A Review on Deep Learning in Healthcare Industry

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Abstract:

Deep Learning (DL) is one of the emerging technologies to satisfy the needs and applications for future generation. It is the subset of Artificial Intelligence (AI) and Machine Learning (ML) algorithms which help to stores large amount of data in the healthcare industry. Further, it helps the doctors for continuous monitoring and provides accurate results for future diagnosis. Also it satisfies several parameters based on deep learning algorithm such as accuracy, detection of hidden layer and storage of data for continuous monitoring. Based on that, this paper suggest some of the applications in healthcare industry like Medical Imaging, Genome, E-health records, and Drug discovery with proper references focused on deep learning algorithms.

Keywords: *Deep Learning (DL) Machine Learning (ML), Artificial Intelligence (AI).*

I. Introduction

Towards our future technology healthcare has the greater potential for analyzing people health outcomes with the help of doctors. This helps the doctors to analyze their patients records at anytime anywhere in the environment. Besides, these records are collected through Internet of Things (IoT) and wearable devices, which only convenient for small data processing. When it comes into big data analysis Deep Learning is a best choice. It can handle millions of data and obtain accurate results for continuous diagnosis. Generally, Deep Learning (DL) comes under the subset of Artificial Intelligence (AI) and Machine Learning (ML) as shown in fig. 1. The role of Artificial Intelligence (AI) has popularly increases for cancer detection, diagnosis and treatment. Despite of deep learning gives more precise diagnosis results when compared to both AI and ML. It has more capability to solve the complex problems and provide accurate results for further diagnosis [1]. Following that, Cellscope, says this technique helps the parents to monitor their children health records through a smart device like tablets and mobile phones, this leads to reduce frequent visits to the doctor clinic [2]. Hence, deep learning helps the doctors to provide better treatment for diagnosis. In future, the combination of deep learning with healthcare can make a tremendous change in the world that collects a huge volume of data including patient's records, medical reports, and insurance records. Also, it gives better outcomes when it applies in the neural networks which representations are learned from raw data format [3]. This representations are to be analyzed with multi levels of abstraction,

then computational models of deep learning are need to be designed with multiple layers that based on neural networks . The deep learning supports for high level data classification with number of hidden layers, then the hidden layer nodes are feed into the supervised layer to fine tune the entire network using back propagation algorithm. In order to prevent the network in over fitting the new methods are introduced in . The development of high level modules in neural network like Theano Caffe , TensorFlow and speedup the computation in graphical processing units also proposed. Besides, deep learning turned through good approaches in high-dimensional data, discovery of internal structures and accurate performance in object detection [9, 10], speech recognition , understanding of natural language and translation As well as relevant clinical methods have been obtained in health care like classification of skin cancer , detection of diabetic retinopathy in retinal fundus photographs, and prediction of DNA- RNA sequence in binding proteins . Further, the classification of Parkinson's disease (PD) was proposed which involve three types of classifiers using frequency domain analysis for proper classification to PD patients. After, the classification of emotional status in Parkinson's disease was proposed using machine learning algorithms. This method used to detect the accurate results for further investigation . Rejith, Kamalraj Subramaniam, et.al, suggested the analysis of emotional states in Parkinson's disease using some feature extraction techniques like Entropy, Energy-Entropy and Teager Energy-Entropy Features for PD classification in accurate manner .[4]

The deep models are trying to establish for several tasks of solutions. In future, the ways towards the next generation are based on deep learning for real time application in Healthcare industry. Finally, this paper divided into two folds: Concepts of deep learning with various types of algorithms and how it works in the various applications of healthcare industry.[5]
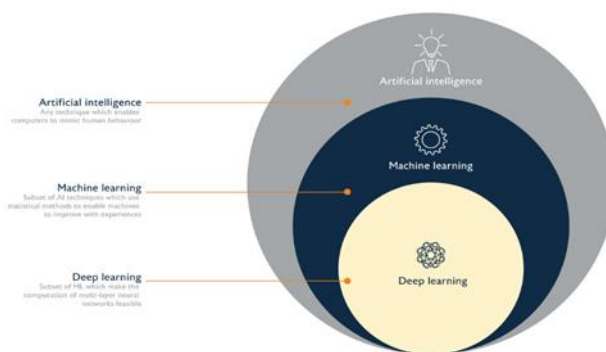
Fig.1 Basic diagram of Deep Learning

II.   Deep Learning in Healthcare Industry

Nowadays, Deep Learning occupies major role in the medical field to identify the millions of hidden data's, also to develop the healthcare industry as much better. In Healthcare, Deep Learning provides the doctors in comfort zone for analyzing various types of disease and helps them to treat in an accurate manner. It leads to take better decisions in the medical field and for efficient results some of the emerging applications are discussed with related articles .[6]
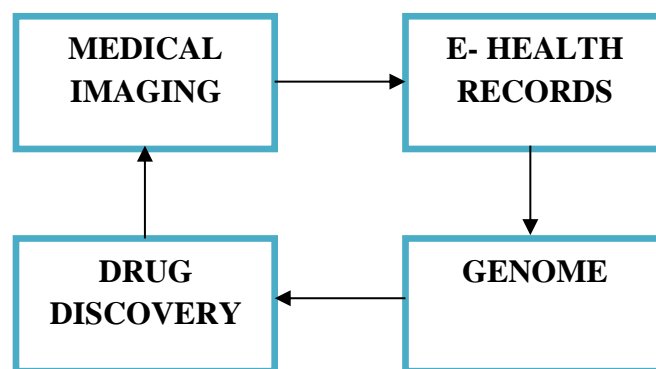
Medical imaging

In recent times, the medical field plays an important role in healthcare industry for handling big data analysis which consists of several techniques like X-Ray, CT, MRI, ECG, PET and so on. Further, these methods are used to diagnose various types of diseases such as brain tumor, cancer, and heart disease. Sometimes it is difficult to identify by using traditional approaches like

Machine Learning. To reduce this obstacle, deep learning came into existence. It helps doctors to identify the category of diseases for easy diagnosis and provide accurate results for further treatments .[7]Following that, the initial applications of deep learning are based on image processing with some clinical data. The main data analyses are concluded in which especially on the brain to predict the Alzheimer disease by using (MRI) Magnetic Resonance Imaging and its variations. Likewise, the hierarchical representations of knee MRI scans are automatically segmented by using CNNs and predict the risk of osteoarthritis .Consequently, the CNNs used to determine the diabetic retinopathy in retinal fundus photographs which obtained high sensitivity and specificity over about 10,000 test images with respect to certified ophthalmologist annotations . The performance of CNNs is well good in different types of skin cancer with biopsy clinical images over 130,000 of images with large datasets (1942 biopsy-labeled test images) [8]The Deep learning also applied in 3D MRI to segment the multiple sclerosis lesions in liver and identify the breast nodules in benign and malignant from ultrasound images . More recently, Gulshan et al. used CNNs to identify diabetic retinopathy in retinal fundus photographs, obtaining high sensitivity and specificity over about 10,000 test images with respect to certified ophthalmologist annotations. CNNs also obtained performances on par with 21 board-certified dermatologists on classifying biopsy-proven clinical images of different types of skin cancer (keratinocyte carcinomas versus benign and malignant) over a large data set of 130,000 images and 1942 test images for biopsy results [9]

Genome:

Deep learning is a highly promising technique in future genomics, which is used to understand the function of DNA and gives idea about the disease which affects most of the patient [2]. The main aspects of deep learning are to capture the internal structure of genomes (DNA sequencing, RNA measurements) and large datasets with efficient throughput . [10] The first genomics applications in neural networks are concluded as CNNs with deep neural architectures, and unchanged input features. In recent times, most of the researches are directly apply into CNNs with raw sequence of DNA. The main description of CNNs was inspired by cat's visual cortex in . To obtain translation invariant descriptors, the local connections and weights across the units are followed by sub sampling . However, the CNNs work with less parameter, by calculating inputs and sharing information in small regions. This leads to train the DNAs models on larger sequence of windows that enhance to detect the similar patterns. The DeepBind was proposed in it is a deep architecture based on CNNs that predicts both DNA- and RNA-binding proteins. It was help to quantify the effects of sequence and identify the functional single nucleotide variations (SNVs). Following that, to predict DNase I the open source framework was proposed in , to conclude the hypersensitivity across multiple types of cell and the chromatin accessibility are quantize with the effect of SNVs. Finally, concluded that deep learning is widely used to improving the results of drug discovery for genomic medicine.[11]

E- Health records:

In recent times deep learning has been implemented in E-Health Records (Electronic – Health Records) which includes both structured (ie. Diagnosis, laboratory tests) and unstructured data (ie. Clinical notes). It is the major part of this review that focused on e- health records in healthcare system with a deep architecture for a specific, supervised and predictive analysis of clinical data which obtain better results than traditional machine learning algorithm likeaccuracy, F-score and Area under the Receiver

Operating Characteristic Curve in. Most of the paper work through supervised networks, to implement the patient data some reviews also concluded with unsupervised learning models which are performed using shallow classifiers like random forests, and logistic regression. Further various works are applied in deep learning to predict diseases by using patient's clinical status. In Liu et al, proposed four-layer CNN to predict congestive heart failure, chronic obstructive pulmonary disease and several advantages over baselines. DeepCare is used for LSTM - long short-term memory, hidden units, pooling layer and word embedding in [12]The DeepCare is used to analyze the future prediction on diabetes, disease progression model for mentally affected people. Further, in Choi et al. proposed RNNs with Gated Recurrent Unit (GRU) to develop a prediction model that uses patients data for end to end prediction for frequent analysis. Sometimes this model gives inaccurate results due to poor transmission from one place to another. In order to meet out these, Miotto et al. developed to learn the deep analyzes of patient representations from e-health records by using three-layer Stacked Denoising Autoencoder (SDA) in. This representation was applied to predict the risk of disease using shallow classifiers like random forest. Hence, this method was performed on 76,214 patients who are all affected by 78 diseases from same clinical domain. This leads to give better prediction results than raw data e-health record or traditional algorithms.[13]

Drug discovery:

In past few decades, the development and discovery of new drug is a tedious and time consumption process. In order to make it efficient, expert's moves through advance technology called Deep learning. In healthcare DL helps to discover a new medicine for future developments. Whereas, these technology creates more benefits to doctors for analyzes the patient's medical records for further diagnosis. Moreover, this technology is gaining insights from patient symptoms and tests [14]

III.   Conclusion

Healthcare is going to be a tremendous change in the world. In future, the entire healthcare industry moves through Deep Learning algorithms such CNNs, RNNs and DeepCare which gives better results for diagnosis. Also it satisfies some deep learning parameters like accuracy, hidden layer detection and handling large amount of data for continuous analysis. Based on that, it is mostly applicable for several healthcare applications such as Medical Imaging, Genome, E-health records and Drug discovery. These are explained with proper references and lots of reviews are focused on deep learning algorithms.

REFERENCES

1. Deep Learning in Healthcare.
2. https://www.allerin.com/blog/top-5-applications-of-deep-learning-in-healthcare
3. Riccardo Miotto, Fei Wang, Shuang Wang, Xiaoqian Jiang and Joel T. Dudley, 'Deep learning for healthcare: review, opportunities and challenges', Bioinformatics, 2017.
4. . LeCun Y, Bengio Y, Hinton G. Deep learning. Nature 2015;521:436–44
5. Srivastava N, Hinton GE, Krizhevsky A. Dropout: a simple way to prevent neural networks from overfitting. J Mach Learn Res 2014;15:1929–58.
6. Abadi M, Agarwal A, Barham P, et al. TensorFlow: large-scale machine learning on heterogeneous distributed systems, 2016. http://arxiv.org/abs/1603.04467.
7. Krizhevsky A, Sutskever I, Hinton GE. ImageNet classification with deep convolutional neural networks, Advance Neural Informatics Process System, pp. 1097–1105, 2012.
8. Szegedy C, Liu W, Jia Y, et al. Going deeper with convolutions. In 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 1–9.

9. Rejith KN, Kamalraj Subramaniam,'Analysis of Emotional States in Parkinson's Disease using Entropy, Energy-Entropy and Teager Energy-Entropy Features', Indian Journal of Public Health Research & Development, 2018.

10. Srinivasan, V., Singh, J., Pandi-Perumal, S. R., Brown, G. M., Spence, D. W., & Cardinali, D. P. (2010). Jet lag, circadian rhythm sleep disturbances, and depression: the role of melatonin and its analogs. Advances in therapy, 27(11), 796-813.

11. Manogaran, Gunasekaran, P. Mohamed Shakeel, H. Fouad, Yunyoung Nam, S. Baskar, Naveen Chilamkurti, and Revathi Sundarasekar. "Wearable IoT smart-log patch: An edge computing-based Bayesian deep learning network system for multi access physical monitoring system." Sensors 19, no. 13 (2019): 3030.

12. Singh, S. K., Srinivasan, K. K., Singare, D. S., Gowthamarajan, K., & Prakash, D. (2012). Formulation of ternary complexes of glyburide with hydroxypropyl-β-cyclodextrin and other solubilizing agents and their effect on release behavior of glyburide in aqueous and buffered media at different agitation speeds. Drug development and industrial pharmacy, 38(11), 1328-1336.

13. Kalaiselvi, C., & Nasira, G. M. (2015). Prediction of heart diseases and cancer in diabetic patients using data mining techniques. Indian Journal of Science and Technology, 8(14), 1.

14. Shakeel, P. M., Baskar, S., Dhulipala, V. S., Mishra, S., & Jaber, M. M. (2018). Maintaining security and privacy in health care system using learning based deep-Q-networks. Journal of medical systems, 42(10), 186.