 23, 8)	520
max_pooling2d_2 (MaxPooling2)	(None, 11, 11, 8)	0
flatten (Flatten)	(None, 968)	0
dense (Dense)	(None, 128)	124032
dense_1 (Dense)	(None, 6)	774
Total Parameters	127806	
Trainable Parameters	127806	
Non-trainable Parameters	0	

Table 1. Table represents the total number of parameters and types of filters applied

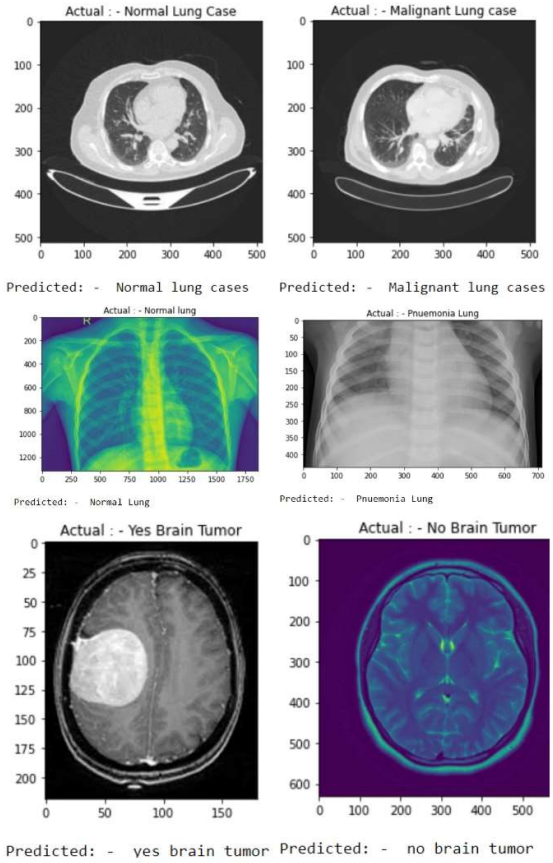

Fig.4. Predicted Disease Results

```
Confusion Matrix
[[ 53   0   0   1   0   0]
 [  0  10   0   0   0   1]
 [  0   0 152   0  10   0]
 [  1   0   0  46   0   0]
 [  0   0  22   0 407   0]
 [  0   5   0   0   1  10]]
```

Fig.5. Confusion Matrix for trained model

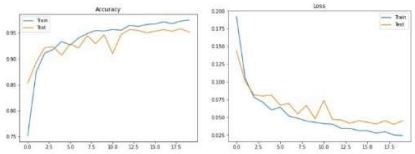

Fig.6. Graphs depicting the Accuracy and Loss for the trained model

Model	Accuracy
CNN + Sequential	94.297%

Table 2. Accuracy of trained model

5.CONCLUSION AND FUTURE WORK

We have implemented a machine learning model using convolution neural network to distinguish the presence of the diseases. Images with variable size have been used to train the machine learning model. Our model is able to detect whether the person is suffering from the above-mentioned diseases with an accuracy of 94.297%.

In the future, we will try to expand this application for other diseases which involve the use of image classification. We will also try out various other machine learning models to try and improve our model's accuracy.

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