A REVIEW ON THE PREDICTION OF CONGENITAL HEART DISEASE USING DEEP LEARNING AND MACHINE LEARNING TECHNIQUES.

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Abstract - *Congenital heart disease(CHD) is a leading cause of newborn mortality and morbidity around the world. Early detection and management can dramatically minimize the risk of negative result. Chest X-Ray(CXR) is a useful examination for medical practitioners to diagnose CHD. The CXR is a simple, rapid and inexpensive examination that provides useful diagnostic information clearly displays heart shapes and sizes with low doses of radiation. The system is built on deep learning and machine learning techniques and proposes an efficient and accurate assistance system for medical practitioners to diagnose CHD. As a result, the deep learning assisted Convolutional Neural Network(CNN) has been devised and applied for decision support systems that assist doctors in diagnosing CHD successfully. Another aspect of the problem that has been studied in this study is the prediction of CHD using machine learning techniques. As a result of the established prediction models and deep learning categorization, very precise and reliable CHD diagnosis may be made, reducing the frequency of misdiagnosis that might cause patients to panic.*

***Key Words*: Convolutional Neural Network, Chest X-Ray, Cardiomegaly**

1.INTRODUCTION

A congenital heart defect (CHD), often referred to as a congenital heart anomaly or congenital heart disease, is a birth disorder in the structure of the heart or major arteries. The signs and symptoms vary depending on the type of problem. Symptoms might range from non-existent to potentially fatal. Rapid breathing, bluish skin (cyanosis), low weight gain, and tiredness are all possible signs. Certain illnesses during pregnancy, such as rubella, use of certain medications or drugs, such as alcohol or cigarettes, tight parental relationships, and poor nutritional status or obesity in the mother are all risk factors. A risk factor is having a parent with a congenital cardiac defect. Adolescents aged 13 to 17 years old experienced the greatest increase in prevalence, followed by adults aged 18 to 40 years old.

CHD is divided into two categories. They are acyanotic and cyanotic, respectively. Congenital heart disease can be caused by a variety of conditions. There are two types of pulmonary vascularity: high (pulmonary plethora) and diminished (pulmonary vascularity). The aetiologies of cyanotic congenital heart disease can be separated into those with enhanced pulmonary vascularity (pulmonary plethora) and those with normal vascularity.

A chest x-ray (CXR) can detect a ventricular septal defect or cardiomegaly. CXR is easy to use, takes less time, is inexpensive, and emits minimal quantities of radiation. The information gathered from diseased children's chest x-rays can be utilized to predict CHD and treat it as soon as possible. Changes in the heart can be caused by a variety of heart diseases. Changes in the structure of the heart can be caused by a variety of disorders.

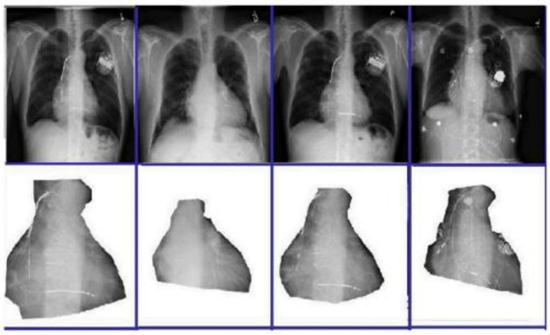

Fig -1: Manually made masks for localizing cardiomegaly

Deep learning has been widely employed in the prediction and analysis of congenital cardiac disorders, with noticeable improvements. A method for automatic image interpretation is deep learning, a branch of machine learning. Deep learning–based analysis has lately been applied in numerous medical settings using imaging modalities, such as diagnosis of heart problems, as deep learning became a rapidly evolving paradigm for computer vision. Previous research has shown that a deep learning based approach can be used to objectively recognise diseases or discoveries in a variety of imaging modalities, with one of the studies demonstrating that deep learning based analysis has the potential to outperform clinicians. Given the capabilities of deep learning as demonstrated in earlier studies, it was expected that deep learning-based analysis might quantitatively predict CHD from CXR in patients with congenital heart disease.

Using machine learning techniques for this prediction and handling of data can become very efficient for medical people. Diabetes, smoking, or excessive drinking, high cholesterol, high blood pressure, or obesity are all factors that can increase the risk of heart disease. Working in the heart, for example, becomes harder or requires extra effort if a person has high blood pressure. If we try to control the above-mentioned causes, we may be able to lower our risks of developing a cardiac disease. Machine learning algorithms have proven to be particularly effective tools for CHD study prediction. Traditional statistical models fare better in terms of prediction. Machine learning techniques provide real-time insights, and when combined with the explosion of computing power, they are assisting healthcare practitioners in diagnosing patients more rapidly and precisely. Minimize medical and diagnostic errors, predict bad reactions, and reduce healthcare costs for both providers and patients by developing innovative new pharmaceuticals and treatments.

2. LITERATURE REVIEW

B. Mihai-Sorin et al. [1] The utilisation of two different types of network architectures, namely LeNet and Network in Network(NiN), is discussed in this study. Multiple databases will be used to test the networks in this article. One of them comprises photographs representing burn wounds from paediatric cases, another contains a large number of art images and additional facial databases were used. Simple structures like LeNet and NiN have proven to be trustworthy for low-complexity classification, but they are insufficient for more challenging jobs.

Tataru Christine et al. [2] Using digital image processing techniques and an expert radiologist, deep learning was used to the unique CXR dataset to construct a simple preprocessing pipeline. As a result, built a pipeline that can use CXR photos to apply three neural network architectures that have proven successful in classification tasks: GoogLeNet, InceptionNet, and ResNet. In final model's accuracy are presented. There are several approaches to improve the above model. By, further preprocessing, such as removing lungs from pictures or clipping edges of CXR images to highlight lung regions. To direct toward clinical use, weighting examples so that sensitivity rather than specificity is highlighted. The level of uncertainty in a physician's ground truth diagnosis is taken into account. incorporation of a segmentation component so that the network can learn small, particular properties instead of only macro features.

Krizhevsky A et al. [3] The 1.2 million high-resolution photos in the ImageNet LSVRC-2010 contest were used to train a massive, deep convolutional neural network to categorise them into 1000 separate classes. It did not employ any unsupervised pre-training in our tests to keep things simple, even though it expect to help, especially if it get enough computational capacity to greatly increase the size of the network without a matching increase in the amount of labelled data. The results have improved as we have grown our network and trained it for longer periods of time, but it still have a long way to go before it can match the infero-temporal pathway of the human visual system. Eventually want to employ very big and deep convolutional nets on video sequences, where the temporal structure provides very useful information that is missing or less visible in static images.

Rubin Jonathan et al. [4] The results of training and testing a series of deep convolutional neural networks on this dataset to recognise numerous common thoracic disorders are presented in this research. On such a massive collection of chest x-ray images, which is over four times the size of the largest previously available chest x-ray corpus, CNNs are trained for this task (ChestX-Ray14). The CNN training approach could be improved by using techniques known to increase image-based classification performance, such as data augmentation and pixel normalisation and when making a categorization judgement, Here only consider radiograph pixel information, To make an accurate final assessment for numerous illnesses meticulous study of a patient's history and current clinical record is essential.

Abdelilah Bouslama et al. [5] In this paper, it provides a full process for detecting Cardiomegaly disease from X-Ray pictures automatically. The procedure is broken down into four steps. Here, Cardiomegaly was detected with an accuracy of between 93 and 94 percent.

S. Tuli et al. [6] HealthFog, an unique framework for integrating ensemble deep learning with Edge computing devices, was proposed and deployed for a real-world application of autonomous Heart Disease analysis. FogBus, a fog-enabled cloud framework, is used to deploy and test the proposed model's performance in terms of energy consumption, network bandwidth, latency, jitter, accuracy, and execution time. By introducing a new Fog-based Smart Healthcare System for Automatic Diagnosis of Heart Diseases using deep learning and IoT dubbed HealthFog, It is just focused on the healthcare aspects for heart patients. Prior studies on such Heart Patient analyses did not use deep learning and hence had a low prediction accuracy, rendering them useless in practise. Using unique communication and model distribution strategies like ensembling, this study allows large deep learning networks to be incorporated in Edge computing paradigms, allowing for excellent accuracy with very low latencies.

R. Poplin et al. [7] Here Deep-learning models were constructed using retinal fundus pictures from 48,101 patients in the UK Biobank. The UK Biobank clinical validation dataset had a mean age of 56.98.2 years, while the EyePACS-2K clinical validation dataset had a mean age of 54.910.9 years. The findings show that using deep learning to retinal fundus images alone may predict various cardiovascular risk variables, such as age, gender, and blood pressure. This is corroborated by our preliminary MACE prediction results, which are comparable to the composite SCORE risk calculator in terms of accuracy.

K. M. Z. Hasan et al. [8] For the identification of heart disease, a novel classifier SDA -Sparse Discriminant Analysis approach was presented. If the limits between classes are nonlinear or if subgroups are available within each class, the time complexity of this technique will be decreased by optimal scoring analysis of LDA, and it will be comprehensive to execute sparse discrimination by the combination of Gaussians. The proposed strategy increased prediction accuracy by 96%. The results significantly outperform those reported in previous research in the literature.

S. M. Awan et al. [9] This paper describe the various techniques used in Artificial Neural Networks (ANN). The accuracy is calculated and visualised, for example, the ANN accuracy rate is 94.7 percent, but the accuracy rate with Principle Component Analysis (PCA) is 97.7 percent. The best prediction rate attained in each of the techniques/methodologies is summarised by investigating, analysing, and conducting an ensemble base technique, and the results/prediction rate for each algorithm are reported in a tabular form as well as graph representations for clear understanding. It can be raised even more by tweaking the settings and making them more suitable for each method and data type.

R. Jin et al. [10] In this research, With a training set of data, a deep learning algorithm was used to create a neural network model to predict the risk of cardiovascular disease, which was then validated with another set of data. When compared to genuine diagnostic data, this model had a confidence level of 70%, indicating that big data and deep learning can be used to create a potent prediction tool.

3. CONCLUSIONS

The correct diagnosis of congenital cardiac disease can save lives, while erroneous diagnosis can be fatal. Different machine learning algorithms and deep learning are used in this research to compare and analyse the outcomes of the CHD dataset. More techniques to combine ML and DL models with specific multimedia for the benefit of patients and clinicians could be discovered.

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