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Medical Image Analytics using Deep Learning (Convolutional Neural Networks)

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ABSTRACT

Technical developments are being done in medical field. In order to improve medical results and healthcare facilities, machine learning and deep learning concepts are being used. Various experiments and efforts are done to detect diseases and provide platforms to provide better healthcare. Involvement of technology has made healthcare field more efficient and trustworthy. The 'Medical Image Analytics' is a machine learning as well as deep learning tool that would provide platform for processing medical images and extracting features not visible to human eye and provide accurate results and help to healthcare organizations. It strives to help healthcare organization for providing better healthcare facilities. This project is intended for use in various healthcare fields and organizations. Some features of the disease in medical images can be nit invisible or not clear to human eyes. Improper detection of features can lead to improper detection of diseases and may lead to failure or degradation in health and healthcare facilities. Thus, using techniques like deep learning and machine learning increases the detection of features in medical images. Also, it is helpful if diseases can be detected at an early stage and therefore, the project would aim to detect diseases at an early stage in future.

Keywords : Deep Learning, Convolutional Neural Networks, Lung Tumor, Feature Extraction, Classification, Augmentation

I. INTRODUCTION

The project investigates the use of machine learning and deep learning for image analysis and pattern recognition. The field of healthcare has the potential to benefit from visual analysis and pattern recognition using machine learning. Machine learning techniques can be used to analyze MRI's, X-rays, etc. to aid in diagnosing and making a prognosis. It is clear that feature extraction and machine learning and deep learning algorithms provide a viable approach to creating such a system. The project takes medical images as an input (basically x-ray images) then the system augments the images and then using CNN algorithm which analyze the images. The CNN algorithm performs various image processing techniques such as image classification, segmentation, object detection and others. The features are thus extracted from the images and the system or images are trained and tested. Hence, it is detected whether image is infected or not. Hence, the system uses machine learning and deep learning concepts to detect a disease.

II. RELATED WORK

1] **Detection of Cancer in Lung With K-NN Classification Using Genetic Algorithm by P. Bhuvaneswari, Dr. A. Brintha Therese.**

- This paper focuses on early stage lung cancer detection. Genetic K-Nearest Neighbor (GKNN) Algorithm is proposed for the detection which is a

non parametric method. This optimization algorithm allows physicians to identify the nodules present in the CT lung images in the early stage hence the lung cancer

- In traditional K-NN algorithm, initially the distance between all the test and training samples are calculated and K-neighbors with greater distances are taken for classification. In this proposed method, by using Genetic Algorithm, K (50-100) numbers of samples are chosen for each iteration and the classification accuracy of 90% is achieved as fitness. The highest accuracy is recorded each time.

2] **Lung tumor segmentation algorithm by Selin Uzelaltinbulat",Buse Ugur**

- This paper is a development of an algorithm based medical image processing to segment the lung tumor in CT images due to the lack of such algorithms and approaches used to detect tumor where most of researches involve machine learning to solve such segmentation problem.
- The experimental results show that the techniques used in this system were efficient enough to segment the tumor in many images since they consider the image's intensities variance separately for each image It found that the developed system was capable of segmenting tumors of different tumor and non-tumor images of the used database by achieving high accuracy of 97.14%.

3] **Segmentation of lung nodule in CT data using active contour model and Fuzzy C-mean clustering by Ezhil E. Nithila *, S.S. Kumar**

- The aim of this paper was to develop a region based active contour model and Fuzzy C-Means (FCM) technique for segmentation of lung nodules. Ultimately, detection and assisted diagnosis of nodules at an earlier stage increase the mortality rate. Among many imaging modalities, Computed Tomography (CT) is the most sought because of its imaging sensitivity, high resolution and isotropic acquisition in locating the lung lesions. Hence we have used this in understanding in our project to come to a conclusion that we need to use deep learning for achieving the desired reults.

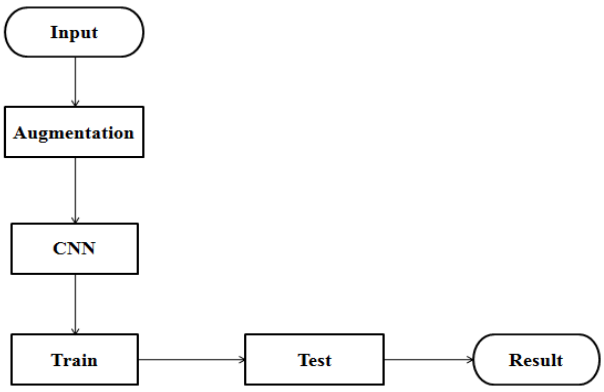
III. METHODOLOGY

Convolutional Neural Networks are a bit different. First of all, the layers are organized in 3 dimensions: width, height and depth. Further, the neurons in one layer do not connect to all the neurons in the next layer but only to a small region of it. Lastly, the final output will be reduced to a single vector of probability scores, organized along the depth dimension.

CNN is composed of two major parts:

- **Feature Extraction**: In this part, the network will perform a series of convolutions and pooling operations during which the features are detected. If you had a picture of a zebra, this is the part where the network would recognize its stripes, two ears, and four legs.

- **Classification**: Here, the fully connected layers will serve as a classifier on top of these extracted features. They will assign a probability for the object on the image being what the algorithm predicts it is.



Input:

It is the database of medical images or a medical image to be processed. The medical image is to be a 2-D image.

Augmentation:

Augmentation is basically the pre-processing done to artificially expand the dataset. This is done as to increase data samples of the given dataset.

CNN:

Convolutional Neural Networks are a bit different. First of all, the layers are organized in 3 dimensions: width, height and depth. Further, the neurons in one layer do not connect to all the neurons in the next layer but only to a small region of it. Lastly, the final output will be reduced to a single vector of probability scores, organized along the depth dimension. A convolutional neural network consists of an input and an output layer, as well as multiple hidden layers. The hidden layers of a CNN typically consist of a series of convolutional layers that *convolve* with a multiplication or other dot product. The activation function is commonly a RELU layer, and is subsequently followed by additional convolutions such as pooling layers, fully connected layers and normalization layers, referred to as hidden layers because their inputs and outputs are masked by the activation function and final convolution.Though the layers are colloquially referred to as convolutions, this is only by convention. Mathematically, it is technically a *sliding dot product* or cross-correlation. This has significance for the indices in the matrix, in that it affects how weight is determined at a specific index point.

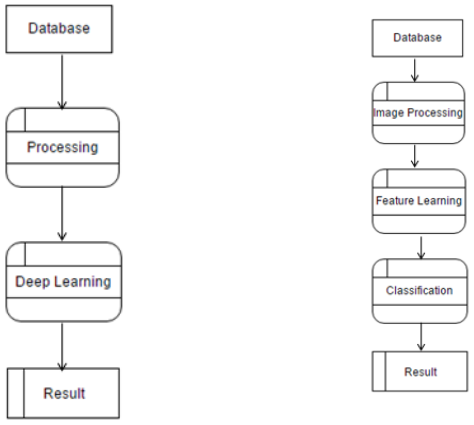
Train and Test:

The system is thus trained and tested on the basis of obtained results from previous modules.

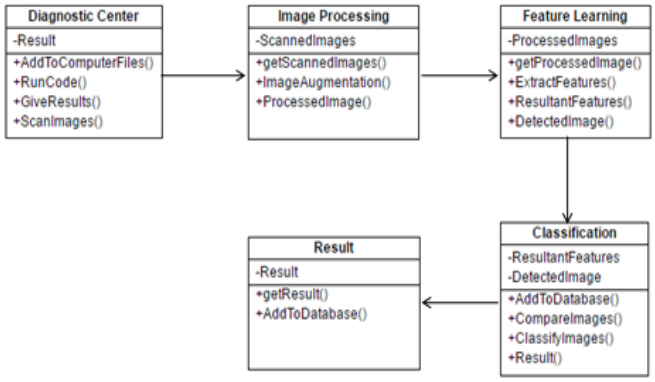
Result:

The final result is obtained after all he modules have been successfully implemented.

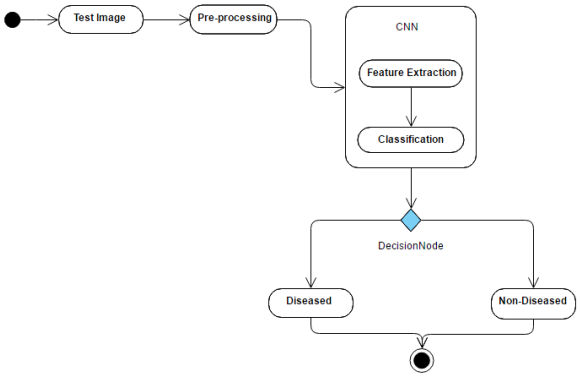
Data Flow Diagram



Class Diagram

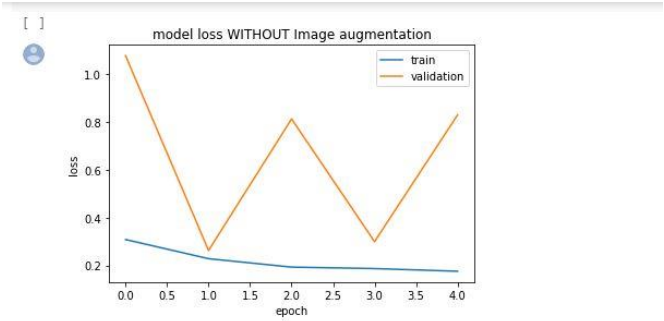


Activity Diagram-

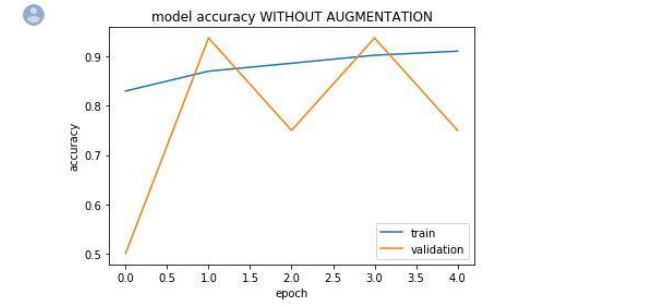


Testing

Testing is the process of evaluating a system or its component(s) with the intent to find whether it satisfies the specified requirements or not. In simple words, testing is executing a system to identify any gaps, errors, or missing requirements in contrary to the actual requirements.




```
plt.plot(history_WA.history['acc'])
plt.plot(history_WA.history['val_acc'])
plt.title('model accuracy WITHOUT AUGMENTATION')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'validation'], loc='lower right')
plt.show()
```

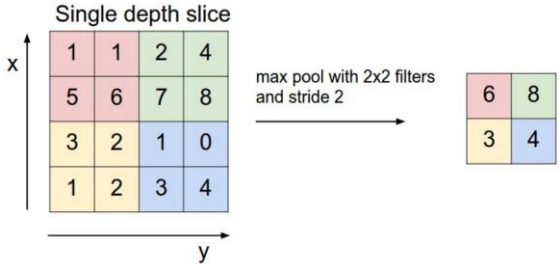


Layers used to build Convolutional Nets-

A convnets is a sequence of layers, and every layer transforms one volume to another through differentiable function.

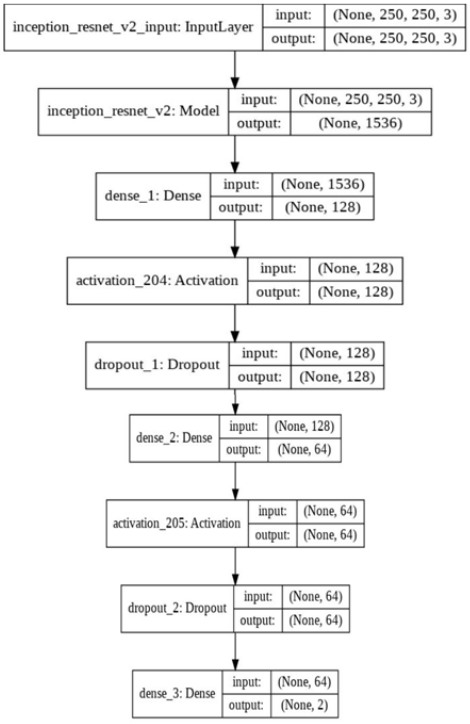
Types of layers: Let's take an example by running a convnets on of image of dimension 32 x 32 x 3.

1. Input Layer: This layer holds the raw input of image with width 32, height 32 and depth 3.
2. Convolution Layer: This layer computes the output volume by computing dot product between all filters and image patch. Suppose we use total 12 filters for this layer we'll get output volume of dimension 32 x 32 x 12.
3. Activation Function Layer: This layer will apply element wise activation function to the output of convolution layer. Some common activation functions are RELU: max(0, x), Sigmoid: 1/(1+e^-x), Tanh, Leaky RELU, etc. The volume remains unchanged hence output volume will have dimension 32 x 32 x 12.
4. Pool Layer: This layer is periodically inserted in the covnets and its main function is to reduce the size of volume which makes the computation fast reduces memory and also prevents from overfitting. Two common types of pooling layers are max pooling and average pooling. If we use a max pool with 2 x 2 filters and stride 2, the resultant volume will be of dimension 16x16x12.



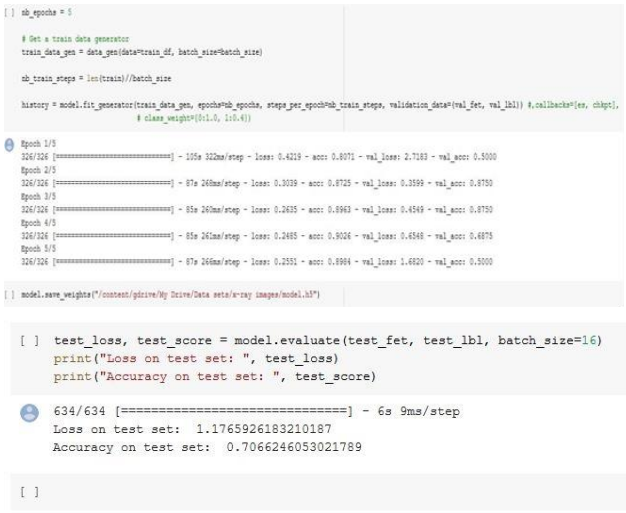
5. Fully-Connected Layer: This layer is regular neural network layer which takes input from the previous layer and computes the class scores and outputs the 1-D array of size equal to the number of classes.

We have used the following layers in our network and this is the input and output we got-



IV. RESULTS AND DISCUSSION

This is the accuracy we achieved after implementing our algorithm in 5 epochs



V. CONCLUSION

As the technologies are developing, its usage has been flourishing and new domains of implementations are being evolved. Medical is also a domain where new technologies are being made. Machine learning and artificial intelligence techniques are used to improve health results and to detect diseases at an early stage as well as detecting patterns is also being made easy. Research is being done to detect a disease accurately through pattern recognition. Thus using various methodologies medical field can be improvised and can enhance it.The project strives to improve and help healthcare facilities and organizations. Hence, the main goal is to do the same in future. As we mentioned that detection of diseases at an early stage can help in better treatment of diseases. Thus, detection of diseases at an early stage will be the main aim. Also, building platforms and algorithms for detection of other diseases is also the target. Economically, the project aspires to reach to as many healthcare organizations as possible.

VI. REFERENCES

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