Symptoms Identification of Cancer using Deep Learning

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Abstract

The science of resolving medical problems by analysing images generated from variety of high dimensional images like MRI, CT etc. is occurring a value added necessity in the society in the field of medical diagnosis and prediction. The basic objective of this is to extract information in an effective and efficient manner for improved clinical image diagnosis. In this, deep learning is successfully used as a machine learning tool where neural network is capable of automatically learning features. Among deep learning techniques, deep convolutional networks are actively used for the purpose of medical image analysis. This includes application areas such as segmentation, abnormality detection, disease classification, computer-aided diagnosis (CAD) and retrieval. In this study, a comprehensive review of the current state-of-the-art in medical image analysis using deep convolutional networks is presented. The challenges and potential of these techniques are also highlighted.

Keywords: Convolutional Neural Networks (CNN), Recurrence Neural Network (RNN), Graphics Processing Unit (GPU), Computer-Aided Diagnosis (CAD), Human Development Index (HDI).

Introduction

Cancer is one of the 2nd leading cause of deaths worldwide. Although the causes of cancer remain largely unknown, particularly for those that occur during childhood, there are many factors known to increase risk. Both researchers and doctors are facing the challenges of fighting cancer.

As per the estimation report published by International Agency for Research on Cancer (IARC), there will be 17.0 million new cancer cases in worldwide, of which 657,000 will occur in countries with a low HDI, 2.8 million in medium-HDI countries, 6.4 million in high-HDI countries, and 7.2 million in very high-HDI countries. Also the future estimation says that by 2040, the global burden is expected to grow to 27.5 million new cancer cases and 16.3 million cancer deaths simply due to the growth and aging of the population and most of the countries the mortality rate increases due to late detection of the disease and inaccurate treatment that to treatment not performed in proper time. So the early detection of cancer is the top priority for saving the lives of many. Typically, visual examination and manual techniques are used for these types of a cancer diagnosis. This manual interpretation of medical images demands high time consumption and is highly prone to mistakes.

For this reason, in the early 80's, the method followed mostly was computer-aided diagnosis (CAD) systems brought to assist the physicians to improve the efficiency of medical image interpretation. Feature extraction is the key step to adopt machine learning. Different methods of feature extraction for different types of cancer have been investigated in However, these methods based on feature extraction have weaknesses. To overcome these weaknesses and to enhance the performance the updated and most popular technique of Deep learning has the adopted to get the advantage of generating directly from raw images the high-level feature representation. In addition to deep learning, Graphics Processing Units (GPU) are also being used in parallel, for feature extraction and image recognition. For example, convolutional neural networks have been able to detect cancer with better performance.

Data Collection and Analysis

The data collections can be both qualitative and quantitative collected from the variety of datasets like uscs_map_death_all, INbreas and BreakHis dataset for breast cancer testing; and Danish Lung Cancer Screening Trial (DLCST) for lung nodule classification. Apart from these interviews, questionnaires, direct observations, informal discussions etc. from different workplaces related to cancer. In case of questionnaires it is based on a scale based calculations. In the workplace site exposure measurement the factors & variables affecting the environments are kept in mind while analyzing the data.

The quantitative data collected from both primary and secondary resources are done using the Python programming and SPSS tool for statistical analysis depending on variety of the data.

Literature Review

The below mentioned literature review is on Indian context and International context separately and all articles refereed shows that the deep learning technique of Convolutional Neural Networks and RNN is mostly used suitable to get the better and promising early estimation of the disease and the prediction of prescription and treatment for decreasing the mortality rate due to cancer in the world.

Paper Title, Year	Author	Methodology	Results or Findings	Parameters used	Comments, Ideas for Future
Medical image processing schemes for cancer detection: A survey. IEEE-2014	Priya Darshini Velusamy; Porkumaran Karandharaj	1. FPGA (Field Programmable Gate Array) 2. Reconstruction algorithms, Monte Carlo simulation and CA (Cellular Automata) Based Segmentation method.	CA based segmentation method is comparably efficient method since the computation time is low due to inherent parallelism of the proposed algorithm.	1. Peak current component for simulated output with the scattering centre. 2. Noise ratios 3. LEGP	To develop hybrid intelligent algorithms for image analysis and to examine the real time cancer images and provide better solution for analysis and diagnosis.
Deep Learning Applications in Medical Image Analysis. IEEE–2017	JUSTIN KER1, LIPO WANG 2, JAI RAO1, AND TCHOYOSON LIM3	CNN architecture combinations or hyper parameter optimization.	Data or class imbalance in the training set effect can be ameliorated by using data augmentation to generate more training images of rare or abnormal	1. Different types of images 2. Image pixel values 3. Kernel function value i.e the stride length	For more volumetric images some types of robust techniques need to be developed for the efficient and accurate analysis of medical images.

			data, though there is risk of over fitting		
Deep Learning for Medical Image Processing: Overview, Challenges and the Future	Muhammad, Imran Razzak, Saeedanaz Ahmad Zaib	Consists of different methods for image filters which transform 2D into 3D.	The penetration of Deep learning into the health care division, especially image processing will lead to a tremendous outcome in the near future to the real world problem.	CNN, DBN, DBM, DNN, RNN	Great accuracy Models learn rapidly, but the learning process is slow, needs to improve and need to increase a great deal of labeled data from a big dataset.
Deep Learning for Image-based Cancer Detection and Diagnosis — A Survey	HuZilong, WangZiming, ZhangKai, SunQingling	CNN, FCN, SSAE, and DBN	Attempts are being made to compare different Deep Learning techniques for different types of cancers detection & diagnosis based on the medical image processing.	Radial basis function, kernel function value, pixel density	CNN has been studied and used in different types of cancer detection. Most of the DNN architecture performs poorly on blur and noisy images which gives a future task to find the techniques for this.

| Deep Learning Techniques for Medical Image Segmentation: Achievements and Challenges	Mohammad Hesam Hesamian WenjingJia, Xiangjian He & Paul Kennedy	Deep Learning for Image segmentation and CNN for Organ Segmentation	Attempt to compare different network structures, training techniques and challenges with their solutions. Using	Image propagated signals, organs & tissues inherent imaging.	Performing the annotation on new images and will be very tedious and expensive task.

Methodology

In this research, we primly focus on the new knowledge-based system for Diagnosis of different probable images for cancer using some of the techniques like machine learning and Deep learning algorithms like CNN, FPGA, Bowtie Antenna (a genetic algorithm) techniques .Here mostly we are proposing to use the CNN based classifier to gather and accommodate the local drifts and vary in properties of a very few class will be occurred. Generally, we are carrying out the research in 3 phases like: First, the Prediction can be possible by using the existing patterns and values of the images, in order to predict unknown or future values of interest., Second, the analysis and description focuses on finding appropriate patterns describing the available images with its features, Third, use of different rule-based decision tree approach, deep learning algorithms to generate predictive behavior of the disease and its probable remedies. Here also the predictive technology with the knowledge-based system can assist medical practitioners in the healthcare practice as a clinical analytical method. The analysis and learning of the training data are performed via classification algorithm. We are supposed to use the In classification test data to estimate the accuracy of the classification rules. The classifier-training algorithm uses these pre-classified to determine the set of parameters required for proper discrimination.

Deep learning in medical image processing, proceeding from theoretical foundation to applications by initially discussing some of the fundamentals of neural networks and perceptron. The perceptron is a mathematical model of a biological neuron

In recent years deep learning had a tremendous impact on the field of image recognition, image analysis by using several algorithms and techniques like Decision Tree, Bayesian Nets, Nearest Neighbours and Neural Nets. Still among these we choose the Convolutional Neural Networks (CNN) as it not only classify the photo automatically rather describes various elements in the pictures and helps in prescribing the remedies by describing every segments with a proper grammar. Deep learning method has become a popular approach for big data process and analysis. Deep learning has the capability to yield useful and important features from data that can ultimately be useful for improving predictive power.
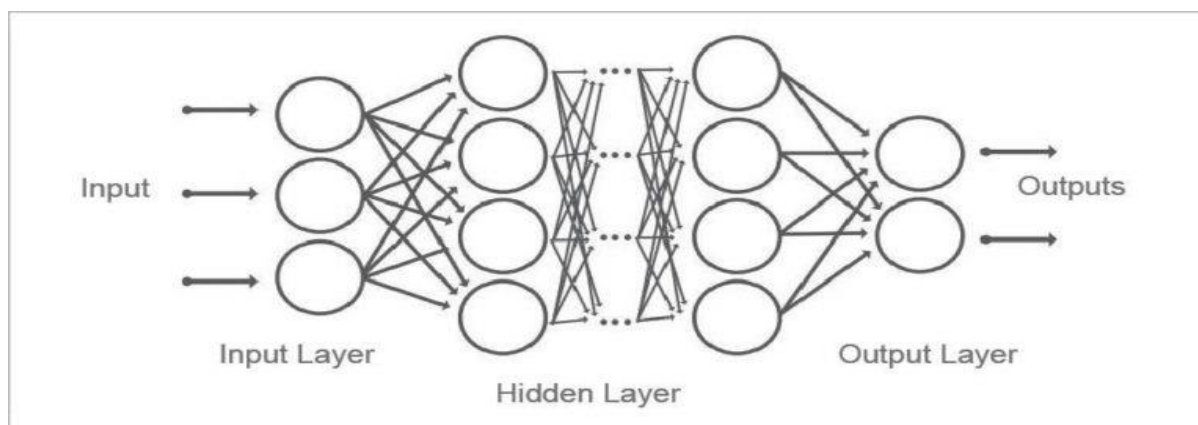
Even though there are many types of deep learning algorithms present including deep belief networks (DBN), Artificial Neural Network (ANN), Convolutional Neural Networks (CNN), and more that can also be used for prediction problems and diagnose the image data, Still CNN Deep Learning models, with their multi-level structures, as shown above, are very helpful in extracting complicated information from input images. Convolutional Neural Networks are also able to drastically reduce computation time by taking advantage of Graphics Processing Unit (GPU) for computation which many networks fail to utilize and it is also a widely used technique which includes different areas of applications like disease classification, segmentation, CAD and retrieval. Apart from all these Convolutional neural networks are also able to drastically reduce computation time by taking advantage of GPU for computation which many networks fail to utilize.

Future Scope

It is expected to see more studies applying more complex deep learning models and transfer learning for cancer detection in the future studies. The point of research must be on potential of end-to-end trainable deep learning model in the future with large training data. Apart from this it is also noted that there were few studies investigating the effect of intrinsic characteristics (contrast, signal to noise ratio, etc) of medical image on the performance of deep learning models. It was mentioned in that most deep neural network architectures performed poorly on blur and noisy nature scene images, even if they were trained on low quality images. Thus how to improve the performance of deep learning based cancer detection and diagnosis when the images have low contrast and signal to noise ratio is an important research direction.

Conclusion

In recent studies on the subject of applying deep learning techniques in image based cancer detection and diagnosis. During recent years, deep learning has gained a central position with regard to the automation of our daily life and has delivered considerable improvements in comparison with traditional machine learning algorithms. These applications are organized in different categories depending upon specific types of cancers, including breast cancer, lung cancer, skin cancer, prostate cancer, brain cancer, colonial cancer, cervical cancer, bladder cancer, and liver cancer. The popular image based deep learning models, including convolutional neural networks, fully convolutional networks, auto encoders, Recurrence neural networks and deep belief networks are in discussion in current scenario.

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