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Application of Deep Learning in Medical Data Analysis

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Abstract:

The data of medical health has also incremented dramatically and methods of interpreting medical-driven huge big data have originated as the requirement with time, assisting in the reorganization of medical health condition intelligently the with the use of technologies of computer widely. Due to the heterogeneous, noisy, and unstructured nature of medical big data, it is still a difficult task to analyze medical big data. The conventional methods of machine learning can't find out the major information involved in the medical big data efficiently, while deep learning designs a hierarchical model. It consists of effective features of extraction, potential feature expression, and typical model construction. This paper is dedicated to surveying different approaches for medical big data processing using a deep learning approach and extracting finding for future research scope.

Keywords: Medical big data, analysis, deep learning, intelligent recognition

I. INTRODUCTION

The inspections of images of medical like, CT Scans, MRIs, and X-Rays are very typical work because the data of digital medical is increasing every year needs the techniques of analysis of high efficiency. Deep learning is trending because of its special categorization of millions of images [1]. It specially performed nicely in co-partnership with medical imaging. The doctor can inspect the disease based on present medical big data for a certain disease and can diagnose it in advance for controlling and preventing the disease before its invasion, predict the consecution of disease correctly and make high-risk patients more [2]. The prescriptions of current working treatment increase the confidence of patients about the treatments and resettlement, and always support in achieving the effects of therapeutic better. In the first phase, it is required to collect and record images of the indicators of medical inspection of patients in the process of inspection of medical big data. Then the variance between the image of the patient and the normal image is inspected for the analysis of disease and diagnosis earlier [3]. Various conventional algorithms for analyzing medical big data have been studied, including algorithms of random forest, support vector machine, logistic regression, and so on. Deep learning is set at the front lines of healthcare along with the other implementations and has generated effective outcomes by inspecting a large amount of electronic medical data for disease treatment. And the extracting of features by the preferential method of task become complicated. It detects the abstract and deep characteristics from the data and holds a broadrange of dependencies in data effectively, applying inspection of both text and image data efficiently [4]. the methods of deep learning perform better in the analysis of big data than the conventional methods with incrementing the number of transcript data and medical images. And they require minimal time and resources of computation in pre-processing of data and extracting the features [5]. In this paper, section II describes different deep learning approaches with their advantages as well as disadvantages. In section III, a brief description of recent advancement in medical data analysis are discussed. Finally, in section IV conclusion and future advancements are discussed.

II. OVERVIEW OF DEEP LEARNING

In machine learning small dataset is required to train the model whereas a large dataset is required to train the model. The processing of machine learning takes less time to train the model but takes more time of computation for testing so Low-end machines are sufficient, whereas high processing is needed for the process of training in deep learning but very small time is required for testing. So the deep learning is believed to be an originated part of machine learning, consisting of representation learning and diverse learning. The branch of ML, deep learning has proved its efficiency over conventional models of machine learning in most of the areas of use, especially in the applications of real-life [7]-[11]. Following are the discussion of some methods of deep learning:

A. Deep Autoencoder

Combining the decoder and encoder type neural network is the process of designing of autoencoder, represented in fig 1(a). The data of raw input is fed into the units of encoder where characteristics are withdrawn and fed into the decoder for the reconstruction of data from the withdrawn characteristics. the divergence of decoder and encoder decreased slightly While training the model of the deep autoencoder. The extraction of characteristics by the encoder and their reconstruction by the decoder is not supervised data. Various kinds of deep autoencoders like sparse autoencoders and denoising autoencoders are in researchers' focus.

B. Restricted Boltzmann Machines (RBMs)

Boltzmann Machines (RBMs) is a variety of randomized neural networks in which enables the dispensation of Boltzmann on nodes. This deep network is created in two layers, hidden and visible layer. The same layer nodes are not linked, while the nodes are fully linked with the other layers as represented in fig.1(b).

C. Deep Brief Networks (DBNs)

Deep Brief Networks (DBNs) are directed of a stack of various layers of RBM where each layer node is linked to other layer nodes represented in fig 1(c). The process of training in the DBN is done in two levels. With the help of data labeled, the fine-tuning learning technique is supervised while the technique of pre-training is unsupervised. So it is directed at both unlabelled training layers and labeled training layers.

D. Convolutional Neural Networks (CNNs)

CNN is a kind of deep neural network that is implemented for interpreting the same as HVS (human visual system). Previously, CNN presented great success in the computer vision field. Currently, it has been also enabled in other fields. With the help of CNN's various interfaces of human-computer are developed recently. CNN shows the benefits over networks of feed-forward because they can search the localities of the feature. So it has the capability in processing and extracting the features.

E. Recurrent Neural Networks (RNNs)

RNNs (Recurrent neural network) is a kind of architecture of the neural network that is implemented for sequential data, especially used for the problems of prediction of time series. In such a network previous state outcome is fed into the current state outcomes whereas, in all the conventional networks, all outputs and inputs are not dependent on each other. In RNNs the invisible state memories information related to the sequence. Fig 1(e) represents the RNN's structure. The standard RNNs can control only sequences of limited length. an enhanced version of RNNs has been introduced as Gated Recurrent Unit (GRU), Long Short-Term Memory (LSTM), etc. to solve such a problem.

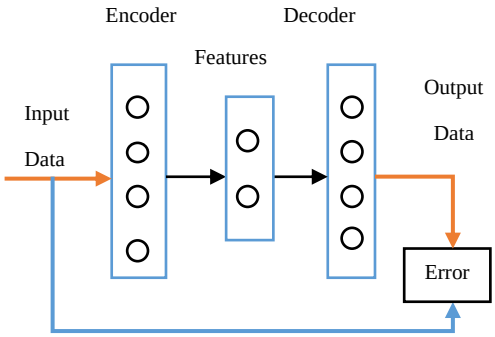
F. Generative Adversarial Network (GAN)

A GAN (Generative Adversarial Network) is a kind of neural network model having two units of sub-network, generator, and discriminator as in fig 1(f). The generator produces the fake date relate to the actual date whereas distinguishing between actual and fake date is done by the discriminator. The losses are propagated back by both discriminators as well as generators. Thus, the discriminator and generator enhance each other.

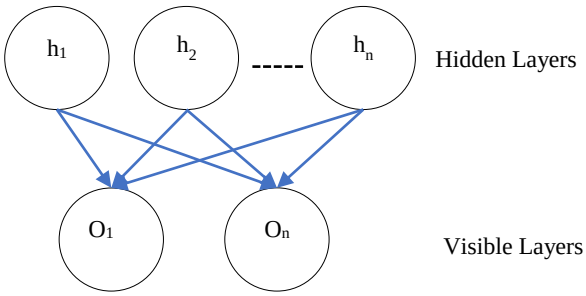
Some of the differences between different deep learning models are stated below in table 1.

Table 1. Advantages and Disadvantages of Deep Learning Models

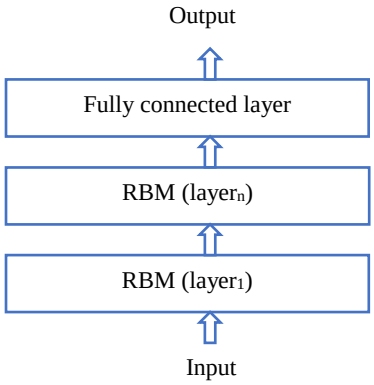
Deep Learning	Advantages	Disadvantages
Deep Autoencoder	Unsupervised learning.	It is compressive and decompressive. So, sometimes it may be lossy.
Restricted Boltzmann Machines (RBMs)	Layer to layer pretraining. Can be trained on unlabelled data. Better learning generative process	High computational cost. Slow training process.
Deep Brief Networks (DBNs)	Performs better than boosting. Effective in pattern recognition	High computational cost. Slow training process.
Convolutional Neural Networks (CNNs)	Removes the overfitting problem of traditional neural networks. High accuracy. Effective in pattern recognition. Weight sharing among layers.	High computational cost. Slow training process in absence of GPUs.
Recurrent Neural Networks (RNNs)	Store information concerning time. Remember the previous features.	Gradient vanishing problem. Problem in processing long sequences.
Generative Adversarial Network (GAN)	Better data distribution Any kind of generator network can be trained Avoiding approximation for calculation Avoid to use Markov chains and reduces the computational cost	Without good synchronization between generator and discriminator, it is hard to train the model. Missing learning pattern



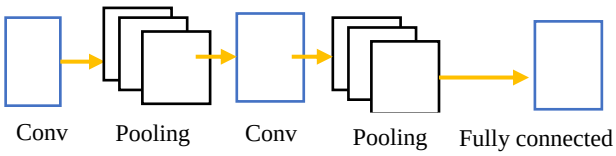
(a) Deep Autoencoder



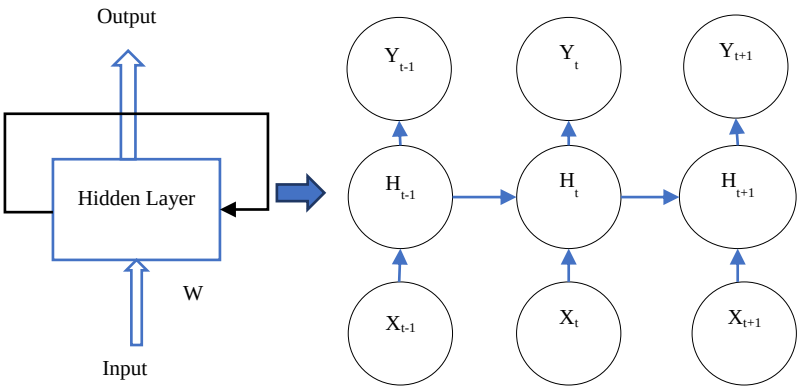
(b) Restricted Boltzmann Machine (RBM)



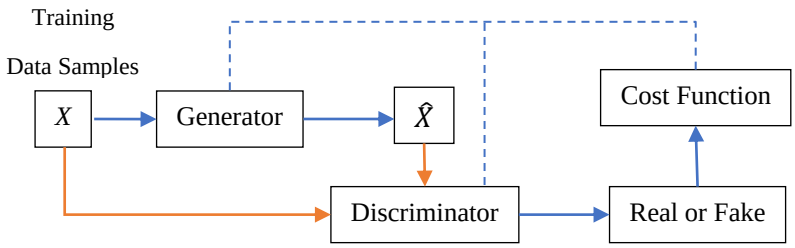
(c) Deep Brief Network (DBN)



(d) Convolution Neural Network (CNN)



(e) Recurrent Neural Network (RNN)



(f) Generative Adversarial Network

Fig.1. Examples of Deep Learning

III. LITERATURE REVIEW

In the past few years, the applying of methods of deep learning in the field of inspection of medical big data has been tried by several teams of researchers. In [2] author made an inspection model of data based ondeep learning for the transcripts and medical images and is used for the reorganization and diagnosis of disease intelligently. The huge medical big data is used for selecting and optimizing the parameters of model used by the model and learns the pathological process of inspection automatically of doctors or researchers of medical vie the model, and finally conductsjudgment of disease intelligently and efficient decisionbased onresults of inspecting medical big data. In [12] author introduced the architecture of the algorithm for inspection of the supervised multimodal image with cross-modality fusion at the level of feature learning, decision-making, and classifier. In [13] author design and develop deep convolutional neural networksbased ona system of image segmentation. The training of networks with multimodal images indicates better performance in comparison with the single-modal images trained networks. The author inspected the signal of brain state and proposes a methodology to enhance the decoding of brain state. However, the algorithm doesn't have a good effect of inspection on the signal of brain state, and there is a large amount of noise information.In [14] author developed anarchitecture of deep learning for classifying the results of data inspection in multiple varieties. The algorithm's time performance is low due to the big count of framework layers of deep learning. In [15] author introduced the use of both algorithms of unsupervised and supervised learning for learning the features of deep convolution images, to inspect the medical images. But only the information of the medical image can be processed by this algorithm and not the information of the medical text.

Table 2: Comparative Performance Evaluation

Ref	Deep Architecture	Diagnosis Field	Performance
[2]	3-D CNN	Brain Tumor	Accuracy =~90%
[16]	Deep Convolution Neural Network (Inception-V3)	Skin cancer	Accuracy = 55.4% ± 1.7%
[17]	Ensemble CNN	Breast Cancer	Recall=94% Precision=95%
[18]	DCN	Breast Cancer	AUC = 0.733
[19]	3-D CNN (UNET)	Brain Tumor	Dice Score is 0.71
[20]	3-D CNN (UNET)	Lung Tumor	Accuracy = ~80.5%

IV. CONCLUSION

With a steep increase in the medical big data field, there is an increase in the demand for medical big data processing methods. Due to the diverse and complex nature of medical data, it is quite a difficult task to process or analyze them. In this paper, it has been seen that deep learning hasan effective response as compared to other techniques. In this paper medical image is considered to be one of the sources of big data that is used for the diagnosis of medical data. This paper directs future researchers towards designing of a more robust and accurate deep learning model for early diagnosis and risk prediction for specific diseases.

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