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A Survey on Medical Image Interpretation for Predicting Pneumonia

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Abstract: Pneumonia is a disease which occurs in the lungs caused by a bacterial infection. Early diagnosis is an important factor for the successful treatment process. Generally, the disease can be diagnosed from chest X-ray images by an expert radiologist. The diagnoses can be subjective for some reasons such as the appearance of disease which can be unclear in chest X-ray images or can be confused with other diseases. Therefore, computer-aided diagnosis systems are needed as tools to assist in the clinical interpretation of chest x-rays would therefore fulfill an unmet need. This present a survey of the research in deep learning applied to radiology.

Index Terms - Machine learning, Deep learning, Medical imaging, CNN

I. INTRODUCTION

Medical image analysis is an active field of research for machine learning, partly because the data is relatively structured and labeled, and it is likely that this will be the area where patients first interact with functioning, practical artificial intelligence systems [1]. Deep neural network models have conventionally been designed, and experiments were performed upon them by human experts in a continuing trial-and-error method. This process demands enormous time, know-how, and resources. To overcome this problem, a novel but simple model is introduced to automatically perform optimal classification tasks with deep neural network architecture. The neural network architecture was specifically designed for pneumonia image classification tasks. The proposed technique is based on the convolutional neural network algorithm, utilizing a set of neurons to convolve on a given image and extract relevant features from them. Demonstration of the efficacy of the proposed method with the minimization of the computational cost as the focal point was conducted and compared with the exiting state-of-the-art pneumonia classification networks. In recent times, CNN-motivated deep learning algorithms have become the standard choice for medical image classifications although the state-of-the-art CNN-based classification techniques pose similar fixated network architectures of the trial-and-error system which have been their designing principle.

The application proposed will be able to act as a diagnostic tool based on a deep-learning framework and CNN for the screening of patients having Pneumonia. The Application utilizes transfer learning, which trains a neural network with a fraction of the data of conventional approaches. The dataset contains X-ray images of having Pneumonia and not having Pneumonia

II. LITERATURE SURVEY

Manali Shaha et al.[2] proposed Research in image classification seen the evolution in computer vision algorithm from first order moments to handcrafted features to end to end machine learning approaches to improve the classification accuracy.This paper talks about the success of CNN in the order of machine learning and computer vision field. Alex proposed an evolutionary CNN architecture named AlexNet for object recognition task. The major hurdle in training of CNN is availability of large database. To improve the accuracy researches proposed deeper CNN architecture. Simmon el al proposed VGG16 architecture for object recognition task. Improved VGG16 architecture known is VGG19 overcome the drawbacks of AlexNet and increase the system accuracy. Two databases calTech256 and GHIM10K where used to analyze and compare AlexNet and VGG16.SVM classifier was analyzed. Accuracy of CNN highly depends upon the three factors: 1) Large scale database, 2) High end computational model and 3) Network depth.

Shoji Kido[3] proposed Computer-aided diagnosis (CAD) systems include two types of CAD algorithms such as (CADe) and (CADx). CADe which is computer aided detection which detects abnormal lesion CADx which is computer aided diagnosis that differentiates abnormal lesion into benign or malignant. Image features that could detect and classify abnormalities of the lung diseases such as lung nodules or lung disease patterns. These image features are useful for the computer-aided classification on the lung diseases. Defining such image features is a difficult task due to the complicated image patterns. Deep learning techniques improved state-of-the-art in fields of the speech and vision. Therefore with the features of (CADe) and (R-CNN) and CNN have developed an image based (CADe) for detection of lung abnormalities by use of (R-CNN).In image cases there are four cases: 1.Lung nodules. 2. Diffuse lung diseases. 3. Image based CADx by use of CNN. 4. Image based CADe by use of R-CNN.

Zulfikar Aslan [4] proposed that CNNs are designed to process data types that consist of the multiple dimensions as 2-d images. There is a hierarchy of simple and complex cells from the elements inspired from visual cortex of a human. RNNs are mainly developed for the task of analyzing discrete arrays of data. RNNs have structure of circular connected nodes. There are various imagining modalities in medical field & use of these technologies has increasing. There will be different images from the medical Imagining modalities .CNNs are generally used for tasks of classification, localization, detection, segmentation & registration over the medical image.

Enes Ayan [5] Proposed Pneumonia is inflammation of the tissues in one or both lungs that usually caused by a bacterial infection. Chest x-ray images are the best known and the common clinical method for diagnosing of pneumonia. Dataset represents the distribution of the data when training, validating and testing phases of the model. Data samples from the dataset show pneumonia cases and normal cases. Data argumentation avoids the over fitting and improves the accuracy. Transfer Learning is the idea of overcoming the isolated learning paradigm and utilizing knowledge acquired for task to solve. Data argumentation was used for avoiding over-fitting, xception and vgg16 networks accuracy and loss graphics. While training the model we used transfer learning and fine tuning. Every network has own detection capability on dataset. Xception network is more successful for detecting pneumonia cases.

Phat Nguyen Kieu [6] proposes Chest x-ray images or radiographs provide a single view of the chest cavity. Chest x-ray provides a complete view of the chest internals and thus can be used to detect easily. To extract the information for the task at hand without feature selection CNN is better to work with images. To support physicians in diagnosing disease in medicine and treatment of doctors. The results of their initial findings and compare performances of deep neural nets using a combination of different network topologies and optimization parameters. To predict the accuracy of the classification results of data multi-CNN model used Hold-out method for evaluating. To compute the results we use multi-CNN model.V-64L and V-64R is used to know the probability value for the input images. To train the model CNN component are trained.

Emir Skejić et al. [7] Introduced Google TensorFlow is a platform for building models in machine learning. The basic unit in tensorflow is a computational graph, which consist of nodes, which are operations and edges which represent tensors. The core of tensorflow is implemented in C++ programming language; however the main language is python. Methods like (a) Convolution one of the use of convolution in image processing is edge detection. (b)Edge detection Edge detection is often the first step in image preprocessing, which uses two methods Image gradient and Canny filter. (c)Gaussian filtering This is often-used method for reducing Gaussian noise in image .other methods are Image resize, Image segmentation, Image deblurring and Image rotation. All experiments are performed on a single machine running 64bit linux or intel processors. (a) Smaller data size CPU (central processing unit) outperforms GPU (graphics processing unit) in most cases. (b) For bigger data GPU gave better performance. GPU efficiently handled all the bigger inputs with increase in speed size of 3.6 times to 15 times, but for smaller data computation is lower.

Ling Shao [8] proposed that there are three types of knowledge that are useful for knowledge transfer: 1) source domain features; 2) source domain features and the corresponding labels; and 3) parameters of the pre learned source domain models, which indicate instance-based transfer learning inductive transfer learning and parameter-based transfer learning, respectively. Through the performance comparisons between knowledge transfer techniques and non-knowledge transfer techniques, we can conclude that brutal forcing the source domain data for learning can degrade the performance of the original learning system, which demonstrates the significance of knowledge transfer. To transfer the source domain knowledge to the target domain, methods are designed from either the feature representation level or the classifier level. In general, the feature representation level knowledge transfer aims to unify the mismatched data in different visual domains to the same feature space and the classifier level knowledge transfer aims to learn a target classifier based on the parameters of pre learned source domain models, while considering the data smoothness in the target domain. Thus, the feature representation level knowledge transfer techniques belong to either instance-based transfer or inductive transfer, while most classifier level knowledge transfer techniques belong to the parameter-based transfer.

Transfer learning is a tool for improving the performance of the target domain model only in the case that the target domain labeled data are not sufficient, otherwise the knowledge transfer is meaningless. So far, most research on transfer learning only focuses on small scale data, which cannot well reflect the potential advantage of transfer learning over regular machine learning techniques. The future challenges of transfer learning should lie in two aspects: 1) how to mine the information that would be helpful for the target domain from highly noisy source domain data and 2) how to extend the existing transfer learning methods to deal with large-scale source domain data.

Lisa Torrey [9] proposed an inductive learning task, the objective is to induce a predictive model from a set of training examples [28]. Often the goal is classification, i.e. assigning class labels to examples. Examples of classification systems are artificial neural networks and symbolic rule-learners. Another type of inductive learning involves modeling probability distributions over interrelated variables, usually with graphical models.

Examples of these systems are Bayesian networks and Markov Logic Networks. The predictive model learned by an inductive learning algorithm should make accurate predictions not just on the training examples, but also on future examples that come from the same distribution. In order to produce a model with this generalization capability, a learning algorithm must have an inductive bias – a set of assumptions about the true distribution of the training data. The bias of an algorithm is often based on the hypothesis space of possible models that it considers. For example, the hypothesis space of the Naive Bayes model is limited by the assumption that example characteristics are conditionally independent given the class of an example.

In inductive transfer methods, the target-task inductive bias is chosen or adjusted based on the source-task knowledge. The way this is done varies depending on which inductive learning algorithm is used to learn the source and target tasks. Some transfer methods narrow the hypothesis space, limiting the possible models, or remove search steps from consideration. Other methods broaden the space, allowing the search to discover more complex models, or add new search steps.

Okele Stephen [10] proposed a convolutional neural network model trained from scratch to classify and detect the presence of pneumonia from a collection of chest X-ray image samples. Unlike other methods that rely solely on transfer learning approaches or traditional handcrafted techniques to achieve a remarkable classification performance, we constructed a convolutional neural network model from scratch to extract features from a given chest X-ray image and classify it to determine if a person is infected with pneumonia. This model could help mitigate the reliability and interpretability challenges often faced when dealing with medical imagery. Unlike other deep learning classification tasks with sufficient image repository, it is difficult to obtain a large amount of pneumonia dataset for this classification task; therefore, we deployed several data augmentation algorithms to improve the validation and classification accuracy of the CNN model and achieved remarkable validation accuracy

III. Conclusion

In this study we have found the need of computer-aided system for predicting the accurate probability of a person having Pneumonia. The most common method used is transfer learning. The CNN architectures VGG16, VGG19, AlexNet, Inception and ResNet are trained using the Chest X-ray dataset. The model which gives the most accurate prediction will be considered for computer-aided System. Keras integrated with the Tensor flow can be used to load the selected model architecture. Each model architecture is trained in google colab..

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