INDIRA COLLEGE OF ENGINEERING AND MANAGEMENT

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PROJECT SYNOPSIS

ON

COVID-19 Detection Using Chest Radiography

Submitted

BY

Shweta Gaikwad (71830753E)

Pallavi Karde (71830817E)

Vaibhav Maindad (71830870M)

Kaustubh Pawar (71830937F)

B.E

IN

COMPUTER ENGINEERING

Project Guide	HOD (Comp Engg Dept)
Prof. Sumit Harale	Prof. Manjusha Tatiya

1. Aim

Covid-19 detection using chest radiography/X-Ray using convolutional neural Network.

2. Introduction

Throughout the world has put an unprecedented load on healthcare systems around the globe. It is a highly infectious disease caused due to SARS n-CoV2 (severe acute respiratory syndrome novel coronavirus-2). The disease originated in December 2019 and has affected more than 200 countries worldwide. It is declared a pandemic by the world health organization (WHO). The disease has a mortality rate of 2%, which is due to massive respiratory failure and alveolar damage. The current form of testing, i.e., viral nucleic acid detection using real-time polymerase chain reaction (RT-PCR), is the acceptable form of COVID diagnosis. However, in many countries, especially developing nations where testing kits are not adequate and widespread testing has not started, early, automatic, and cost-effective diagnosis can be crucial for timely monitoring of the spread of disease. Non-contact automated diagnosis systems can prove to be an essential tool in containing the virus spread (even in healthcare professionals) with the timely referral of patients to care facilities and quarantine. Currently, in India, the cost of the RT-PCR test is very high and is out of budget for most of the population. Financial constraints arising from diagnostic test cost is a significant concern for patients in major developing nations. Healthcare systems across the globe have evolved in multiple domains to enhance the detection and diagnosis rates with the central aim of being minimally invasive. This underlines the fact that invasive procedures for the detection and diagnosis of diseases should be avoided to a great extent and wherever possible. The inclusion of medical imaging techniques like ultrasound, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Functional Magnetic Resonance Imaging (fMRI), etc. has dramatically changed the way that diseases are detected, diagnosed, examined, or analyzed. Since each of these imaging modalities has a unique underlying physics of operation, each imaging modality is different. Hence, every imaging modality cannot be used for every anatomical site. Among these imaging modalities, the best that suits the study of lungs and its health conditions is the radiograph. The details from a radiograph can aid a radiologist or other relevant healthcare professionals to evaluate lungs to diagnose conditions like a persistent cough, breathlessness, etc. Radiographs can also be utilized to diagnose conditions like emphysema, pneumonia, and cancer. In addition to this, generating radiographs from a subject is relatively straightforward in practice. This makes radiographs suitable for detection and diagnosis in emergency situations. With the advent of these medical imaging modalities, researchers and other professionals have continuously attempted to develop computer-aided systems that act a second opinion to the healthcare experts. There is a plethora of work in literature wherein computer-aided detection and diagnosis systems have been developed. These systems have been developed for numerous applications like the detection of brain tumors, thyroid

nodules, ground-glass opacity, Alzheimer's disease, etc. With the help of publicly available datasets of chest radiographs (X-ray images) of COVID-19 patients and healthy cases, the study of automatic COVID detection became possible through the use of radiographs, which demonstrate COVID positive patients, other bacterial pneumonia patients, and healthy patients. Chest radiographs are the universally used imaging technique for diagnosis, and almost all the healthcare facilities, even in remote (underdeveloped) areas, have radiographic imaging as a basic diagnosis system. CT imaging can also be used for COVID-19 detection, but due to the non-availability of CT scanners in small healthcare facilities and its time-consuming nature, it prohibits the timely detection and screening of COVID patients. Also, real-time chest radiographic imaging can help to study the progression of the disease, which in turn can help to better screen the patients at different stages of disease. A deep learning based model was developed that can be used to automate COVID19 detection and screening with high accuracy and sensitivity. This could reduce the number of RT-PCR tests required as only those patients can be sent for viral nucleic tests, which test positive with this model. In recent years deep learning models have been very successful in object detection and classification. In medical image analysis and classification, these models have started to prove very useful and are of great help to doctors, especially radiologists, to detect patterns in medical images. Computer-aided diagnosis (CAD) systems employed with deep learning techniques help professionals to make clinical decisions. Deep learning architectures, especially convolutional neural networks (CNNs), help in automatic feature detection in images. The repeated process learns rich and discriminative features of linear and non-linear transformations at every layer of the CNN model. The network starts with more straightforward features and learns more abstract and discriminative features deeper into the network. This study aimed to utilize state of the art deep learning techniques for automatic COVID-19 detection on chest radiographs to assist in testing and screening of COVID-19 patients.

3. Literature Survey

In the paper Automatic detection of COVID-19 from chest radiographs using deep learning written by M.K. Pandit, S.A. Banday, R. Naaz, M.A. Chishti showed that we can use chest radiograph for the covid detection. They made automated system to process the data and infection detection. They used Deep learning convolution neural network and transfer learning. They used VGC-16 network for covid detection. VGC-16 is 16-layer convolutional neural network. which consists of 13 convolutional layers and 3 fully connected layers. It also contains 5 max-pooling layers. It is very slow to train (the original VGG model was trained on Nvidia Titan GPU for 2-3 weeks). The size of VGG-16 trained imageNet weights is *528* MB. So, it takes quite a lot of disk space and bandwidth that makes it inefficient. Total number of parameters used are: 134,268,738. Accuracy claimed by author for 2-class is 96% and for 3-class is 92%

In the paper COVID-19 detection and heatmap generation in chest x-ray images written by Worapan Kusakunniran showed that we can use chest X-ray and generate heat map or covid detection. They used Res-Net-101 architecture. The whole net is trained using the large size of 1500 × 1500 x-ray images. The

heatmap under the region of interest of segmented lung is constructed to visualize and emphasize signals of COVID-19 in each input x-ray image. Lungs are segmented using the pretrained U-Net. The confidence score of being COVID-19 is also calculated for each classification result. In this paper authors have used RESNET-101 network. Very deep neural network (101 layers) and number of parameters is around 44 million. Better accuracy (for 3 class) but very heavy network.

In the paper SOM-LWL method for identification of COVID-19 on chest X-rays Written by Ahmed Hamza Osman, Hani Moetque Aljahdali, Sultan Menwer Altarrazi, Ali Ahmed. They used SOM-LWL algorithm to detect covid infection. They detected covid-19 pneumonia infection in the lungs using chest X-Ray.
In this paper authors have used SOM-LWL algorithm (instance based algorithm). Classification costs are high, Large amount of memory required to store the data, and each query involves starting the identification of a local model from scratch. Better accuracy is achieved for 3 class classification (97%).

4. Why is the particular topic is chosen?

- The outbreak of COVID-19 or coronavirus was first reported in 2019.
- It has widely and rapidly spread around the world. The detection of COVID-19 cases is one of the important factors to stop the epidemic, because the infected individuals must be quarantined.
- In pandemic year 2020 COVID-19 was not able to detect through RT-PCR test, there was some false negative and false positive reports so doctors had to check CT scan report to detect the infection.
- One reliable way to detect COVID-19 cases is using chest x-ray images, where signals of the infection are located in lung areas.
- We propose a solution to automatically classify COVID-19 cases in chest x-ray images.

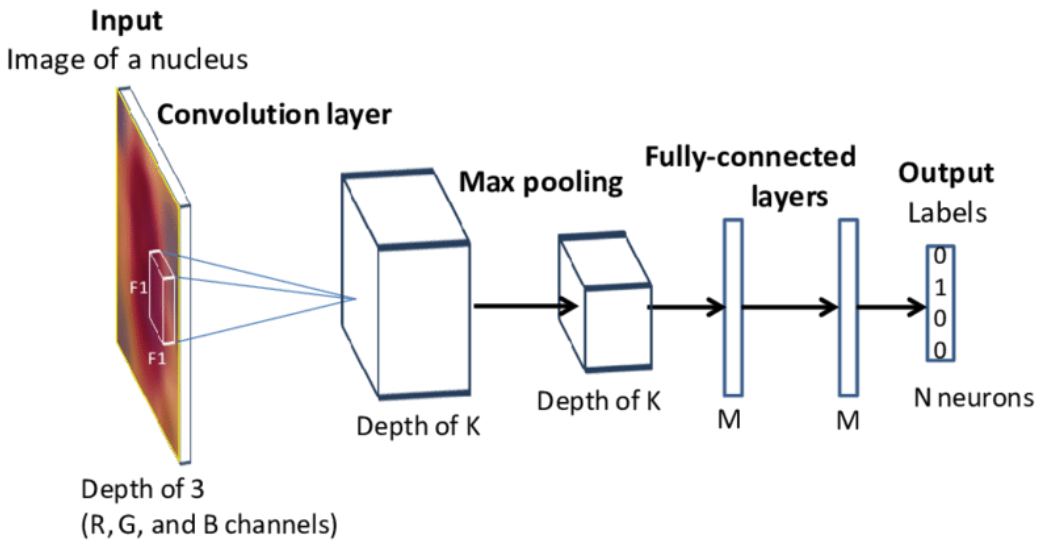
5. Objectives and Scope of the Project

- Determine the infection using nonhuman contact method using chest radiographs.
- To be used in clinical diagnostics for imaging and low cost.
- The non-contact method with acceptable accuracy is a potential alternative for rapid COVID-19 testing that can be adapted by the medical fraternity considering the criticality of the time along with the magnitudes of the outbreak.
- To be used as second opinion for doctors.
- To help doctors to detect patterns in medical images.
- Computer-aided diagnosis (CAD) systems employed with deep learning techniques help professionals to make clinical decisions.

6. Proposed Methodology (System architecture and Module details)

The system used to create this project is CNN (Convolutional Neural Network). In the studied paper every author used convolutional neural network to detect the infection. With CNN they also used RES-Net, Pre-learned network, transfer learning, VGC-16, SOM-LWL algorithm. But there is common thing and that is CNN. CNN is used to extract the features. In CNN filters, fully connected layers are present. Filters are used to filter the features. We can train fully connected layer by freeing them. Max pooling is used to get 2D matrix by selecting maximum value.

Block Diagram-Example



SOFTWARE AND HARDWARE REQUIREMENTS:

Software requirement: -

Sr.No.	Software Component	Details
1	Operating System	Windows7
2	Technology	Deep Learning
3	Tool	Google Colab, Anaconda, Python
4	Database	Chest Radiography Database

Hardware requirement: -

Sr.No.	Component	Details
1	Processor	Intel i3 generation
2	Memory	RAM: 512 MB, Hard Disk: 250 GB

7. What contribution would the project make?

- Covid-19 has spread across different lengths and breadths of the globe, taking a death toll to in Lakhs. The number is well expected to rise even more significantly.
- In the absence of a thoroughly tested and approved vaccine, the onus primarily lies on obliging to standard operating procedures and timely detection and isolation of the infected persons.
- The detection of SARS n-CoV2 has been one of the core concerns during the fight against this pandemic. To keep up with the scale of the outbreak, testing needs to be scaled at par with it.
- With the conventional PCR testing, most of the countries have struggled to minimize the gap between the scale of outbreak and scale of testing.
- The proposed model is a non-contact process of determining whether a subject is infected or not and is achieved by using chest radiographs; one of the most widely used imaging technique for clinical diagnosis due to fast imaging and low cost.
- It can be used as second opinion for doctors and also to help doctors to detect patterns in medical images.
- Computer-aided diagnosis (CAD) systems employed with deep learning techniques help professionals to make clinical decisions.

8. Limitations

- There is 10 to 20 % chance for false positive or false negative report.
- In some areas where internet connection or electricity is not available this system cannot be implemented.
- This system requires desktop pc or laptop for execution.
- Person needs to take X-Ray of the chest separately for the testing process.

9. Schedule of Project

2nd August 2021: - Project Title Selection
10th August 2021: - Guidance Lecture on BE project
13th August 2021 – 14th August 2021: - Project Review for topic finalization
27th August 2021 – 28th August 2021: - Project Review 1

10. Conclusion

- We used the deep learning model to detect COVID19 using chest radiographs automatically.
- The study shows the robust and effective method of non-contact testing on COVID patients, which can help in early and cost-effective detection and screening of COVID cases.
- Grad CAM images of chest radiographs are presented, which shows the regions of interest for confirmed COVID-19 positive cases, bacterial pneumonia, and healthy cases.
- We believe that this study could be used as an initial screening, which can help healthcare professionals to treat the COVID patients by timely detecting better and screening the presence of disease.
- It provides not only a cost-effective but also an automatic noncontact testing method, which helps in reducing the risk of COVID contraction by medical practitioners.

11. References

[1] M.K. Pandit, S.A. Banday, R. Naaz, M.A. Chishti, Automatic detection of COVID-19 from chest radiographs using deep learning, Radiography, Volume 27, Issue 2, 2021, Pages 483-489, ISSN 1078-8174, https://doi.org/10.1016/j.radi.2020.10.018.

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