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COVID-19 Detection with X-Ray and CT-Scan Using Machine Learning

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Abstract: ***We researched the diagnostic capabilities of deep learning on chest radiographs and an image classifier based on the COVID-Net was presented to classify chest MRI images. In the case of a small amount of COVID-19 data, data enhancement was proposed to expanded COVID-19 data 17 times. Our model aims at transfer learning, model integration and classify chest MRI images according to three labels: normal, COVID-19 and viral pneumonia. According to the accuracy and loss value, choose the models ResNet-101 and ResNet-152 with good effect for fusion, and dynamically improve their weight ratio during the training process. After training, the model can achieve 96.1% of the types of chest MRI images accuracy on the test set. This technology has higher sensitivity than radiologists in the screening and diagnosis of lung nodules. As an auxiliary diagnostic technology, it can help radiologists improve work efficiency and diagnostic accuracy.***

COVID-19 is posed as very infectious and deadly pneumonia type disease until recent time. Despite having lengthy testing time, RT-PCR is a proven testing methodology to detect corona virus infection. Sometimes, it might give more false positive and false negative results than the desired rates. Therefore, to assist the traditional RT-PCR methodology for accurate clinical diagnosis, COVID-19 screening can be adopted with X-Ray and CT scan images of lung of an individual. This image based diagnosis will bring radical change in detecting corona virus infection in human body with ease and having zero or near to zero false positives and false negatives rates. This paper reports a convolution neural network (CNN) based multi-image augmentation technique for detecting COVID-19 in chest X-Ray and chest CT scan images of corona virus suspected individuals. Multi-image augmentation makes use of discontinuity information obtained in the filtered images for increasing the number of effective examples for training the CNN model. With this approach, the proposed model exhibits higher classification accuracy around 95.38% and 98.97% for CT scan and X-Ray images respectively. CT scan images with multi-image augmentation chieves sensitivity of 94.78% and specificity of 95.98%, whereas X-Ray images with multi-image augmentation achieves sensitivity of 99.07% and specificity of 98.88%. Evaluation has been done on publicly available databases containing both chest X-Ray and CT scan images and the experimental results are also compared with ResNet-50 and VGG-16 models.

Keywords: Machine Learning, convolution neural network, MRI images.

I. INTRODUCTION

The global spread of the COVID-19 pandemic has caused significant losses. The most critical issues, medical and healthcare departments are facing is the fact that the COVID19 was discovered promptly. Therefore, it is of great importance to check the diagnosis of the suspected case, not only to facilitate the next step for the patients, but also to reduce the number of infected people. MRI examination is considered to be the most commonly used MRI examination method because of its low cost, wide range of application, and fast speed. It plays a pivotal role in COVID-19 patient screening and disease detection. Because COVID-19 attacks human respiratory epithelial cells, we can use MRI to detect the health of the patient's lungs. How to detect these features from MRI has become a top priority. The deep convolutional neural network has achieved unprecedented development in image recognition, especially in the field of auxiliary medical diagnosis technology. Neural networks have been successfully used in identifying pneumonia from MRI achieving performances better than those of radiologists. The main objective of using deep learning model is to achieve higher accuracy of classification with chest X-Ray and CT scan images by separating the COVID-19 cases from non-COVID-19 cases. The databases of X-Ray and CT scan images are publicly available in GitHub repository for the purpose of experiments. Both these datasets contain chest images of COVID-19 and non-COVID-19 individuals. The X-Ray database contains 67 COVID images and the same number of non-COVID images whereas CT scan database contains 345 COVID images and the same number of non-COVID images. To conduct the experiment, images are down sampled to 50×50 dimension from their original size. The random sub sampling or holdout method is adopted to test the efficacy of the model. Moreover, this result exhibits more consistency while layers are being changed in CNN based deep model.

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To evaluate the framework in a robust and effective way, a number of evaluation metrics such as classification accuracy, loss, area under ROC curve (AUC), precision, recall, F1 score and confusion matrix has been used. The values of these metrics have been determined on different ratios of training and test samples considering a number of layers in deep model. The model is correctly able to classify the chest X-Ray and CT scan images of COVID-19 cases from non-COVID-19 cases.

II. SYSTEM ANALYSIS

A. *Existing System*

The radiologist check the mri and write the reports and recommend to the doctor, sometimes the appointment of radiologist will cost time and the delay of reports will occur because it is done by the human, sometime human error will occur while writing a report and the delay of report might be a big problem in emergency situation. And the cost of radiologist is also high at sometime if the test are very intensive and it might cost much high.

B. *Disadvantages Of Existing System*

1) Need a Proper radiologist to suggest the MRI result.
2) Sometimes if the radiologist is not available then the delay of report can occur and it can leads to some serious problem to the patient.
3) The hospital has to physical has the radiologist present always his salary can impact the cost of treatment.

C. *Proposed System*

Chest MRI images as the research object. However, radiologists and experts mainly interpret images based on personal clinical experience when analyzing MRI images. Usually, different doctors or experts have a different understanding of the same image. Moreover, the situation of the same image in different periods are not entirely consistent, and the conclusions produced will be different. Also, the workload of interpretation of images is vast, and doctors are prone to misdiagnosis due to fatigue. Therefore, there is an urgent need for a computer- aided diagnosis system to help radiologists interpret images faster and more accurately. We use the method of automatically extracting features from deep convolution neural networks. This method does not require traditional manual methods for feature extraction, avoiding complex feature extraction processes.

D. *Advantages Of Proposed System*

1) There is no need of radiologist to need in the hospital.
2) As we are using a ML Agent there is no need of radiologist.
3) Cost and salary of the radiologist will be saved.
4) Efficient and accurate data will be given as the output.
5) Small clinics can also be benefited from this.

III. SYSTEM REQUIREMENTS

A. *Hardware Requirements*

RAM : 8 GB Ram
Processor : Intel i5 Processor or More
Hard Disk : 512 GB
GPU : 2 GB
Hard Disk : 20 GB
Floppy Drive : 1.44 MB
Key Board : Standard Windows Keyboard
Mouse : Two or Three Button Mouse
Monitor : SVGA

B. *Software Requirements*

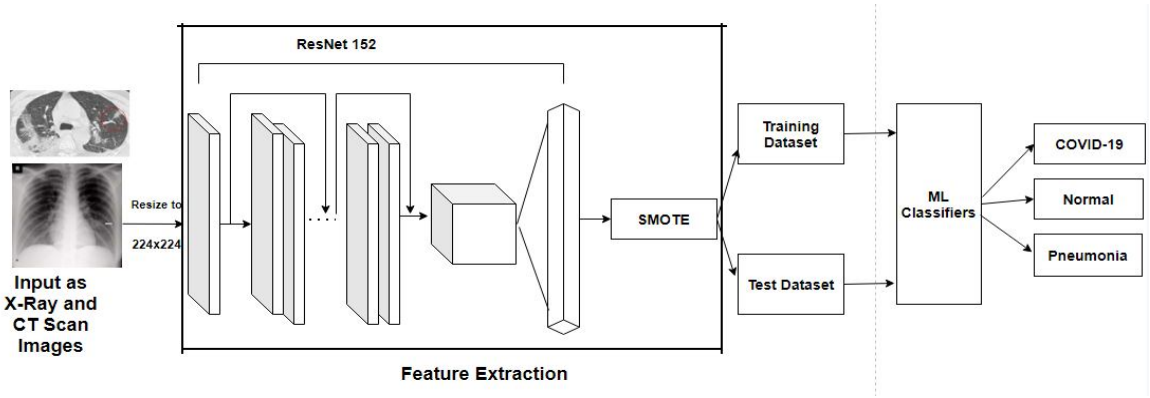
Platform : ANACONDA NAVIGATOR
Editor Used : JUPYTOR NOTEBOOK
Operating System : Windows 10
Data Set : CSV
Framework : Tensorflow, skikit learn
Cloud Platform : Google Cloud

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IV. SYSTEM DESIGN

A. *System Architecture*



V. MODULES

A. Collecting Covid CT Dataset
B. Data Pre-processing and Augmentation
C. Convolutional Neural Network
D. Transfer Learning
E. Fine-Tuning the Architectures

VI. SYSTEM TESTING

A. *Unit Testing*

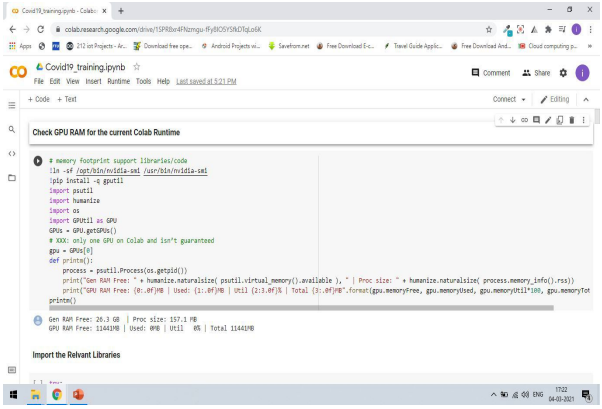
Unit testing is a level of software testing where individual units/components of a software are tested. The purpose is to validate that each unit of the software performs are designed. A unit test is the smallest testable part of any software. Unit testing is the first level of software testing and is performed prior to integration testing. Also called White box testing.

B. *Integration Testing*

Integration testing is defined as a type of testing where software modules are integrated logically and tested as a group. The purpose of this level of testing is to expose defects in the interaction between these software modules when they are integrated.

VII.SYSTEM TESTING

System testing falls under the black box testing. System involves the external workings of the software from the user's perspective.



A. *External Workings*

1) Dataset are passed into the Model with the use of Algorithm once the model is trained then we can save it in a PKL or H5 format.
2) We will run the Accuracy test to validate our model.

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VIII. CONCLUSION

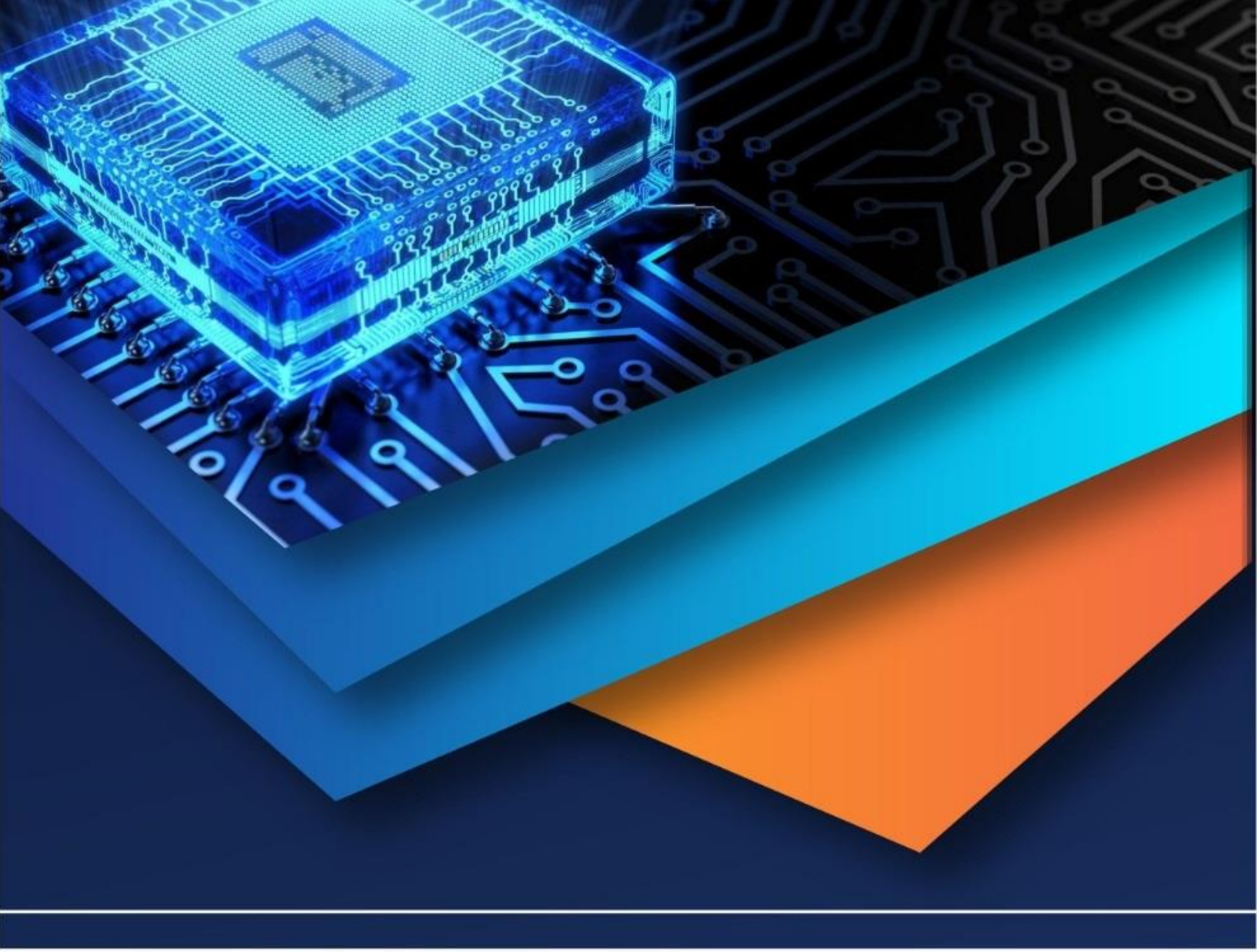
In response to this outbreak of COVID-19, deep learning has played an indispensable role, which makes it possible to accurately judge and respond to the epidemic. We researched the analytical and diagnostic capabilities of deep learning on chest radiographs and present an image classifier based on the COVID-Net to classify chest MRI images. Our model aims at the transfer learning, model integration and classify chest MRI images according to three labels: normal, COVID-19 and viral pneumonia. According to the accuracy and loss value, choose the models ResNet-101 and ResNet-152 with good effect for fusion, and dynamically improve their weight ratio during the training process. After training, the model can achieve 96.1% of the types of chest MRI images accuracy on the test set. It provides a reference method for medical and health institutions, government departments and even the global diagnosis of COVID-19 epidemic situation.

IX. FUTURE ENHANCEMENT

Covid-19 pandemic is a growing manifold daily. With the ever-increasing number of cases, bulk testing of cases swiftly may be required. In this work, we experimented with multiple CNN models in an attempt to classify the Covid-19 affected patients using their chest MRI scans. Further, we concluded that out of these three models, the XCeption net has the best performance and is suited to be used. We have successfully classified covid-19 scans, and it depicts the possible scope of applying such techniques in the near future to automate diagnosis tasks. The high accuracy obtained may be a cause of concern since it may be a result of overfitting. This can be verified by testing it against new data that is made public shortly. In the future, the large dataset for chest MRI can be considered to validate our proposed model on it. It is also advised to consult medical professionals for any practical use case of this project. We do not intend to develop a perfect detection mechanism but only research about possible economically feasible ways to combat this disease. Such methods may be pursued for further research to prove their real case implementation.

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