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A REVIEW OF DEEP LEARNING CLASSIFICATION TECHNIQUES USED IN MEDICAL IMAGE ANALYSIS

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Abstract: The methods and techniques with respect to medical image analysis have improved over the years from time taking manual analysis to the point where image analysis can be done with minimal amount of human interaction. Deep learning has emerged to be a promising technique apart from the other machine learning algorithms because of its precision, efficiency and accuracy. It is being implemented into the different imaging tasks namely, classification, segmentation and registration. This review paper will be concentrating on the classification techniques used primarily in medical imaging.

Keywords - Artificial Intelligence, Deep Learning, Medical Imaging, Image Classification.

I. INTRODUCTION

With the advancement in science and technology, there has been a lot of improvement in the field of medical imaging. Various techniques have been developed to form images of the human body for diagnosing and treatment purposes. Medical imaging creates a large amount of raw data. While the surge in data is a boon to the researchers, it can be quite daunting to go through a large amount of data and analyze it manually. Artificial Intelligence has come up with ways to analyze medical images with the least interaction from humans with minimal percentage of error. These techniques are efficient and process with a speed that is not possible by humans. Deep Learning is supposed to be playing a very substantial role in the advancement of medical imaging techniques in the coming years. This is due to the fact that deep learning can extract features and relations from the given dataset with huge precision in addition to giving attention to minute details.

II. DEEP LEARNING

With the advancement in science and technology, there has been a lot of improvement in the field of medical imaging. Various techniques have been developed to form images of the human body for diagnosing and treatment purposes. Medical imaging creates a large amount of raw data. While the surge in data is a boon to the researchers, it can be quite daunting to go through a large amount of data and analyze it manually. Artificial Intelligence has come up with ways to analyze medical images with the least interaction from humans with minimal percentage of error. These techniques are efficient and process with a speed that is not possible by humans. Deep Learning is supposed to be playing a very substantial role in the advancement of medical imaging techniques in the coming years. This is due to the fact that deep learning can extract features and relations from the given dataset with huge precision in addition to giving attention to minute details.

III. LITERATURE SURVEY

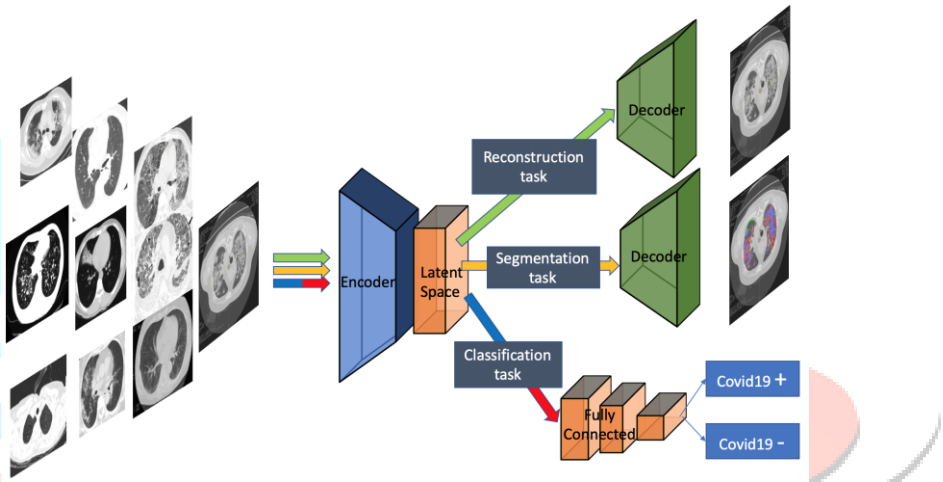
In this literature survey, deep learning classification techniques are reviewed for classifying the type of brain tumor by looking through brain MRI images and for detecting COVID-19. Brain tumor is the formation of a cluster of cells in or around the brain due to the uncontrolled division of cells. It can be classified into benign tumor and malignant tumor. The benign tumor is non-cancerous so its formation is gradual while the malignant tumor is cancerous and grows rapidly.

In the research paper (2) by Mohsen et. al., Deep Neural Network classifier was used to classify the brain MRI images into tumours of four categories - normal, glioblastoma, sarcoma and metastatic bronchogenic carcinoma tumours. The dataset used had 66 brain MRIs out of which 22 were normal while the other 44 were abnormal. The obtained dataset was segmented using Fuzzy C-Means. Feature extraction was done using Discrete Wavelet Transform and reduction using Principal Component Analysis. The performance of the DNN classifier was compared with four other classification algorithms, namely, K-Nearest Neighbour with K=1 and K=3, Linear Discriminant Analysis and Support Vector Machine and was found to be the best among the used algorithms with a precision of 0.97.

In (3), Muhammad et al proposed a new CNN based multi - grade brain tumour classification system. The segmented brain tumour MRI images are extensively augmented to extend the dataset even further. Rotation, flipping, skewness, and shears are done for geometric transformations invariance. Gaussian blur, sharpening, edge detection, and emboss are used next for invariance in noise. VGG-19 CNN architecture is fine tuned for grade classification of brain tumour as the mentioned architecture has 3x3 kernels for all convolutional layers with a stride of 1. This is done to capture all the features minutely unlike other CNN architectures which have increased stride.

In (4), Neelapu et. al. proposed a deep learning based CNN architecture which aimed at classifying medical images. The proposed architecture comprised of 9 phases, out of which the first 6 were convolution and pooling layers and the last three were completely associated layers. It was concluded that the proposed model had a better accuracy than the previously used SVM and ELM. The accuracy was found to be more than 0.98 for a sample size of 1000.

In (5), Amyar et. al. proposed a novel multi-tasking deep learning model for jointly detecting COVID-19 in a CT scan image of the lungs as well as segmenting the image. For the purpose of classification, the output of the encoder is followed by a convolutional layer, a max pooling layer and then a flatten operation. The last layer of the model is a dense layer with one neuron using a sigmoid activation function for classification. An accuracy of 0.86 was achieved by the model which was compared to a CNN model with 8 layers and an accuracy of 0.73.



The proposed architecture, composed of an encoder and two decoders for image reconstruction and infection segmentation. A fully connected layers are added for classification (COVID vs non-COVID) (5)

IV. CHALLENGES FACED

Deep learning requires a large amount of dataset to be acquired to train the model as the precision of a supervised model is solely dependent on the amount of data fed to it. There is a dearth of dataset especially involving rare uncommon diseases. The dataset which is already present has a variety of dimensions which has to be normalized before it can be used to train a model. The issue of privacy is also prevalent in the availability of data as patients have the legal right to the non-disclosure of their personal information. This makes it even more difficult for data to be easily available to researchers online.

V. CONCLUSION

In the recent years, deep learning has taken the role of automation of our day to day lives with great satisfaction from all the people involved. It has delivered much better and more efficient ways to tackle our everyday work. The incorporation of deep learning in the medical field has been slow compared to the other fields due to the nature of the field and its need for precision. Deep learning has proved to be significant to the advancement of medical imaging with its state-of-the-art performance in dealing with various tasks including classification, segmentation, etc. Hence, it can be concluded that in the coming years, deep learning will have an even greater impact in the field of medical image analysis.

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