Deep Learning in Medical Research

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Abstract **- Deep Learning proposed by Hinton[1] is a new learning algorithm of multi-layer neural network and is a type of machine learning . Deep Learning helps researchers analyze medical data to treat disease. It also helps in diagnosis of disease in early stages like cancer, Alzheimer's disease and so on. This paper analyzes research directions and future prospects of Deep Learning in medical field which help patients to enhance quality of life. Also ease doctors to make strong predictions on basis of datasets previewed.**

I. INTRODUCTION

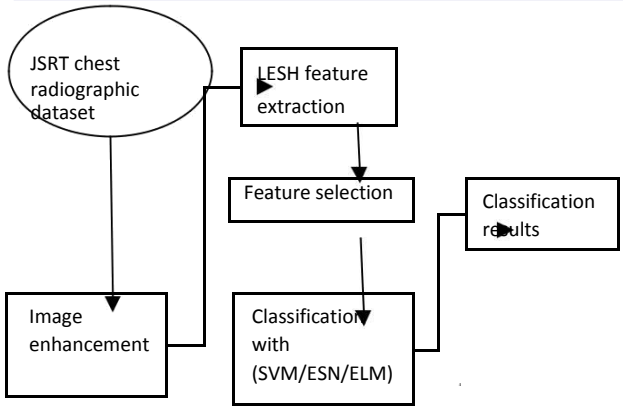
Early diagnosis of certain diseases is essential for the progress of more prevailing treatments. Artificial Intelligence (ML/DL) employs a variety of probabilistic and optimization techniques that permits PCs to gain from vast and complex datasets. It is used to interpret and analyze data. Furthermore it can classify patterns and model data. It permits diseases to be made that couldn't be made generally utilizing routine systems while sparing time(Mitchell T,1997). Machine Learning (DL) methodologies having extensively used for computer aided diagnosis in medical image formation mining (Supekar,2008) and retrieval (Bookheimer 2000) with wide variety of different applications especially in detection and classification[3] of brain disease using CRT images[2] (Cruz,2006) and X-rays (Petricoin,2004) it is just been generally late that specialists have endeavoured to apply machine learning towards prediction of deadly life threatening diseases. As a consequence , the literature in the field of disease prediction and machine learning (DL) is relatively small. However today's imaging technologies and high throughput diagnostics have lead us overwhelmed with large number (even hundreds) of cellular ,clinical and molecular parameters . In current circumstances, the standard measurements and human instinct don't frequently work. That is the reason we must depend on intensively computational and non traditional approaches such as machine learning. The custom of using Machine Learning as a part of disease prediction and visualization is a fragment of an expanding shift toward customized prescription(Cruz,2006).This drift is important, not only for the patients in increasing their quality of life and life style, but for physicians in making treatment decisions and also for health economists.

II. MACHINE LEARNING

Before starting the detailed analysis of machine leaning methods, it is significant to have a better understanding of what actually machine learning is and what machine learning techniques are commonly used in disease prognosis. Machine learning comes under the umbrella of artificial intelligence and has variety of tools to make statistical, probabilistic decisions based on previous learning. It uses past learning (training) to classify new event and predict new patterns. Machine learning is very powerful as compared to standard statistical tools. In machine learning, a good understanding of a problem and limitations of the algorithms are needed to be understood well to get effective results. Therefore, it has a good chance for success if an experimentation is properly conducted and training is carefully and correctly employed and results are vigorously validated. Furthermore, all the algorithms and methods in machine learning are somewhat made different. For instance, few methods are designed on the basis of certain assumptions or for certain type of data which make it inapplicable for other type of data. That is why it is crucial to apply more than one machine learning method on given training data. Machine learning generally have three types of learning algorithms[2]: 1. Supervised learning 2. Unsupervised learning (Duda RO, 2001) 3. Reinforcement learning (Mitchell T, 1997). In supervised learning, a training data is given whereas the program tries to learn it and learns how to draw the input to the required output. The unsupervised learning algorithms employs self-learning based on unclassified and unlabeled data. Interestingly, the algorithms used in prognosis and diagnosis are almost all supervised learning algorithms including Artificial Neural Networks, Decision Trees, genetic algorithms and linear discriminant analysis. Other techniques which are generally in use are SVM, AR mining, and Ensemble methods. In comparison to the above, SVM or support vector machine is somewhat newer technique (Duda RO, 2001) and is world known machine learning technique now but it is almost unidentified in some diseases prognosis field. The other methods such as KNN (K-Nearest Neighbours) and DTs (decision trees), are not widely used in disease predictions. Although, many high quality papers were studied for this review. However, almost all of them lacked a valid proven dataset , lacked external or internal validation, were using too many attributes (causing over training) and no well defined standard was made with which results were compared.

III. DEEP LEARNING

Consider a particular disease to describe how the diagnosis takes place using deep learning. Let us consider the disease to be lung cancer. The following may be one of the model that is proposed for the diagnosis.



Steps of the proposed CDSS[4]

The above proposed system consists of four steps as depicted in the figure.

A. Dataset

Experimentation is conducted on digital datasets of chest radiographs provided by Japanese society of radiological technology (JSRT) .This dataset contains images of 2048 X 2048 pixels. All images have declared with presence of nodules as well as classified as malignant based upon histologic and cytologic examination[5].

B. Image Preprocessing

Chest radiographs have low contrast which hinders detection of nodules in the images. In the method first divides the image into contextual blocks(Tiles). Further, it calculates the histogram or each block using a specific number of bins for grey level values. Later the values are clipped, interpolated and mapped for the final image.

C. Image segmentation

The lung area from the chest radiographs is extracted from which lungs with and without nodules are discriminated. Algorithm developed by Wong et al.[6] The region further helps to classify them as malignant or benign case.

D. Feature extraction and selection

From the segmented image, histogram of local energy information, LESH[7] was calculated for sub regions of segmented area as the feature set, this resulted in a feature vector which was later fed into classifier. The classifiers are of three types:

1. Support Vector Machine 2.Echo State Network[8] 3. Extreme Learning Machine.

IV. CONCLUSION

Although Deep Learning has acquired some success, it is still its infancy. This paper gives an overview of Machine Learning and also illustrates the necessity of Deep Learning in medical field with an example of lung cancer using a model. There is still a lot of work to be studied for deep learning, using efficient algorithm to improve the training field is worthy of study. With the deepening of theory study and methods of Deep Learning, Deep Learning will be more widely used in various fields mainly in Medicine to make our life easier and better.

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