Original Article

Certain Investigation Of Medical Image Analysis Using Object Recognition And Semantic Segmentation

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Abstract

People anticipate the best level of care and services, regardless of cost, in this high-priority industry. Despite consuming a large portion of the expenditure, it failed to meet social expectations. Medical experts are primarily responsible for the interpretation of medical data. Picture interpretation by human experts is restricted owing to subjectivity, image complexity, wide variances among interpreters, and exhaustion. Following the success of deep learning in other real-world applications, it is now giving intriguing solutions for medical imaging with high accuracy, and it is being hailed as a critical approach for future applications in the health industry.

Keywords— Medical Image analysis, Convolution Neural Network, Health Care, Image Segmentation.

1. INTRODUCTION

As a consequence of significant developments in image-gathering technology, there was a scarcity of health-care data in the past, but the data are now fairly vast (going to big data), making picture analysis complex and intriguing. This rapid development of medical pictures and modalities necessitates enormous and time-consuming efforts on the part of medical experts. These efforts are susceptible to subjectivity, are prone to human error, and may vary substantially depending on the area of specialty. To automate the process of diagnosis, a further possibility is to

make use of methods from the field of machine learning; however, standard machine learning approaches are unable to cope with circumstances that are very complex. The efficient combination of high-speed computing with machine learning[1-2] has the potential to handle enormous amounts of medical picture data, allowing for accurate and speedy diagnosis.

Deep learning will not only assist in the selection and extraction of characteristics, but it will also assist in the creation of new ones. In addition, deep learning will not only diagnose the condition, but it will also assess predictive targets and give actionable prediction models to effectively support clinicians. In recent years, there has been a tremendous expansion of both machine learning (ML) and artificial intelligence (AI). The fields of medical image processing, computer-aided diagnosis, image interpretation, image fusion, and picture registration have all benefited from the use of machine learning and artificial intelligence techniques [3-5]. Former algorithms have limitations in terms of their capacity to understand real photographs in their unprocessed state. Furthermore, they are time-consuming, need the expertise of trained professionals, and take a significant amount of time to fine-tune the features. The latter algorithms are given raw data to work with, automatically learn new features, and are lightning fast. These algorithms make an effort to automatically learn several levels of abstraction, representation, and information from a large number of photos that demonstrate the necessary data behaviour. A deep learning boom has been ignited as a result of recent developments in machine learning methods [6]. This is despite the fact that automated sickness detection based on older methodologies in medical imaging has shown for decades that it can achieve very high levels of accuracy.

2. LITERATUREREVIEW

Deep Convolutional Neural Networks have been frequently used for medical picture segmentation over the last decade and have been demonstrated to perform well. However, because to the inductive biases contained in convolutional networks, they are unable to recognize long-range picture relationships. To train successfully, the majority of contemporary Transformer-based network designs proposed for vision applications need large-scale datasets.

Furthermore, [7] present a Local-Global training technique (LoGo) to properly train the model on medical pictures, which increases performance even further. To learn global and local features, [8] operated on the entire picture and patches, respectively. On three distinct medical picture segmentation datasets, the proposed [9] Medical Transformer (MedT) is assessed, and it is demonstrated that it outperforms convolutional and other comparable transformer-based designs. In order to do semantic segmentation of Malaysian meals, VGG-16 and VGG-19 networks were used. [10] conducted early research into the use of transfer learning models to distinguish food items in traditional Malaysian dinners. Most contemporary food recognition systems, regardless of portion size, compute the calories and nutritional value of a meal based on food item identification.

3. PROPOSEDMETHODOLOGY

It led to the opening of hitherto unexplored avenues in the field of medical picture analysis. Applications of deep learning in healthcare span a wide variety of issues, ranging from the detection of cancer and the monitoring of diseases to the provision of individualized recommendations for therapy

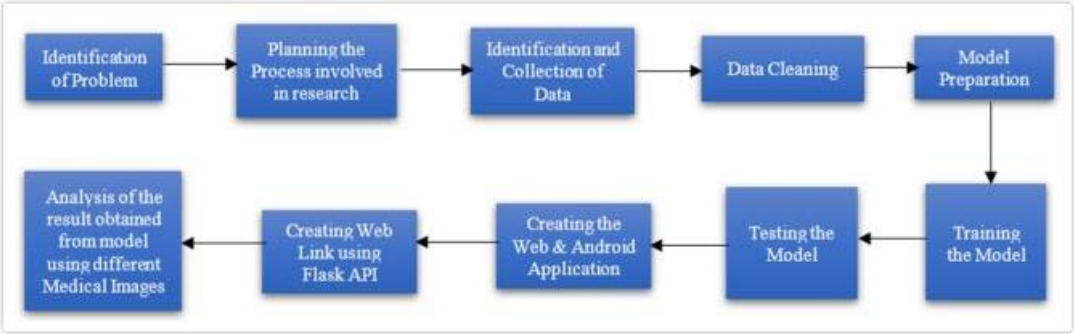

Figure 1: Proposed Framework

Imaging technologies (such as X-rays, CT scans, and MRIs), imaging techniques used in pathology, and most recently genetic sequences have all contributed to the enormous quantity of data that is now at a physician's disposal [22-25]. On the other hand, we do not yet have the necessary tools to transform all of this data into information that is helpful. The following talk will focus on some of the cutting-edge uses of deep learning in medical picture processing.

3.1 Data Collection:

Deep learning requires a vast amount of training datasets because the accuracy of a deep learning classifier is largely dependent on the quality and size of the dataset. Despite this, the lack of available datasets is one of the most significant obstacles to the implementation of deep learning in medical imaging[26-27]. On the other hand, the generation of huge amounts of medical imaging data may be rather difficult since annotation often takes a significant amount of time from medical professionals, and more specifically, it necessitates the input of several specialists so that human error can be minimized. On the other hand, datasets have been gathered from several hospital pathology departments and diagnostics centres [28-30].

3.2 Data Preprocessing:

We need data in order to do machine learning. The more information we gather, the more accurate our model will be. The algorithms that power machine learning are data-hungry. However, there is a catch to this. They need the data to be in a certain format. In the actual world, numerous terabytes of data are produced by a variety of different sources. However, not all of it is immediately useable in certain context. Data may be stored in a variety of formats, including audio, video, photos, text, charts, and logs. However, in order for the machine learning algorithms to deliver useful results, this data must first be cleaned and organized in a manner that can be used. Data pre-processing refers to the process of preparing raw data for use in activities related to machine learning. This involves cleaning the data before it can be utilised. When working on a project involving machine learning, this stage is the very first and most important one. It is the phase that often requires the highest amount of time to complete[31-34].

Because the picture's pixel values span from 0 to 255, we needed to divide the image by 255 in order to normalise it and make it fit within the 0 to 1 range. Normalization was accomplished by dividing the image by 255. The Most Popular Encoding: The input to this transformer should be in the form of an array-like collection of numbers or strings, each of which denotes a value taken from a set of discrete characteristics. A one-hot encoding technique, also known as a one-of-K or dummy encoding strategy, is used to encode the characteristics[35-55]. The result of this is either a sparse matrix or a dense array, and it generates a binary column for each category (depending on the sparse parameter). The encoder creates the categories by default using the one-of-a-kind values that are included inside each feature. You also have the option of manually defining the categories, if that better suits your needs. This encoding is required in order to input categorical data into several of the estimators that scikit-learn provides, most notably linear models and SVMs using the usual kernels.

3.3 Model Architecture:

The proposed architecture figure 2 was built using CNN on various dataset on various disease such a smalaria, retinopathy, brain tumor, breast cancer. The proposed architecture consists of 1 input layer, 7 Hidden layers and 1 output layer.

Input layer consist of input shape of the image and for different dataset the input shape was different ranging from 50 to 224[35-37].First hidden layer consists of convolution layer with 32 filters, kernel size 3,3 with activation function ‘relu’ followed by 2x2 maxpool layer, batch normalization and dropout. Second hidden layer consists of convolution layer with64 filters, kernel size 3,3 with activation function ‘relu’ followed by 2x2 maxpool layer, batch normalization and dropout.Thirdhiddenlayerconsistsofconvolutionlayerwith128 filters, kernel size 3,3 with activation function ‘relu’ followed by 2x2 maxpool layer, batch normalization and dropout.

Fourth hidden layer consists of convolution layer with 256 filters, kernel size 3,3 with activation function ‘relu’ followed by 2x2 maxpool layer.

Fourth convolution layer consist of 4-dimension output and dense layer require 2-dimensional output so in between

convolution layer and dense layer faltten to be used so that it converts 4D to 2D[38-40].

Fifth hidden layer consist of Dense layer with 256 units Sixth hidden layer consist of Dense layer with 128 units. Seventh hidden layer consist of Dense layer with 64 units followed by Dropout

Finally Output layer consist of two units with sigmoid function which helps in predicting two class namely infected and un-infected

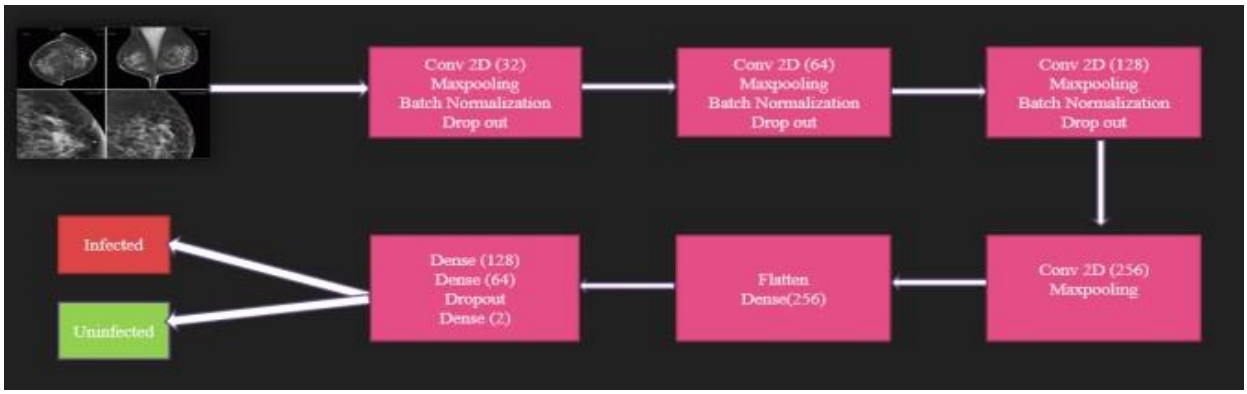

Figure 2: Proposed Architecture.

Model Training:

The model was trained on various data set on different disease such as malaria, retinopathy, brain tumor, breast cancer. The model was trained with following parameters

1. Number of epochs-20
2. Batch Size –128
3. Validation split –0.3
4. Optimizer –'Adam'
5. Loss – Binary cross entropy
6. Metrics –accuracy.

Model Testing:

The test image given and converted into numpy array. The input image should be resized according to the model input requirement on which it was trained as the CNN model require 4D data and our input image is 3D data so input image should be reshaped to the 4D[41-44]. once it is reshaped the image should be normalized by 255 and it has been converted into float 32. The image has been sent to the model for the prediction. Where the model tries to identify the features, which are related to infected or uninfected diseases. at last, we will get the percentage of the predicted label in below figure 3.

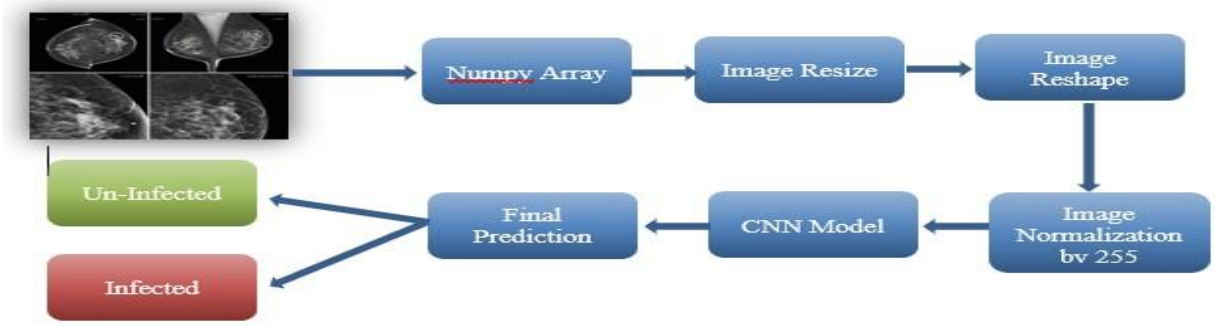

Figure 3: Model Testing

4. RESULTS

In this part, the experimental findings of the suggested segmentation approach are described using Medical Images that include a variety of skin lesions. The picture data set is split into two separate sets in the proposed methodology, which are referred to respectively as the training set and the testing set. The classifiers are taught using the training photos, and the accuracy of the classification is determined only using the testing images. During the testing phase, the proposed method to discover cancer in medical pictures is applied to the testing dataset, and the results derived from this application are assessed using evaluation metrics such as sensitivity, specificity, and accuracy[20].

$$Sensitivity = TP/(TP + FN)$$
$$Specificity = TN/(TN + FP)$$
$$Accuracy = (TN + TP)/(TN + TP + FN + FP)$$

Where TP stands for True Positive, TN for True Negative, FP for False Positive, and FN for False Negative respectively. False Positive and False Negative both stand for the opposite of True Positive. After training the model using two distinct methods, as outlined in section III, the results are as follows: The model was assessed using a variety of metrics and parameters, including accuracy, precision, and recall; an AUC-ROC curve; an F1 score; a confusion matrix; and individual emotion-based accuracy and report.

Architecture Proposed CNN	Data set			
	Malaria	Validation	Test	Cross Validation
Proposed CNN	Brain Tumor	**95.75%**	**95.54%**	**89.05%**
Proposed CNN	Retino pathy	**87.60%**	**87.21%**	**75.65%**
Proposed CNN+VGG 16	BreastCancer	**88.06%**	**88.13%**	**78.82%**
Proposed CNN	Pneu monia	**59.47%**	**59.47%**	**55.73%**

TABLE 1. Accuracy

Table 1 Accuracies obtained for various models

For Malaria data set on proposed CNN was able to predict correctly 3999 as infected out of 4157 and predicted correctly 3905 as uninfected out of 4210 by giving training accuracy of 98.23% and test accuracy of 95.6%.

For Pneumonia dataset to proposed CNN was able to predict correctly 20488 as infected out of 22000 and predicted correctly 25810 as uninfected out of 27000 by giving training accuracy of 100% and test accuracy of 99.5%.For Retinopathy data set on proposed CNN was able to predict correctly 1918 as infected out of 2130 and predicted correctly 1650 as uninfected out of 1700 by giving training accuracy of 98.8% and test accuracy of 95.6%.For Breast Cancer data set on proposed CNN was able to predict correctly 3999 as infected out of 4157 and predicted correctly 3905 as uninfected out of 4210 by giving training accuracy of 86.9% and test accuracy of 92.2%.

5. CONCLUSION

Deep learning has assumed a major role in the automation of our everyday lives in recent years, bringing considerable advancements above standard machine learning algorithms. Most scientists expect that deep learning-based applications would take over human duties over the next 15 years, and that most everyday activities will be done by autonomous robots. However, when compared to other real-world difficulties, deep learning's penetration in healthcare, especially in medical imaging, is fairly low.

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