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# Machine Learning Based Heart Disease Classification

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## Abstract

Machine Learning classification problem is one of the critical problems in Artificial Intelligence. As heart disease is most crucial disease in the whole world. So it is necessary to develop machine learning algorithm for classification of heart disease. To solve the said problem, in this paper Artificial Intelligence based Heart Diseases Classification by using Evolutionary Deep Learning Paradigm is proposed. It delineates an integrated bioinformatics approach in which different aspects of information from a continuum of structured and unstructured data sources are put together to form the user-friendly platforms for physicians and researchers. The main objective of proposed system is to find probability and diagnosis and treatment of the HEART disease. Artificial Neural Network-based tool for challenges associated with HEART. There are some specification of our platform, it include various form of input data it contains medical as well clinical data which can improve performance of system.

**Keywords:** Artificial Intelligence, Deep Learning, HEART, Heart Diseases, Pattern Classification Problem

## Introduction

From December 2019, Corona virus has spread from Wuhan to across the whole world. Causing about 150,000 deaths and 2 million confirmed cases till April 18 around the world. It is a Contagious Respiratory and Vascular disease. Occurs when one get infected with this virus. It causes difficulty of breathing as it give rise to viral pneumonia in patient. The incubation period varies from person to person but mainly lies in between one to fourteen days. Right now there is no therapeutic treatment or vaccine available for it. Due to its faster and easy transmissibility and seriousness "HEART" is declared as pandemic by WHO. Because of constant increase in cases, it has cause an alarming impact on health care department. The serious patients, need to be treated with the help of mechanical ventilator to stabilize their condition.

As a result, it has become vital to diagnosis heart as early as possible, to reduce the pressure on the Healthcare system and to immediately isolate the suspected patient and decrease the chance of them in coming with contact of healthy population. Normally Pneumonia can be diagnosed using a person's chest x-ray image. X-ray are great source for this as they are cheaper, faster, less exposure to radiation for patient then CT and easily available in all healthcare systems making it a Primary source for evaluating a patient for Pneumonia caused by Heart. Mainly data like X-rays are interpreted by medical expert. But it is restricted due to extensive variation that exist across different interpreters, complexity of image and subjectivity of it.

Heart diagnosis can be done with the help of patient's chest x-ray images. Radiological expertise are the one who interpret this data so results completely depends on them but when number of patients is this enormous this work becomes quite hard and frequency of error can increase. A system or application that can diagnosis disease or examine the x-ray images in place of that person will reduce the load on doctor as well as on system. Due to major development in deep learning and its successful implementation in different real world applications. It has become a key method for ongoing problems in healthcare section due to its natural potential to provide promising result with good accuracy for the problems.

The main contribution of this paper is to design Artificial Intelligence based Heart Diseases Classification by using Evolutionary Deep Learning Paradigm. As Covid -19 is most viral Lung disease that put whole world in difficult situation so to develop machine learning algorithm for classification of lung disease. To solve the said problem, it is necessary to design such type of paradigm for fast processing. The key objective of proposed paradigm is to find probability and diagnosis and treatment of the HEART disease.

The paper is categorized into section like: Section 2 described in detail the literature part as related work. The proposed methodology is illustrated in section 3. Section 4 outlined the points as conclusion and future work.

## RELATED WORK

To identify different lung disease, here an architecture based on CNN has been presented in [6].A dataset of 110,000 X-ray images is trained by using CNN model for identification of more than 13 diseases [7].

Genetic deep learning convolution neural network (GDCNN) technique is used [1] where data is trained from scratch and after extracting required features. It is classified into Heart images and normal images. 5000CXR images of a dataset were used. It proves that this technique gives us better results with accuracy of 98.84%, sensitivity of 100%, and specificity of 97.8% with the precision of 93% in detection of heart in compare to other transfer learning techniques.

Lung disease detection by using the transfer learning method developed with the help of residual networks two architecture ResNet-34 and ResNet-50 [2]. Authors used Open-cv and python programming language with PyTorch framework for pre-processing and augmentation of data. Results were as follows where ResNet-34 give accuracy of 66.67% and error rate of 33.33% while, ResNet-50 give accuracy of 72.38% and error rate of 27.62%.

Iterative pruned deep learning model with combination of chest X-ray images for the prediction of heart, designed to improve the performance using RSNA CXR dataset to pre-trained CNNs and customized it as per requirements [3]. It used modality specific knowledge transfer technique. As a result, the best performing model gave accuracy of 99.01%.

A. Ramchandani et.al. used dataset of 6249 chest X-ray images from GitHub repositories and also used pre-trained models such as ResNet-50, MobileNet, Xception, Inception V3 these architectures were further compared based on their performance in which MobileNet was best with maximum score of F1 and specificity of 995 [4]. M. Gao et al Alexnet a pre-trained CNN is used to arrange the images, by making small adjustments to achieve the desired output with their lung CT data [20]. CNN is also used for prediction of pneumonia in [7] [8].

An algorithm named as PathNet algorithm is developed in which Covid-Net is used for detecting pneumonia caused by corona virus using CXR images [30] [26]. Similarly, Coronet named CNN model is used for spotting heart in [27]. A deeper model was stated in [28] by categorizing images. A small dataset consisting of 50 images only, were compared using different seven pre-existing deep learning neural network architecture in [10] [11].Arranging chest x-rays in different categories is solved by proposing new CNN architecture [18] [12] [14].

M. Zhou et. Al. developed a deep learning model by distinguishing of influenza pneumonia and corona virus pneumonia using CT images [21]. Inception ResNetV2, ResNet50 and Inception V3 These three unique deep learning neural networks are used to detect heart using CXR images in which inception-V3 achieved 87% of accuracy and ResNet50 98% [24]. O. Gozes et.al used the dataset consist of 157CT images where used for the identification of heart using different deep learning models [25].

For proper feature extraction and classification of lung tissue modified RBM used which incorporated some CNNs features [18]. Classification of pneumonia, prediction of heart is achieved by using 3D learning model [23],.

## METHODOLOGY

The primary aim of the paper is detect the probability and diagnose HEART Pneumonia; Pneumonia Lung disease cause by novel corona virus. In order to solve the said problem, this paper is proposed the Artificial Intelligence based Heart Diseases Classification by using Evolutionary Deep Learning Paradigm. Such type of applications will help to reduce pressure on medical management as well as healthcare system. The proposed paradigm is classified into three categories like Input Dataset, Deep Learning Algorithm and Classification subsystems.

### 3.1 Input Datasets

The first step of Application is to collection of data form Kaggle, A12 Semantic Scholar, HEART explorer. The dataset contains more than 216 HEART chest X-ray images. It contains 1000 pulse normal patient chest images and pneumonia images.

### 3. 2 Deep Learning Algorithm

Deep learning has special techniques which functions like neurons of human body called as artificial neural network in which each layer has multiple neurons. CNN is a very powerful algorithm which is widely used for image classification and object detection. CNN algorithm train on large database such as ImageNet. ImageNet need not to train on first few layers. Upper layers is used to match current problem which is called Transfer Learning which is discuses in section 3.2.1.

This model is used to pre-trained CNN models on the ImageNet database which reduces the need to train the data from scratch. A pre-trained model is useful when there is time boundary, every-time it is not possible to build the model from scratch that why pre-trained model come into existence .ImageNet in one of most wide, large, real-world database with the help of these pre-trained models weights obtained are then transferred to the specific CNN model which going to use transfer learning technique

#### 3.2.1 Transfer Learning

Transfer learning is the type of machine learning. Transfer learning has capacity to create new artificial intelligence model by existing neural network. So, by using it as base for new model. The basic flow structure of deep learning algorithm is as shown in Figure 1.

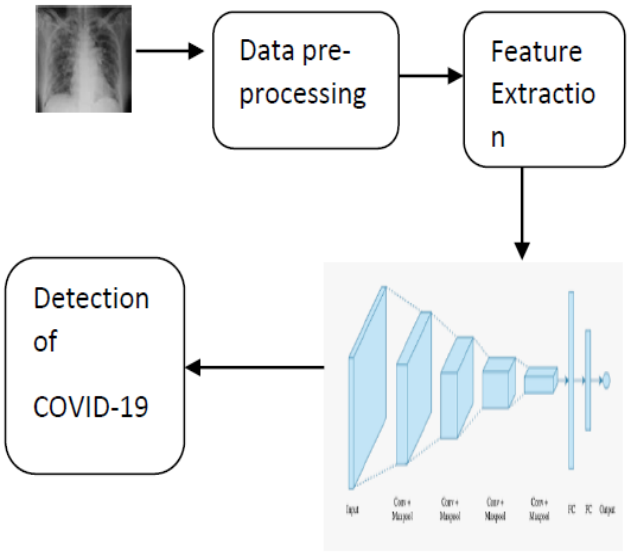


**Figure** 1 Basic structure

### 3.2.2. Image pre-processing and Feature Extraction

Image pre-processing and feature extraction techniques are needed for any image based application. The aim of Image pre-processing technique is to remove background of image with lot of noise. In our application raw size of image is 1012*974. First step of Image pre-processing is to pruning images with cropping the background and newly generated is 140 × 240 pixels. In addition, the median filter is applied. After removing the noisy images, a dataset with images for three labels HEART, PNEUMONIA and NORMAL with given images in each label was extracted.

### 3.3 Classification (Training of CNN model)

Keras framework with TensorFlow is used here. Keras provide pre-trained weights from the ImageNet database on these pre-trained models. ImageNet database on which our model is based may not similar to images but it help to make task more efficient. It also helps to reduce requirement of large volume date for training.

Adam algorithm is also used for optimization which is next version of stochastic gradient descent and Adam is getting more and more popular in recent days and has seen border adoption for deep learning

application. As an activation function, ReLu activation function is used as it is most commonly used activation function for the output of CNN neurons.

As the current dataset is to large, it required high computational power for training our CNN model. The accuracy of the proposed paradigm is depending on the optimization algorithm. The performance is measured by using the parameters like accuracy, specificity, precision and recall/sensitivity. It is a great advantage for us that today large number of datasets is available. With this available dataset further we will be implementing a system which will be used for detecting HEART and differentiate between Bacterial Pneumonia and HEART Pneumonia. The details steps are as shown in figure 2.

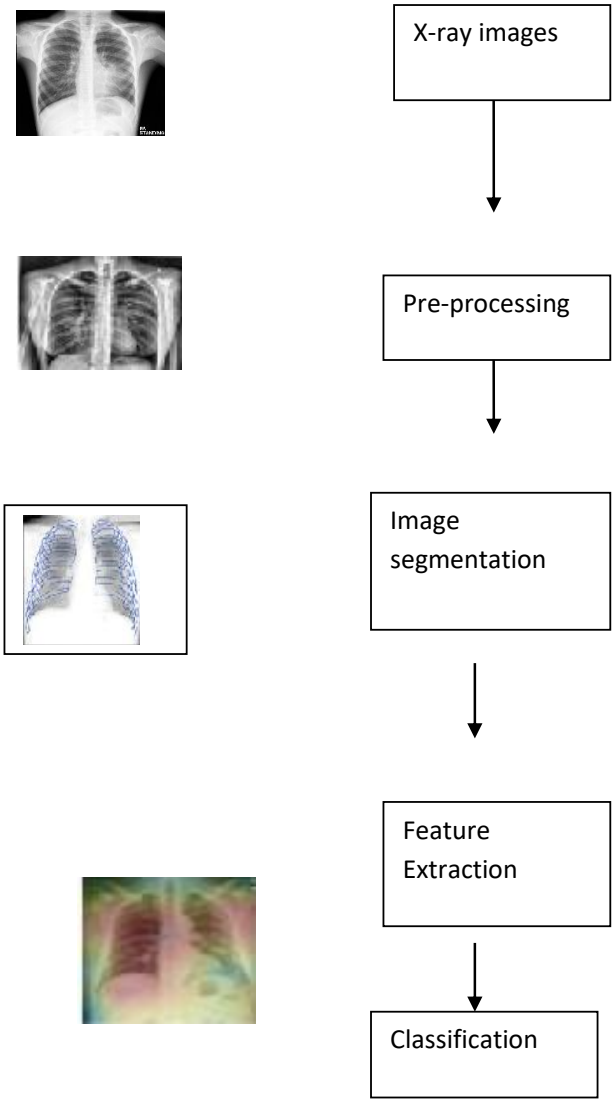


**Figure 2** Phases of proposed paradigm

## 4. CONCLUSION

Covid 19 disease had greatly impacted on our daily lives all over the world. To resolve this issue it is necessary to detect the disease as early as possible. As deep learning plays an important role in medical domain and all other domains. So we are going to use some deep learning techniques to detect the Covid19 patients.

In this paper, the Artificial Intelligence based Heart Diseases Classification by using Evolutionary Deep Learning Paradigm is proposed in which some CNN models are used to detect the disease. Here, the pre-trained models are used in ImageNet database as it will reduce the work to train the CNN model from scratch. Using transfer learning technique the weight on the pre-trained models will be transferred to specific CNN model. On the basis of patients Chest X-rays it will train the model and predict the covid 19 disease and will also differentiate between bacterial pneumonia and other types of pneumonia.

To identify COVID 19, large number of chest X-ray images is trained using CNN model. In convolutional neural network there are different types of models like ResNet, MobileNet, VGG-16, VGG-19, inception, exception, etc. We will be using any of these CNN models to train our data and will check which CNN model performs better in order to predict the COVID 19 disease.

As the available dataset is too large we will be requiring high computational power for training our CNN model. As high computational power will be required to train the CNN model, it is better to use kaggle GPU or Jupyter Notebook GPU for fast processing. The accuracy of our model will be depending on our optimization algorithm which will be used. The performance of the models which we will be using will be measured on parameters like accuracy, specificity, precision and recall/sensitivity. It is a great advantage for us that today large number of datasets is available. With this available dataset further we will be implementing a system which will be used for detecting HEART and differentiate between Bacterial Pneumonia and HEART Pneumonia. The further process can be extend by using various optimization algorithm in combination with deep learning mode.

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