International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 7 July 2021, pp: 2758-2763 www.ijaem.net ISSN: 2395-5252

Empirical Evaluation of Deep Learning and Convolution Neural Network in Detection of Diesese Covid-19

Dr. Manoj A. Wakchaure [1], Vaishnavi S. Ransing [2],
Department of Computer Engineering, Amrutvahini college of Engineering ,Sangmner,Maharashtra,India

----
Submitted: 05-07-2021 Revised: 19-07-2021 Accepted: 22-07-2021

ABSTRACT— - There has been a rapid increase in growth of Covid 19 which has left a problem of efficient diagnosis and cheap diagnosis of covid 19 patients. Using medical imagingtechniques Like CT and X-ray combined with Deep learning are proving to be quite effective in the Diagnostic process. CT scans are widely used for the diagnostics which have been proven to be fast and have shown promising results and are sensitive even when the PCR test fails. But there are some flaws with CT scans like they are hard to sterilize, expensive and they arehighly radiating. In this paper the ultrasound imaging technique is used which is cheaper, easy to use, fast and safe. All Dataset are Gathered from various Sources of around 1000 images which consist of health lungs, Covid Affected lungs and bacterial Pneumonia Affected Lungs. This has been assembled from various data sources which has been processed for deep learning Models and are open access. Then the deep learning model is trained which has a greater accuracy.

Keywords—Deep neural network, deep learning, COVID-19,CNN,PCR,CT-Scan,Patient Mobilization

I. INTRODUCTION

The covid 19 in a year has affected hundreds of millions of people worldwide and has caused a chaos all around the world and has caused stress to people and medical all the medical professionals. The best cure found until now is only the fast diagnostic techniques that can help to stop the spread. Biomedical imaging techniques have great potential in tackling the convention methods of covid testing such as RT-PCR and IGM/G specifically. There are studies that show that CT scan can detect covid at higher sensitivity rates than RT-PCR. While CT scan are the best tool in which X-rays are still used as first line of diagnostics. The Lungs Ultrasound Imaging is already an Established method for monitoring Pneumonia and other lung diseases. The strengths of ultrasound are enormous like its simplicity in execution, the ease of repeatability and its execution with reallocation. The Diagnosis can be fastened by connecting the system to the cloud and uploading the images instantly to the cloud. There was lot of work done for automatic detection of Covid using XRAY and CT sacn but less work has been done using Ultra sound images.

II. HISTORY & BACKGROUND

Using Computer Aided Diagnosis for Pulmonary Pathologies is a field of research using X-ray images that has in existence since the 1960. Although X Ray Imaging is widely used for detection of many lung diseases and it is not suitable for Covid detection in earlier stages. Instead it has useful for bilateral multifocal consolidation and partially fused into massive consolidation.

CT scan uses X Rays images as a Source but they have higher image quality, contrast and resolution as it uses focused X Ray beams. CT scans are widely accepted as the Gold standard of medical imaging. There has been extensive research using CT scan Images for detecting Lung Cancer worldwide use machine learning and deep neural networks to increase the accuracy and efficiency of diagnosis. Many researchers have achieved incredible results by using CNN and CT. CT has been a viable technique and has been used the most for detecting covid reviews have shown high detection rate in Symptomatic patients. But CT scan has a downside that it exposes patient to excessive radiations, its extensive sterilization, its complicated system and patient Mobilization.

Ultrasound imaging has widely been used in diagnosis in the field of cardiology and recently covered many other organs. The Ultrasound has been popularized due to advancements in technical space like machine learning algorithms instead of its low quality and high signal to noise ratio. Many researches have used ultrasound for detecting different types of cancers like Pancreatic, lungs, breast and prostate. Ultrasound can detect Interstitial thickening and physiological phenomena linked to structural changes in lungs. There are not much work been published on Covid detection using ultra sound.

In [1], Elene Firmeza Ohata, Gabriel Maia Bezerra, have developed a system for automatic Covid detection using X-rays with a dataset that consist of around 194 images of patients affected with Covid 19 by applying the concept of transfer learning. By using different architecture of CNN on Image net and adopted them so they can behave as the feature extractor for the images. They combine CNN with Machine learning methods like k Nearest Neighbor, MLP and SVM. And have achieved of accuracy around 98%.

In [2], Jingxin Liu, Zhong Zhang, Lihui Zu, Hairihan Wang developed a system using AI to identify presence of Covid 19 infection in CT scan Images, using classification methods and DL target detection biased a Recurrent neural network structure and also a 2D layer structure. The result showed that the spatiotemporal sequence convolution kernel based on time and space attributes can effectively extract the latent image semantic features of multiple image data of COVID-19 patients. By comparing with Faster RCNN, YOLO3 and SSD algorithm models, the detection method proposed in this paper can obtain more accurate comprehensive detection results.

In [3], Pedro Silva, Eduardo Luz , Guilherme Silva, David Menotti have proposed a system for screening of Covid 19 on a voting based approach in this system the images are classified in groups of system where all the patients are classified in groups and it achieve a accuracy of around 88 %.

III. DESIGN ISSUES

PROBLEM STATEMENT

To use ultrasound images to detect and diagnose COVID-19 using deep learning and CNN technique. The dataset is divided into three lung classification which consist of ultrasound Imaging, pneumonia and healthy lungs.

OBJECTIVE

- The proposed research detects and diagnose of COVID-19 using deep learning and CNN technique.
- To implement an automatic detection system as a quick alternative diagnosis option to prevent COVID-19 spreading among people and detection of coronavirus pneumonia infected patient using Ultrasound images by designing a CNN model
- The performance analysis of system which provides better prediction accuracy than other recommendation systems.

SYSTEM ARCHITECTURE

The proposed System consists of CNN to tackle the task of covid detection using ultrasound. Uses VGG16 as the base for the model; this deep neural network has been demonstrated to be useful in various deep learning neural networks. Then it is followed by a layer of hidden layer of 64 neurons of Rely activation, which has a dropout of 0.5 and batch normalization, and a final output layer of softmax. Then the model is trained on the Image net which has extracted features like shapes and textures.

All images are resizes in 224*224 and fed through the network. Then the model is trained with cross entropy. The data augmentation techniques are used to change and diversify the dataset. Image Data Generator is also used which does a random transformation on the data set images while generating a batch. There are following transformations used to allow rotation of 10 degree of image height and weight. Augmentation is diverse and valuable to prevent over fitting.

The model is trained to differentiate between healthy, Covid19 and Pneumonia patients. The pretrained dataset used by VGG 16 where only defined last 64 neuron for training purposes.

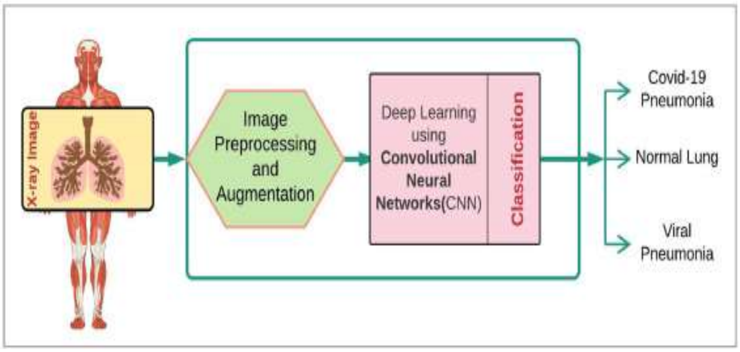

Fig. 3. A Proposed System Architecture

MATHEMATICAL MODEL

Let S is the Complete System Consist of S= {I, P, D, O}

I = Input Ultrasound Image
P = Process
D = Dataset
Step1: Entering the ultrasound images in thesystem
Step2: Converting the data into frames forprocessing.
Step3: Data Preprocessing.
Step4: Feature extraction and feature selection. Step5: Training and Testing dataset.
Step6: Classification.
Step7: Final output optimized classifier and its performance indicator.
O= Output

METHODS

A.Imaging

Biomedical imaging has the potential to complement conventional diagnostic procedures for COVID (such as RTPCR or immune assays). It can provide a quick assessment and guide downstream diagnostic tests, especially in triage situations or low-resource settings. Although RT-PCR has a sensitivity that is not higher than 80% for any moment in time after infection, it is the sole recommendation for COVID-19 diagnosis according to the ACR. Several studies

reported that CT imaging can detect COVID-19 at higher sensitivity rate compared to RT-PCR (98% vs 71%, Fang et.

al., 2020 and 88% vs. 59% Ai et. al., 2020). In any case: Even if the sensitivity of PCR would be 100%, we have to recognize that both PCR and CT are not available to the majority of the world's population. This calls into play surrogate imaging modalities (chest X-Ray and lung ultrasound) to rapidly screen and stratify COVID-19 suspects.

B. Ultrasound Imaging

Ultrasound data was shown to be highly correlated with CT, the gold standard for lung diseases. Instead of CT, ultrasound is non-invasive, cheap, portable (bedside execution), repeatable and available in most medical facilities. But even for trained doctors detecting COVID-19 from ultrasound data is challenging and time-consuming. Since their time is scarce, there is an urgent need to simplify, fasten & automatize the detection of COVID-19. This project is a proof of concept, showing that a CNN is able to learn to distinguish between COVID-19, Pneumonia and healthy patients with an accuracy of 89% and sensitivity for COVID of 96%. This is by no means clinically relevant and tons of further work must be done, e.g. on differentiating COVID from other viral pneumonias.

C. Point of care Ultrasound

a. Cheap: While one X-ray examination is estimated to cost around $370, and CT starting from $500 to $3000, ultrasound (US) may be a bargain with only approximately $140. Also, the device itself is reasonable and
thus easy to distribute, ranging from $2000 for portable devices.
b. Easy to use: most doctors skills to perform an ultrasound. There are not any safety measures like radiation,
and therefore the devices are handy.
c. Fast: With one device, it's possible to perform 4 to five lung screenings per hour
d. Portable: “point-of-care” says it all. The patients do not have to be moved, which saves lots of time and effort.
e. Safe: With US, you do not use any irradiating element. Period. Any X-Ray or CT examination slightly increases the lifetime risk of cancer, especially for younger patients.

DATASET USED

The preprocessed dataset is collected which consist of 64 lungs ultrasound recording divided into 11, 14 and 39 of healthy patient, pneumonia and Covid 19 respectively where 60% data is COVID 19 images. The linear probes give high resolution images. In Proposed system only the convex probes data are used because the data set available majorly consist of convex probes images. For deep organ convex probes are used more. Ideally for lungs linear probes should be used but more hospitals are equipped with convex probes.

Table I . Sources of Dataset

Data source	Data selected	Website description
Grepmed	10 COVID-19, 9 pneumonia and 2 healthy videos	GrepMed is a community-sourced, searchable medical image repository for referencing clinically relevant medical

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 7 July 2021, pp: 2758-2763 www.ijaem.net ISSN: 2395-5252

		images
ThePocusAtlas	8 COVID-19, 3 pneumonia and 3 healthy videos	The PocusAtlas is a Collaborative Ultrasound Education Platform

I defines the sources of dataset in which all data is collected.

IV. RESULT AND ANALYSIS

As mentioned above the model is trained to classify frames as Covid19 Pneumonia or healthy lungs. This ensures while splitting the data that the number of samples for each class is the same size.

The ROC and AUC is 0.94 for the COVID 19 detection with maximum accuracy for each class. Around 620 images of 654 COVID images were classified correctly with a sensitivity of 96%. Around 70 images of Pneumonia were classified as healthy which shows that we require more data for training. It is also necessary that we improve the false negative rate as around 70 covid images were detected as healthy. That is because of the low data of ultrasound for healthy patients as compared to the healthy patients. More data will surely increase the accuracy of the model. Following are the results for our Model.

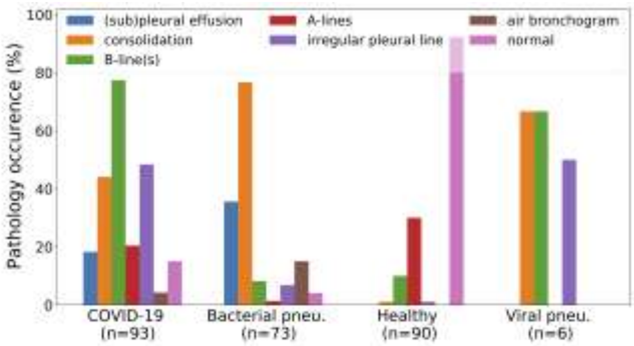

Figure 3: Pathological Occurrence

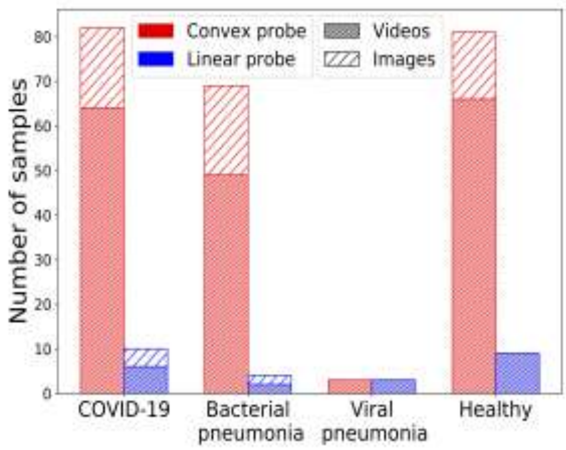

Figure 2: Performance Evaluation

II defines algorithms classification accuracy to that of existing machine learning algorithms.

Accuracy : 0.89 Balacc:0.82					
Class	**Frames**	**Sensitivity**	**Specificity**	**Precision**	**F1 Score**
COVID 19	654	0.96	0.79	0.88	0.92
Pneumonia	277	0.93	0.98	0.95	0.94
Healthy	172	0.55	0.98	0.78	0.62

Table II. System Performance Evaluation

The model is then compare with the COVIDnet model to demonstrate the effectiveness of the model. The Covid net has been trained and used for X Ray images Classification. After training Covid net on data an accuracy of 81% is achieved which is low as compared to proposed model that is 89%. The proposed Model clearly outperforms the Covidnet model.

Table III. Result of score of Covid net

Accuracy : 0.81 Balacc:0.63					
Class	**Frames**	**Sensitivity**	**Specificity**	**Precision**	**F1 Score**
COVID 19	654	0.98	0.57	0.77	0.92
Pneumonia	277	0.89	0.98	0.95	0.94
Healthy	172	0.01	1.00	0.20	0.62

V. CONCLUSION

It can be conclude that Ultrasound imaging can perform a lot better in diagnosis and classification and help a lot in detection of Covid 19 in a cheap price and in a cost effectiveway. More data sets can help increase the accuracy and reduce the errors of our model. Ultrasound can Imagining can reduce a lot of efforts of reallocation and complexity.

REFERENCES

[1] Y. Yang et al., Evaluating the accuracy of different respiratory specimens in the laboratory diagnosis and monitoring the viral shedding of 2019-nCoV infections, 2020.02.11.20021493, February 2020.

[2] R. Selvaraju, M. Cogswell, A. Das, R. Vedantam, D. Parikh, and D. Batra, Grad-cam: Visual explanations from deep networks viagradient-based localization, in Proceedings of the IEEE international conference on computer vision, 2017, pp. 618–626.

[3] S. Sippel, K. Muruganandan, A. Levine, and S. Shah, Review article: Use of ultrasound in the developing world, International Journal of Emergency Medicine, vol. 4, no. 1, p. 72, December 2020

[4] S. Salehi, A. Abedi, S. Balakrishnan, Coronavirus Disease 2019 A Systematic Review of Imaging Findings in 919 Patients, 1–7, March 2020.

[5] Bernheim et al., Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection, Radiology, p. 200463, February 2020.

[6] F. Mojoli, B. Bouhemad, S. Mongodi, and D. Lichtenstein, Lung ultrasound for critically illed patients, pp. 701–714, March 2019.
[7] R. Raheja, M. Brahmavar, D. Joshi, and D. Raman, Application of Lung Ultrasound in Critical Care Setting: A Review, Cureus, vol. 11, no. 7, July 2019.
[8] Vaishnavi S. Ransing, Dr M. A. Wakchaure ``A Covid Detection using deep learning and CNN", in Internation Journal Of Advance Research And Innovative Ideas In Education Vol-7 Issue-3 2021 Page 1691-1694 IJARIIE-ISSN(O)-2395-4396 Download Link : $http://ijariie.com/currentIssue.aspx/IJARIIE14441.pdf
[9] Vaishnavi S. Ransing, Dr M. A. Wakchaure ``Deep Learning and CNN based Covid Detection", in International Journal of Advanced Research in Science, Communication and Technology (IJARSCT) Volume 6, Issue 1, June 2021: Page(62-66) . ISSN (Online) 2581-9429 Download Link : $http://ijarsct.co.in/junei1.html/IJARSCT-Paper1491.pdf
[10] Y. Amatya, J. Rupp, F. M. Russell and D. R. House, Diagnostic use of lung ultrasound compared to chest radiograph for suspected pneumonia in a resource-limited setting, International Journal of Emergency Medicine (IJEM) vol. 11, no. 1, December 2018.
[11] E. Poggiali et al., Can Lung US Help Critical Care Clinicians in the Early Diagnosis of Novel Coronavirus (COVID-19) Pneumonia, Radiology, p. 200847, March 2020.
[12] Q. Y. Peng et al., Findings of lung ultrasonography of novel corona virus pneumonia during the 2019 – 2020 epidemic, Intensive Care Medicine, no. 87, pp. 6–7, March 2020.
[13] L. Demi, T. Egan, M. Muller, Lung Ultrasound Imaging, a Technical Review, Applied Science 10 (2) (2020) 462.
[14] K. He, X. Zhang, S. Ren, J. Sun, Deep Residual Learning for Image Recognition, in: 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Las Vegas, NV, 2016, pp. 770–778.
[15] F.N. Iandola, S. Han, M.W. Moskewicz, K. Ashraf, W.J. Dally, K. Keutzer, "SqueezeNet: alexNet-level accuracy with 50x fewer parameters and <0.5MB model size," arXiv:1602.07360v4 [cs.CV], 2016.