A Review on Deep Learning Algorithms in Healthcare

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Abstract— Deep Learning is a branch of Machine Learning (ML) that is used to solve complex problems and come up with intelligent solutions. Artificial Neural Networks (ANN) are used in deep learning to analyze data and make predictions. In the health sector, deep learning has made it possible to use computer aided technology to predict and diagnose the disease. In this paper , we present a comprehensive review on deep learning algorithms and how it is used in healthcare to predict and diagnose various diseases.

Index Terms— Deep learning, Healthcare, Algorithms, Disease

I. INTRODUCTION

All deep learning is considered as a subset of Machine Learning(ML). Since ML is an Artificial Intelligence (AI) technology, it is capable of learning and developing without being explicitly programmed. Machine learning works on simple concepts while deep learning deals with Artificial Neural Networks (ANN), which are programmed to analyse, learn and respond to complex situations quicker than humans. Deep learning aided with speech recognition, image classification and language translation. Without human intervention it also can be used to solve any kind of pattern recognition problem.

ANN consists of many layers where each and every layer can perform complex operations such as representation and abstraction that make sense of text, images and sound

II. DEEP LEARNING OVERVIEW

Much like the human brain is made up of neurons, Neural networks consists of layers of nodes. The nodes in each layer are linked to the nodes of the adjacent layers. Based on the number of layers it has, the network is said to be deeper. The neuron in the human brain receives thousands of signals from other neurons. In the same way in an ANN, signal travel between nodes and weights are assigned to the corresponding nodes. A node with heavier weights will provide more effect on the nodes in the next layer. The output is produced after compiling the weighted input.

Deep learning algorithms are capable of analyzing vast volumes of data and providing reliable information. Artificial neural networks interpret data based on the answers to a sequence of binary true or false questions requiring extremely abstract mathematical equations when analysing the input data. A facial recognition technology, for example, learns to identify and distinguish edges and lines of faces, then trains to recognise more important portions of the faces, and eventually faces as a whole. Similarly, the software trains itself at each point, increasing the likelihood of correct responses. In this example, the facial recognition software can correctly recognize faces over time.

Since deep learning systems process a huge volume of data and perform many complicated mathematical calculations, they require powerful hardware.

III. DEEP LEARNING ALGORITHMS

Although deep learning algorithms use self-learning representations, they rely on artificial neural networks (ANNs) that reflect the way the brain computes information. Algorithms use unknown elements in the input distribution to extract attributes, group objects, and discover useful data patterns during the training process. This happens at different stages, using the algorithm, just like teaching machines for self-learning.

Two types of learning are mostly used in many applications: supervised or unsupervised. In supervised learning, the algorithm looks at the training data and creates an estimated function that can be used on new instances. Unsupervised algorithms extract insights directly from the data itself, summarising or grouping it so that we can make data-driven decisions based on those insights.

In this digital age, huge amounts of data is generated everyday from social media, IoT and cloud computing technologies etc. In Modern learning methods, it is possible to discover representations that are used to extract ideas from raw facts automatically[1]. Deep learning algorithms are an example of representation of learning methods that use a hierarchical formation of nonlinear functions to convert raw input data into more sophisticated features that enable the recognition of novel patterns [2].

Deep learning models make use of various algorithms. To choose an algorithm that can perform best on a specific task, it is important to have a thorough knowledge of all Deep learning algorithms.

The taxonomy of the deep learning algorithm is shown in Fig.1.

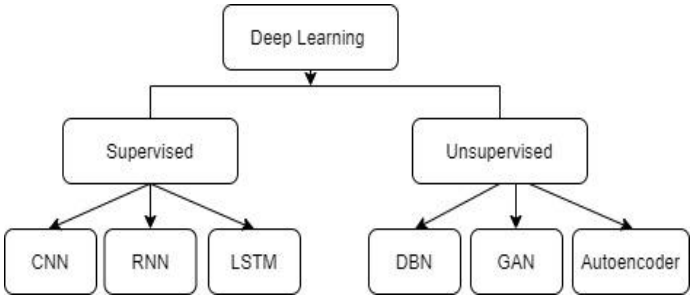

Figure 1 Taxonomy of the deep learning algorithm

Deep learning algorithms, their characteristics and applications are summarized in table 1.

TABLE I. Deep learning Characteristics and applications

Algorithm	***Learning***	***Behaviour***	***Applications***
Convolutional Neural Networks (CNNs)	Supervised	Useful for high-dimensional data, Keeps spatial information	Process medical images, predict time series and identify anomalies in satellite images
Long Short Term Memory Networks (LSTMs)	Supervised	Long-term dependencies are learned and memorised.	Music composition and speech recognition
Recurrent Neural Networks (RNNs)	Supervised	Stores temporal information and Captures time dependencies of data	Time-series analysis, machine translation, Image captioning, natural-language processing and handwriting recognition
Generative Adversarial Networks (GANs)	Unsupervised	Make new data instances that look like the training data	Develop realistic and animated figures,
Autoencoder	Unsupervised	inputs size are reduced to make a smaller representation	Image scanning, pharmaceutical invention, and popularity forecast
Deep Belief Networks (DBNs)	Unsupervised	Without a lot of preprocessing, it's possible to get appealing results from raw data	Image and video recognition and motion-capture data

IV. DEEP LEARNING IN HEALTHCARE

Deep Learning has been used in healthcare systems in recent years. It is assisting numerous medical professionals and analysts in gaining valuable knowledge from clinical data and improving medical facilities in a better way. A significant research field is assessing patients' risk of predicting a disease and delivering customized healthcare. By means of a medical imaging procedure, it is now commonly used for drug discovery and identification of life-threatening disorders such as diabetic retinopathy and cancer.

There is a lot of research work that has already been done using deep learning algorithms to predict the disease.. In this section, the algorithms and their accuracy for diagnosis is discussed. It will be useful for the researchers to identify the best algorithm easily for the prediction and diagnosis of disease.

V. REVIEW OF LITERATURE

In the recent year, Farman Ali et al. [3] have derived a method that predicts heart disease before a stroke or heart attack can occur using back propagation techniques and gradient algorithms. The accuracy of proposed system (98.5%) is compared with traditional classifier models and proved that it is higher than the existing system [13].

In another Heart disease identification system[4], the random forest classifier algorithm is the optimal machine learning algorithm which gives the highest accuracy at 94.9% among other classification algorithms namely SVM , DT, RF and LR to predict the heart disease.To pick essential features from the dataset, the univariate feature selection and Relief are used [14-15].

Tülay Karayılan; Özkan Kılıç[5],, have developed a system that can predict heart disease using artificial neural network- backpropagation technique. Thirteen clinical features were used as input and the output is verified with the accuracy of 95%.

In the review of diabetic disease prediction, Motiur Rahman et al. [6] have developed a navel diabetes classifying model based on Convolutional Long Short-term Memory (Conv-LSTM). When compared to other popular models such as CNN, Traditional LSTM and CNN-LSTM[16-18], the proposed model have obtained the maximum accuracy of 97.26 percent over the Pima Indians Diabetes Database (PIDD).

Swapna G et al [7] have developed an automated diabetes detection system that used deep learning networks such as CNN and CNN-LSTM and used 5 fold cross validation to achieve the highest accuracy of 95.1 percent among the automated diabetes detection methods currently available.

With prediction accuracy of 98.3 percent and 97.11 percent, Safial Islam Ayon et al.[8] developed promising systems for the prediction of diabetes using deep neural networks by training its attributes in a five and ten fold cross validation fashion.

To get a more accurate result, the proposed device uses two individual CNN architectures to segment the Optic Cup (OC) and Optic Disc (OD).This model is trained and validated on the freely accessible DRISHTI–GS database, and it achieves a segmentation accuracy of 98 percent for the optic disc and 97 percent for the optic cup.

H.N. Veena et al. [9] have designed a novel optic disc and optic cup segmentation technique to diagnose glaucoma. In the proposed system two different CNN architectures, to segment the Optic Cup (OC) and Optic Disc (OD), were used to get more accurate results. This model is trained and tested on the publicly accessible DRISHTI – GS database, and it achieves a segmentation accuracy of 98 percent for the optic disc and 97 percent for the optic cup.

U Raghavendraa et al.[10] have proposed a new CAD tool that uses deep learning techniques to accurately detect glaucoma. An 18 layer Convolutional Neural Network (CNN) was successfully trained to extract robust features from digital fundus images, with a 98.13 percent accuracy.

N.Bhaskar et al.[11] have developed a 98.6% accurate automatic detection method for detecting chronic kidney disease using a help vector machine classifier and the Correlation Neural Network (CorrNN).

Marjolein A. Heuvelmans et al.[12] developed a Lung Cancer Prediction Convolutional Neural Network (LCP-CNN) that can classify benign lung nodules with a 94.5 percent accuracy when trained on US screening data.

The summary of various disease detection or prediction is shown in the Table 2.

VI. CONCLUSION

Deep Learning is a subset of Machine Learning that is used to solve difficult problems and construct intelligent solutions. To process the data and make predictions, deep learning employs Artificial Neural Networks. The techniques of Deep learning are being used by many medical professionals and academics to extract valuable knowledge from healthcare data and improve society's medical services. Deep Learning has made computer-aided disease prediction and computer-aided diagnosis possible in the healthcare field.In this paper, based on the previous research work done, the deep learning algorithms and their accuracy for predicting diseases is discussed and summarized. It will be useful for the researchers and medical experts to easily identify the best algorithm for disease prediction in the future.

TABLE 2. SUMMARY OF DISEASE DETECTION OR PREDICTION

Ref.	Year	Cases	Algorithm	Accuracy
3	2020	Heart attack Prediction	Feed-forward network - utilizes back propagation techniques and gradient	98.5%
4	2020	Heart disease identification	SVM, DT, RF and LR	94.9%.

5	2017	Heart disease prediction	Artificial neural network back propagation	95%.
6	2020	Diabetic Detection	Convolutional Neural Network (CNN), Traditional LSTM (T-LSTM), and CNN-LSTM	97.26 %
7	2018	Diabetic Detection	CNN and CNN-LSTM - 5 FC layers	95.1%
8	2019	Diabetes Prediction	Deep neural network and five-fold and ten-fold cross-validation fashion	98.35%, - 5 FC 98.80% - 10 FC
9	2021	Diagnose glaucoma	Deep learning Convolutional neural network	98% - optic disc 97% - optic cup seg.
10	2018	Diagnosis of Glaucoma	Eighteen layer convolutional neural networks (CNN)	98.13%
11	2020	Prediction of Chronic Kidney Disease	Support Vector Machine (SVM) classifier is integrated with the CorrNN	98.67%.
12	2021	Lung cancer prediction	Convolutional Neural Network (LCP-CNN)	94.5 %

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