Diagnosing Covid-19 using Image Processing and Machine Learning

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Abstract: Image Processing has been a fond field for giving elaborated visual data to process the image data to simplify it for human for illustration for machine concept. With image processing you can have better solution for digital images. Training a machine to do something by providing it with certain training data is known as machine learning which may include here image processing. Machine learning have architectures, loss function, models and many other approaches that is used to determine and provide better image processing It is usually applied for image enhancement, restoration and morphing (inserting one's style of painting on an image). The objective is to provide a conceptual transfer learning framework by using image classification with the help of learning models, to support the detection of COVID-19 imaging modalities included CT scan and X-Ray. We will be going to make a custom Dataset and the Data Loader in the PyTorch. Then will train a ResNet-18 model for Image Classification performance. In end we will create a Convolutional Neural Networks and then we will be able to train it to analyze Chest X-Ray scans with honestly high accuracy. We will train the model using the ResNet-18 till the accuracy will be 0.95 or 95% in condition till then will stop the training where performance satisfied. So finally we given the 6 images and created a model and took 6 images from test set and put it in the training model and do the prediction and set the accuracy to the limit. Until the accuracy is not fulfilled the training will happen in the work.

Keywords: Digital Image Processing, X-Ray, Covid-19, Convolutional Neural Network, ResNet-18

1. Introduction

Technical analysis of an image with the help of complex algorithms is known as Image Processing. The image has used an input, and the outcome is the output. The figure 1 shown is the digital image processing and figure 2 shows the image analysis. For example, walking in a garden, seeing a flower, and not knowing the name of the flower. With the help of machine learning, you can identify the flower. The only thing we must do is point our phones towards it. One example is Google lens is one of such examples that delivers the use of machine learning.

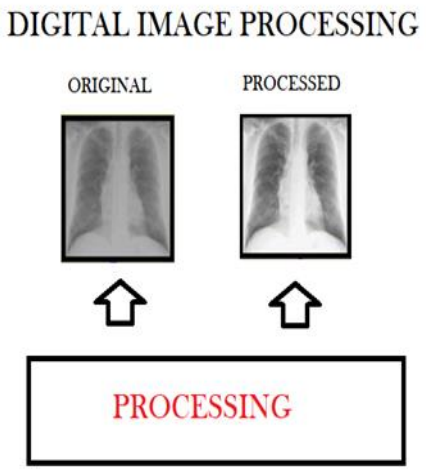

Figure 1: Digital Image Processing

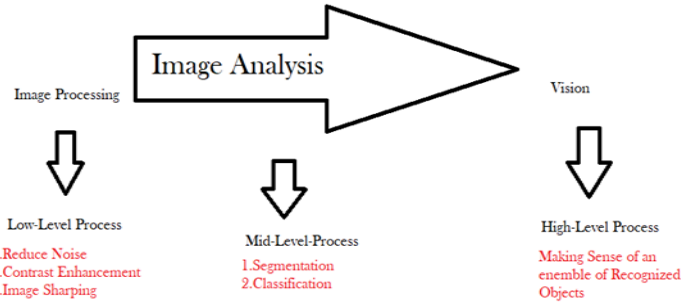

Figure 2: Image Analysis

- It can be used in the Health care industry, defense, automobile industry, agriculture, and a lot more. The greatest potential of AI / Machine Learning is yet to be discovered.
- The ongoing COVID-19 coronavirus disease 2019 pandemic has resulted in over 38,043,916 infections, 1,085,375 deaths and 28,606,252 recovered as of October 13, 2020 (05:22 GMT) across 214 countries and territories.
- The severe acute respiratory syndrome coronavirus 2, the disease is caused which is very deadly in our nature, which has result considerable grow in a little quantity of time, and the many number of patients asking for care and protection in care centers and hospitals.

COVID-19 DIAGNOSIS:

The very most critical threat to our entire world is Covid-19. Covid-19 caused a global pandemic. Lately discovered virus coronavirus has caused the most infectious disease COVID-19. The outburst starts in Wuhan, China on Dec,19 till then this new virus and disease are unknown. Now many countries are getting affected globally by COVID-19. Fever, low energy, headache, and dry cough are very basic and common symptoms of COVID-19.

Other symptoms which are very fewer effects to some of the people include pains, nasal congestion, sore throat, diarrhea, loss in taste, or smell, rashes on skin and discoloration of toes or fingers, headache as shown in figure 3 the Clinical Characteristics and Differential Clinical Diagnosis.

For the collection of a sample of the test, a medical management can perform:

- Swab the back of throat / the nose
- Draw out liquid from the lower respiratory tract
- Also takes sample of a saliva or stool

From the virus the researchers then extract nucleic acid sample and amplify parts of its genome through a reverse transcription PCR (RT-PCR) technique. Two genes can be found within the SARS-CoV-2 genome.

Test results can be:

- +ve if both genes are found
- Ambiguous if only one gene is found
- -ve if neither gene is found

To comfort diagnose COVID-19 or get a correct view of where the virus has spread the doctor could also order a chest CT scan.

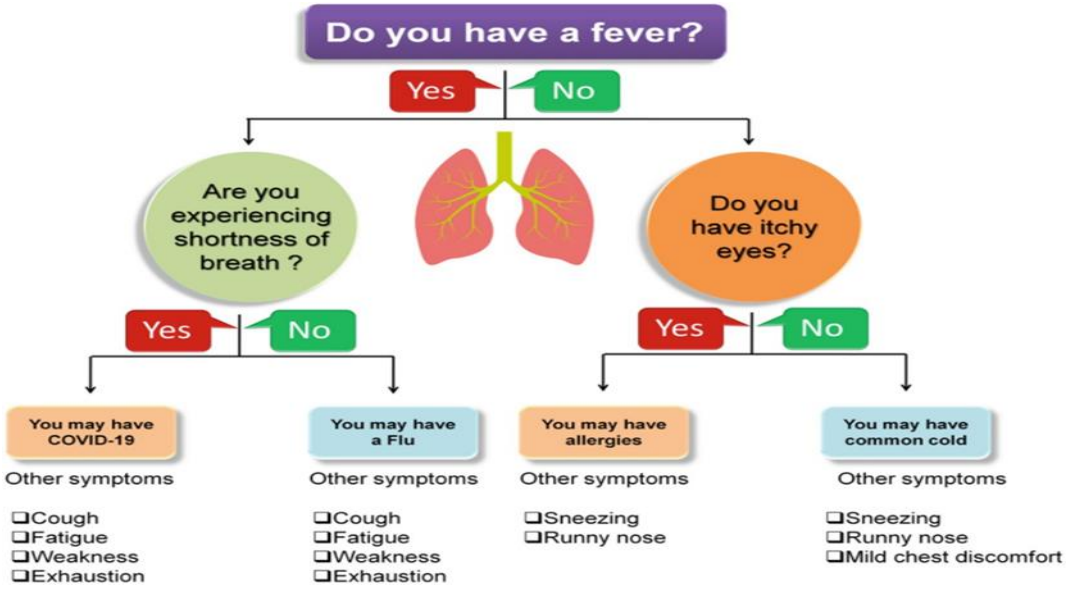

Figure 3: Clinical Characteristics and Differential Clinical Diagnosis [11]

PROBLEM STATEMENT

• Healthcare providers are also infected as they approach patients, which adds to the burden. Personal protection is sorely lacking and the resources needed are the only increased risk of paramedics dealing with treating patients.

• As with the data collection process, they are unable to collect data due to hospitals not allowing them to share data with outsiders.

• The process of combating the coronavirus paper had to deal with a constantly increasing amount of data called big data which is a big challenge for them.

In figure 4 shows a proposed model.

PROPOSED APPROACH

1: Libraries importing
2: Creating the Custom Dataset
3: Doing Image Transformations
4: Prepare Data Loader
5: Data Visualization
6: Creating and Training the Model
7: Show the prediction accuracy to 0.95 or say 95% in condition

PROPOSED MODEL

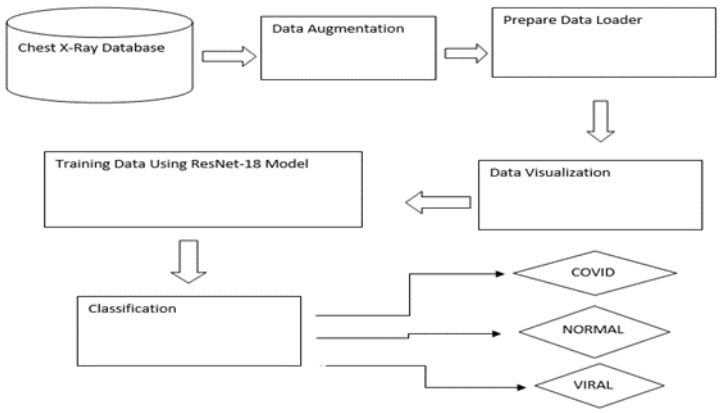

Figure 4: Proposed Model

2. Literature Survey

Srikrishana Karanam, et. al. [3] show that they have developed and designed a system that shows the positioning of the patient without contacting them. The scanning process of patients we can do in a contactless way in this system and in a completely remote way. The methodology author has used for the perfect 3D person body the person positioning regularly compromises a robust dynamic fusion algorithm. Having its multi-modal

interface capability, having enabled the system developed at scare is one of the robust dynamic fusion algorithms that could be accessed for various purposes without re-training the sensor choices. Which finds out the position and its correctness before initiating the scanning of person multi-view positioning visualization is ensured by multi-view synthesizer for the technician. The Issue discussed in this paper is that many of the professional healthcare providers like doctors etc. are themselves getting infected as they get closer to the patients, which adds more burden to an already over-packed hospital system. For personal protective equipment, there is an overall shortage and essential supplies are the only accentuating risk helpers face who treat patients. The author has suggested a solution which is to design a contactless remote accessed framework for the accurate position of the individual, in this paper. The algorithm itself approximates a representation that is in the 3D form concerning the scanner for individual placement, which is unique to the scan protocol and methods. This method provides them with as much knowledge as possible to ensure that they are satisfied with the positioning outcomes, with the aid of algorithm output on a personal computer monitor which is away from ground 0. For medical scans, the potential scope described in this paper is that their method would provide them with a productive and contactless workflow. Does not stop medical staff from performing a scan in closeness with the patient.

Longxi Zhou, et. al.[4] suggested a complete automated, fast, appropriate, right way that can measure CT scans from other origins in the infected areas. This method is founded by first, a CT scan simulator for the virus, by attaching accurate change of active patients data, which is calculated at various period, that also reduces the data scarcity problem, and second by an odd algorithm that is deep learning, clarifying the large-scene-small-object issue, that destroys the 3D segmentation issue into 3 2 Dimensional 1s, and reduced the model intricacy in the manner of immensity and significantly improves the segmentation accuracy at the same time. The methodology they used a method is proposed a preprocessing method in their work into a machine-agnostic standard embedding space to cast lung cancer scan. The deeply perfect segmentation representation is developed in the excellent fixed space. This preprocessing method solves their diversity issue in the data and makes it a method that applies to any dataset that is generated by any CT machine available, a complication in between the accuracy of the segmentation model and deep learning to hook a better tradeoff. The disadvantage in this paper is that during the data collection process not able to collect data due to hospitals is not allowing them to share data with outsiders. The future scope found in this paper is when the outbreak becomes to end, a long term bonding system can be used as a warning to the coronavirus with the help of various platforms like Multi-model learning which are yet to release after few years.

Mohammad Jamshidi, et. al. [5] shows that to fight viruses through Artificial intelligence. Many techniques developed in their work for incorporating COVID-19's diagnosis system a few like deep learning method illustrates to achieve goals like Generative Adversarial Networks, Extreme Learning Machine, and Big/small-term memory, Recurrent Neural Network. With the help of a clinical/nonclinical dataset, they showed mechanisms for the selection of applicable models of estimation and forecasting desired parameters. The methodology they used for researchers and physicians from a continuation arranged and unarranged data sources that are required to be set together for a better stage draws a bioinformatics approach that is integrated into those other different aspects of information. The advantage of is Artificial Intelligence stage is to accelerate the process of diagnosis and treatment of COVID-19 disease. The disadvantage in this paper is in the process to fight against the coronavirus their paper had to deal with the ever-increasing volume of the data which is called big data which is a big challenge for them. The future scope found in this paper is at the Artificial Intelligence stage, it could help in making connections to gets the optimum conclusion between different frameworks and accelerate the process.

Michael J. Horry, et. al.[6] shows that the study aims to support detection of the virus in support of image grouping with the help of a deep learning model for various imaging methods. The methodology they used shows the way transfer learning from deep learning representation can be accessed to undergo covid-19 reveal with the help of images mainly used through medical imaging methods like x-ray, ct scan, and ultrasound. This demonstrates the preprocessing of channels for increasing the quality of the image that is delivered with the help of the deep learning method. The study cracks the challenge of various datasets of covid-19 images. In this paper, the future scope is to plan and research the multi-model data fusion when the available data is acceptable.

Bayley King, et. al.[7] shows that the work the paper shows for the chest x-ray of a patient of covid-19. Unsupervised learning can extract the points of the data which is medical and perfectly classifying the image. The main motive on for the virus is vaccines, therapeutics and accelerating diagnostics. For the chest x-ray of patient of covid-19, a Self-Organizing Feature Map and they can found distinct classification between healthy and sick patients. The methodology and the future scope that had been used in this paper is for unaided learning, the giant courage is that in this labeled data, which is not needed in training processes as the network will clump, input that is given which is decided by identical detail. It implements a feature in the mapping algorithm that is self-organizing for its capacity to be accurately deployed in real-time learning, also continuous learning. It clusters a taking in a set of images of the x-ray of the chest (covid-19) and finding the details which cost knotting of every

segregation. The memory is obligated by the size of the chain which could be minimized to the expanse of resolution penalty. Rather than ill and healthy, various other conditions are grouped. The self-organizing feature map permits learn continuously gain as a more patient x-ray that is taken for covid-19 for lifelong learning.

El-Sayed M. El-Kenawy, et. Al [8] shows in this article proposed 2methods of an algorithm for selection and segregation. From CT scans features are extracted using Convolutional Neural Network named Alex Net. The guided whale optimization algorithm is based on stochastic fractal search which is proposed features selection algorithms. The methodology used In this article paper, On the 3 cascaded phases, a structure for the covid-19 allotment is a proposed based. By a Convolutional Neural Network model, the 1st phase unquestionably extracts functions from the training CT images. To properly select the valuable characters, a suggested feature selection algorithm is implemented, using the Stochastic Fractal Search and Directed whale optimization algorithm technique. To balance the extracted characters, the technique used in the 2nd level is the locality-sensitive hashing synthetic minority oversampling technique. The selected characters are categorized by the proposed voting classifier through the use of particle swarm optimization and Directed WOA techniques in the final process.

3. Working

In this work, we will be going to do the training of Convolutional Neural Network (CNN) to classify the X-Ray scan of the chest using the PyTorch library, and then we will use the ResNet-18 model to train it on a radiography dataset which we took from Covid-19 chest x-ray database. A group of researchers had made a database of images of chest x-ray for covid-19 positive cases and also normal and viral pneumonia images [9]-[10]. In this, we will import the main libraries PyTorch and torch vision and many other usable libraries. The torch which is the open-source scientific framework and a scripting language that is based on Lua programming language and the touch vision library used for package popular dataset model architecture and common image transformations for computer vision specifies the package used to load an image. The torch.manual_seed is used to sets the seed of the random number generator to a fixed value.

In Database, we will save the images in Covid-19, Normal, and Pneumonia. Now select the 30 images each from the Covid-19, normal, and Pneumonia. Preparing training and test set part in this we will create a class where we put dataset and then create a directory of the test. In the test directory, we will make the normal, covid-19, and viral. Then going to check the images if the image is in the PNG form. After that, we will select the images and do the random samples of the 30 images and will put them on the test. The Shutil will help in the image moving as it is automating the process of copying and removal of files and directories. We will create the training and test set. In the test set by randomly collecting the 30 images each from the normal, Covid-19, Pneumonia from the dataset and create it on the test set. Now we have the images in the dataset for training and 30 images each in each class prepared in the test set.

Now going to create a custom dataset that is used to create training and test dataset instances. We will pass the transform which Is going to use for data augmentation. The images are in black and white. So, going to use PIL (Python Imaging Library) which helps in python to allow to load and convert it to RGB form.

The data augmentation artificially creates new training data from existing training data. Data augmentation for training transformation of the image. For the test set we not used transformation, but we still convert the image and to tensor and normalize the value we had in the input images.

We going to prepare a data loader which is python iterators which going to use the dataset and fetch the data and give it to our model in between or during the process of training. After that in the training set, how many images are there will be shown and in same happen to test also. In this, we are going to create a batch of 6. After using the torch utils data loader. This will show the number of batches created for the training set and test set. Now having the data set objects.

In the data visualization, we will be going to show the image by using the matplot library. Our images are going to generate from data loaders. Will use the Y as prediction and X is the label. Green if the label is correct otherwise red.

We Will going to use ResNet-18 model which will import from torchvision models. As there are lots of ResNet but we will use ResNet-18 as it is a smaller CNN that is used to train rather quickly and gives us very nice results. The ResNet-18 model was trained on an image dataset that has a fully connected layer of 1000 classes, but we have to use the 3 classes only, so we are going to change the fully connected layer. So, we do changes in it by changing the output feature to be 3 on behalf of 1000. As we are doing classification, we will use an appropriate loss function that is cross-entropy loss. And also use the Adam optimization. To check predictions will set the Resnet-18 model in evaluation mode. And iterate the test and show in the output the 1 batch. As the model is not trained the prediction that came out will be randomly as shown in figure 5 after this we will go for the training.

We will train the model using the ResNet-18 as shown in figure 6-9 till the accuracy will be 0.95 or 95% in condition till then will stop the training where performance satisfied.

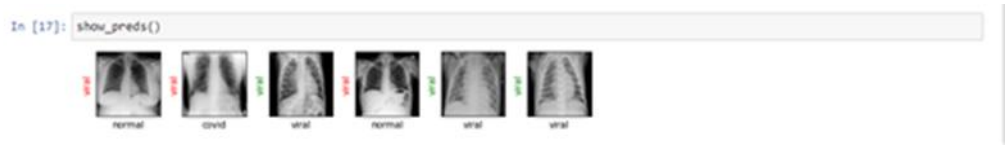

Figure 5: Before Training the Model

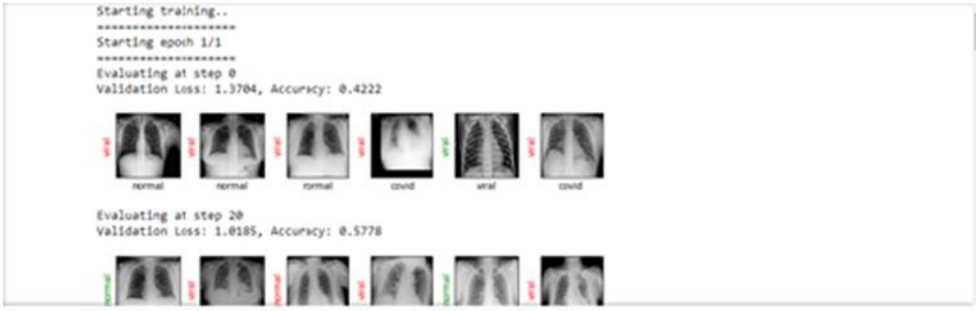

Figure 6: Evaluation at step 0 and 20

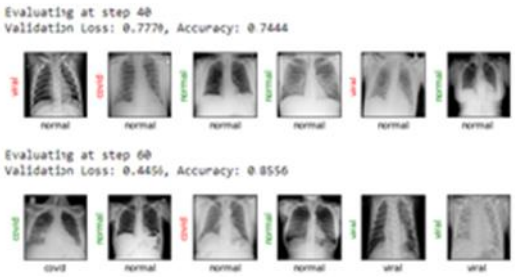

Figure 7: Evaluation at step 40 and 60

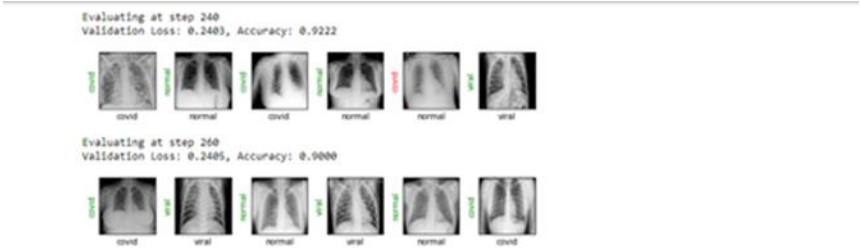

Figure 8: Evaluation at step 240 and 260

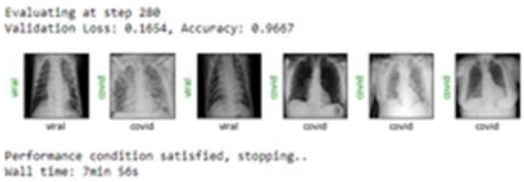

Figure 9: Evaluated at step 280

4. Result

Finally, we were given the 6 images and created a model and took 6 images from the test set and put it in the training model and do the prediction, and set the accuracy to the limit as shown in Figure 10. Until the accuracy is not fulfilled the training will happen in the work. The performance graph of validation loss and accuracy is shown in figure 11.

We will say the dataset in the model which we trained that cannot be diagnosed covid-19 as it is daily evolving. The diagnose is something that can be done by professionals. In this, we predicting the X-rays with the set accuracy.

Figure 10: Final Result

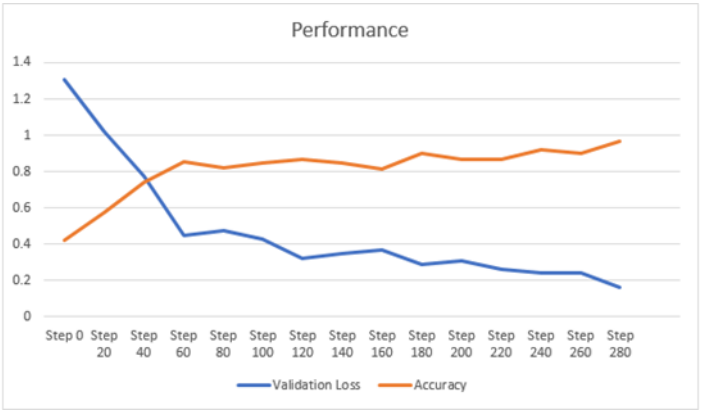

Figure 11: Performance

5. Methodologies

Convolutional Neural Network:

• A feed-forward and a many-layer neural network that uses targeted reading concepts and data analysis. That is mostly used for visual details, like the classification of the image is called the convolutional neural network.

• CNN is a very much strong algorithm that is largely used for image detection and item detection.

• The Convolutional Neural Network is a Deep Learning algorithm that can capture the input image, give importance to the various features/elements in the image and be able to distinguish one from the other.

• CNN is characterized by feature releasing and reading. CNN has been used to improve light intensity.

PyTorch:

Torch

1. Deep Learning Framework.
2. It works on Lua Programming.
3. PyTorch is a combination of Python + Torch.

For python, PyTorch is the machine learning method library that is open-source and that is based on Torch. The application like a natural neural network torch is concerned.

Key Features:

1. Imperative Programming

Tell us what and tell us how.

2. Declarative Programming

Tell us what but not how.

6. Conclusion

The study shows the sorts of diagnoses on Covid-19 using lots of strategies of image processing, machine learning, and many more learning techniques. An overview of all using for accurate 3D patient robust dynamic fusion algorithm body modeling, fully automatic, fast, accurate and machine agnostic method, combat virus through artificial intelligence, the coronavirus (COVID-19) detection using images from x-ray, Ultrasound and CT scan, uses SOFM network, CT scans using Convolutional Neural Network. Image processing has been a fond field for giving elaborated visual data to process the image data to simplify it for humans for illustration for machine concept. With image processing, you can have a better solution for digital images. This research aims to provide a conceptual transfer learning system to assist and support the identification of COVID-19 with the help of image classification for several imaging modes using learning models. The overall project offers knowledge of the best approaches used for detecting and diagnosing COVID-19. We will train the model using the ResNet-18 till the accuracy will be 0.95 or 95% in condition till then will stop the training where performance is satisfied. So finally we were given the 6 images and created a model and took 6 images from the test set and put it in the training model and do the prediction and set the accuracy to the limit. Until the accuracy is not fulfilled the training will happen in the work.

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