A PRELIMINARY REPORT ON

COVID-19 DETECTION USING CHEST X-RADIOGRAPHY

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE

IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS

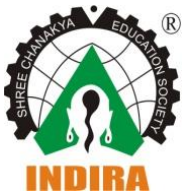
FOR THE AWARD OF THE DEGREE

OF

BACHELOR OF ENGINEERING (COMPUTER ENGINEERING)

SUBMITTED BY

SHWETA GAIKWAD	**BCO53E404**
PALLAVI KARDE	**BCO17E471**
VAIBHAV MAINDAD	**BCO70M426**
KAUSTUBH PAWAR	**BCO37F472**



DEPARTMENT OF COMPUTER ENGINEERING

INDIRA COLLEGE OF ENGINEERING & MANAGEMENT

PARANDWADI, PUNE 410506

SAVITRIBAI PHULE PUNE UNIVERSITY

2021 -2022

CERTIFICATE

This is to certify that the project report entitles

"COVID-19 DETECTION USING CHEST RADIOGRAPHY"

Submitted by

SHWETA GAIKWAD	**BCO53E404**
PALLAVI KARDE	**BCO17E471**
VAIBHAV MAINDAD	**BCO70M426**
KAUSTUBH PAWAR	**BCO37F472**

is a bonafide student of this institute and the work has been carried out by him/her under the supervision of Prof. **SUMIT HARALE** and it is approved for the partial fulfillment of the requirement of Savitribai Phule Pune University, for the award of the degree of **Bachelor of Engineering** (Computer Engineering).

Prof. Sumit Harale
Guide ,
Department of Computer Engineering

Dr. Soumitra Das
Head,
Department of Computer Engineering

(Dr. Sunil Ingole)
Director,
Indira College of Engineering & Management, Pune

Place : Pune

Date :

Sign of Internal Examiner

Sign of External Examiner

ACKNOWLEDGEMENT

It is great pleasure for us to undertake this project. We feel highly doing the project entitled – "COVID-19 DETECTION USING CHEST RADIOGRAPHY".

We are grateful to our project guide Prof. Sumit Harale Faculty member of Indira college of engineering and management and Dr. Soumitra Das, Head of the department of computer engineering and Dr. Sunil Ingole Director of Indira college of engineering and management, Pune.

This project would not have come so far without their help and worthy experience. Whenever we were in need, they were there behind us.

Although, this report has been prepared with utmost care and deep routed interest. Even then we accept respondent and imperfection.

SHWETA GAIKWAD

PALLAVI KARDE

VAIBHAV MAINDAD

KAUSTUBH PAWAR

ABSTRACT

Covid-19 is discovered in 2019. No one knows the origin of this virus. When the virus came it spread throughout the globe. The whole world suffers from it. In the beginning, cases were low, but they increased, and WHO had to declare the pandemic. Covid-19 spread all over the world and millions of cases started to show. The pandemic was horrible. Lots of people are affected due to this.

At the begging of the pandemic, there wasn't a proper testing procedure to detect the infection of the patient. It caused lots of confusion among the people. To prevent the infection people had to take preventive measures and had to get quarantined even though you are not infected, which caused lots of problems. Then the RT-PCR test is used for checking the infection. But this test 2-3 days for detection. And there were millions of testing cases, so it took a lot more time to give results to the patients.

There was another problem that is false positive or false negative reports. People got this kind of report and got the wrong medication. To confirm the report doctor recommended a CT scan of the chest to detect the infection. But CT scan is high in cost. Not every person has that kind of money. Also, not every hospital has a CT scan device. But there is another way to detect the infection and that is through x-ray. X-ray in cheap and every hospital has an x-ray machine.

In this system, we are proposing a deep learning method. In this system, we are going to use chest x-ray images to predict the infection. Deep learning is the future of the medical industry. In this system, the user will get the result in a few seconds.

INDEX

LIST OF ABBREVIATIONS

ABBREVIATION	ILLUSTRATION
CNN	Convolutional Neural Network
RES-NET	Residual neural network

LIST OF FIGURES

LIST OF TABLES

01 INTRODUCTION

Covid-19 is discovered in 2019. No one knows the origin of this virus. When the virus came it spread throughout the globe [1]. The whole world suffers from it. In the beginning, cases were low, but they increased, and WHO had to declare the pandemic [2]. Covid-19 spread all over the world and millions of cases started to show. The pandemic was horrible. Lots of people are affected due to this. The mortality rate of the covid-19 is very low. A lot of people suffer from lung failure [3].

At the begging of the pandemic, there wasn't a proper testing procedure to detect the infection of the patient. It caused lots of confusion among the people. To prevent the infection people had to take preventive measures and had to get quarantined even though you are not infected, which caused lots of problems. Then the RT-PCR test is used for checking the infection. But this test 2-3 days for detection. And there were millions of testing cases, so it took a lot more time to give results to the patients [4,5].

There was another problem that is false positive or false negative reports. People got this kind of report and got the wrong medication. To confirm the report doctor recommended a CT scan of the chest to detect the infection. But CT scan is high in cost. Not every person has that kind of money. Also, not every hospital has a CT scan device. But there is another way to detect the infection and that is through x-ray. X-ray in cheap and every hospital has an x-ray machine [6,7,8,9].

In this system, we are proposing a deep learning method. We are going to use chest x-ray images to predict the infection. Deep learning is the future of the medical industry. In this system, the user will get the result in a few seconds. To predict the infection, we are going to use CNN (Convolutional neural network), ResNet (residual neural network), and VGG-16 and transfer learning. Our project will detect the infection spread in the lungs through a chest x-ray which the user will provide. Then the given image will process through the model and give the result. There will be three types of results positive, negative, and viral [10].

There will be a window in which one box will tell you to upload the image in that box user have to click and upload the image and, in a few seconds, the user will get the result. The system will be easy to use and user-friendly. Every hospital and patient also can use it.

In the proposed system we used CNN, RES-net, VGG-16, and transfer learning. With help of these models, we will be predicting user has a covid infection or not. the covid dataset will be divided into two different datasets training dataset and testing dataset. Meanwhile, the dataset will be cleansed. In which image will get cleared and sharp for training. In the next phase, data will be preprocessed after the preprocessing of the data-specific features of the covid infections will be extracted. This process is done on the training and testing of both datasets. After that machine learning classification or models will be run. The models we are using are CNN. After the classification result will be predicted [fig.4.2.1]. The system will be user-friendly, easy to use.

The proposed system is only predicting the infection is present or not. It will not give any kind of diagnosis for the infection. If the user has covid then he/she must visit the doctor as early as possible. And he/ she needs to take medication which the doctor will provide.

1.1 Motivation

The COVID-19 was first detected in 2019. It has rapidly spread around the world. The detection of COVID-19 cases is one of the important factors to stop the spread because the infected individuals must be quarantined. In the 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.

CT scan reports are too expensive. Not every person affords to do a CT scan. Also, CT Scan machine is very expensive and big and available only in big hospitals and private hospitals. Hospitals are present in the village where no electricity is available and low staff members are present, they don’t have CT scan machine.

One way to detect COVID-19 cases is using chest x-ray images, where signals of the infection are in lung areas. X-rays are cheap and available in a small village as well. And every person can afford a single x-ray. This is the reason we propose a solution to automatically classify COVID-19 cases in chest x-ray images.

1.2 Problem Definition

The spread of COVID-19 or coronavirus was first detected in 2019. It has rapidly spread around the world. The detection of COVID-19 cases is one of the important factors to stop the spread because the infected individuals must be quarantined. In the 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.

CT scan reports are too expensive. Not every person affords to do a CT scan. Also, CT Scan machine is very expensive and big and available only in big hospitals and private hospitals. Hospitals are present in the village where no electricity is available and low staff members are present, they don't have CT scan machine.

There is one way to detect COVID-19 cases is using chest x-ray images, where signals of the infection are in lung areas. X-rays are cheap and available in a small village as well. And every person can afford a single x-ray. We are proposing a system that will detect the infection from an x-ray image of the patient.

02 LITERATURE SURVEY

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 [10]. They made an automated system to process the data and infection detection. They used deep learning convolution neural networks and transfer learning. They used a VGC-16 network for covid detection. VGC-16 is a 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. The total number of parameters used is 134,268,738. Accuracy claimed by the author for 2-class is 96% and for 3-class is 92%

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 [11].

The heatmap under the region of interest of the 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, the authors have used the RESNET-101 network. Very deep neural network (101 layers) and the number of parameters is around 44 million. Better accuracy (for 3 classes) 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 [12]. They used the SOM-LWL algorithm to detect covid infection. They detected covid-19 pneumonia infection in the lungs using a chest X-Ray.

In this paper, the authors have used the SOM-LWL algorithm (instance-based algorithm). Classification costs are high, a large amount of memory is 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%).

03 SOFTWARE REQUIREMENTS SPECIFICATION

3.1 Introduction

3.1.1 Project Scope

Determine the infection using a non-human 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 a 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.

3.1.2 User Classes and Characteristics

Our project will detect the infection spread in the lungs through a chest x-ray which the user will provide. Then the given image will process through the model and give the result. There will be three types of results positive, negative, and viral.

There will be a window in that window there will be one box indicating upload the image here. There will be one button on which the user has to click to upload the image. After successful upload of the image user will get output within a few seconds.

3.1.3 Assumptions and Dependencies

There is the possibility that the system will give a false result. But there is a way to solve this problem. People with a high risk must seek medical attention immediately. If a person doubts the result can get a second opinion from the doctor. The proposed system will not give you any diagnosis. For the diagnosis purpose person must visit the doctor.

The proposed system is dependent upon the image data user will provide. Also, it is dependent upon doctors and their opinion. And it depends upon the opinion of the patient. If he doesn’t want to use the system, no one can force him to use it.

3.2 Functional Requirements

3.2.1 The User Should Be Able to Upload the Image

When the proposed system will run on the device of the user, the user should be able to upload the image into the system. The image will be the black and white and x-ray image.

3.2.2 The User Should Get the Result Within A Few Seconds

After uploading the image into the system user should get the result within a few seconds. And the result should be accurate.

3.3 Nonfunctional Requirements

3.3.1 Performance Requirements

The proposed system should upload multiple images at a time. The system should be able to process multiple images in a minimum time duration. The system should give accurate results to the user

3.3.2 Safety Requirements

Data of the user should be safely stored. Information of the user should not be shared with the third person without the consent of the user. The result should be only visible to the user. Privacy of the user should be maintained.

3.3.3 Security Requirements

The system should be bug-free. The system should be secure from malware, virus, and other external threats.

3.3.4 Software Quality Attributes

- Availability

The system will be working all the time. There is only a 10-15% chance of it won't work. At this time system maintenance will be performed.

- Integrity

We could integrate the system with the hospital management system to reach as many people as we want.

- Performance

The proposed system should upload multiple images at a time. The system should be able to process multiple images in a minimum time duration. The system should give accurate results to the user

- Reliability

Our system will give about 90-95 % accuracy. That means the result will be accurate and the user can rely on our system for the detection of the infection.

- Safety

Data of the user should be safely stored. Information of the user should not be shared with the third person without the consent of the user. The result should be only visible to the user. Privacy of the user should be maintained.

3.4 System Requirements

3.4.1 Database Requirements

To implement this project, we required a database. Covid-19 database is available on different platforms. We used the database from Kaggle. The name of the database is Hide tree COVID-19_Radiography_Dataset. The link for the dataset is

https://www.kaggle.com/tawsifurrahman/covid19-radiography-database

The database contains 4 directories covid-19, normal, lung opacity, viral pneumonia. In the database 3616 COVID-19 positive cases along with 10,192 Normal, 6012 Lung Opacity (Non-COVID lung infection), and 1345 Viral Pneumonia images are present. Database images are of chest x-rays of the patients [14].

3.4.2 Software Requirements

Operating System (OS): Windows 7
Programming Language: Python 3.7
Cloud-based Jupyter Notebook environment to run code: Google colab

3.4.3 Hardware Requirements

Processor (CPU): Intel i3 generation
RAM: 512 MB
Hard Drive: 250 GB or more

3.5 Analysis Models

To implement this project, we used the waterfall model. The waterfall model represents the phases of software implementation in which requirements, design, development, testing, deployment, maintenance are the phases of the model.

In the requirement phase, we gather all requirements for the projects like journal papers, the study of the paper, the study of different algorithms, system requirements, functional requirements, etc. In the next phase i.e., the design phase we figured out how we will make our system. How we will make the system attractive. UI of the system is decided in this phase. In the next phase, actual coding and algorithm implementation is done. After that testing phase will be performed in which different test scenarios will pass to the system and integrity, reliability, compatibility will be tested. Nest is deployment in this phase system will be deployed the platform like browser or mobile and the working system will be ready. And the last one is maintenance in this phase changing the algorithms as per need, making the system more efficient will be done.

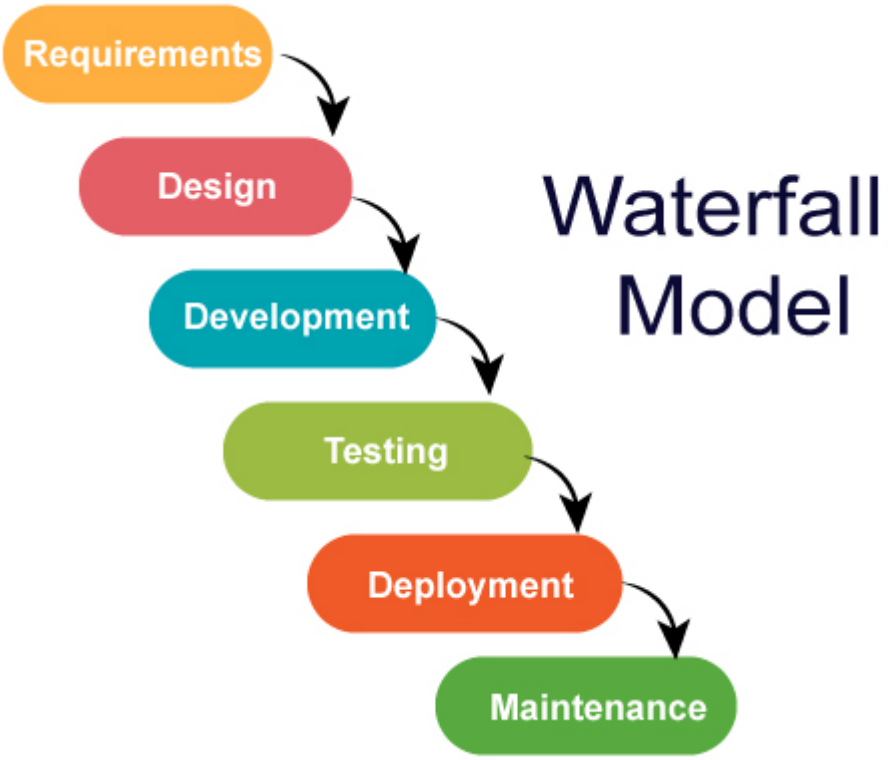


Fig. 3.5.1 Waterfall model

3.6 System Implementation Plan

Given fig. 3.6.1 shows the system implementation plan and schedule of the plan. In the figure green bar and red bar shows the progress of the tasks. The green color indicates the completed tasks, and the red color indicates the incomplete tasks.

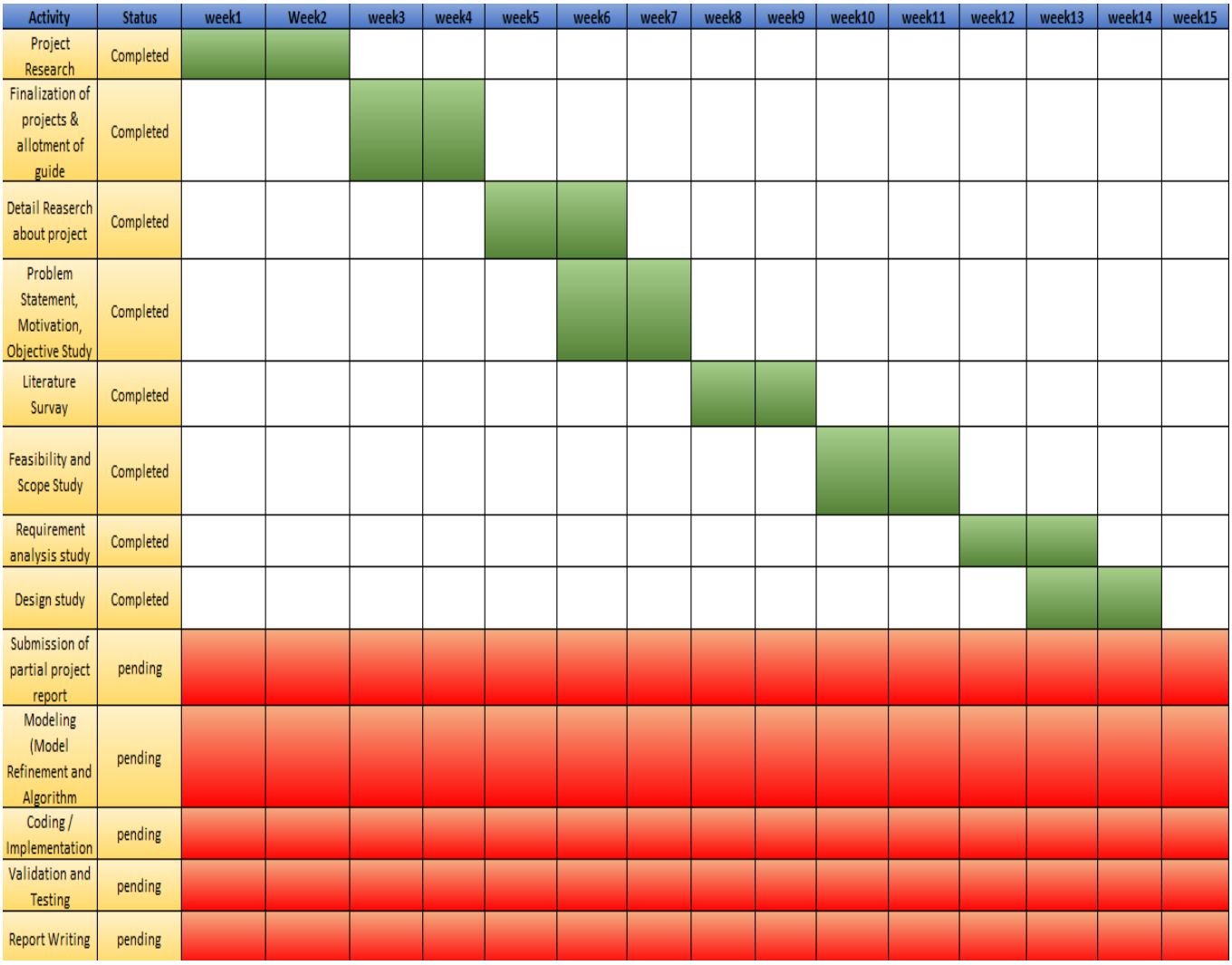


Fig. 3.6.1 System implementation planning

04 SYSTEM DESIGN

Given fig. 4.1 is showing the basic idea about system design. In the system, the covid dataset will be divided into two different datasets training dataset and testing dataset. Meanwhile, the dataset will be cleansed. In which image will get cleared and sharp for training. In the next phase, data will be preprocessed after the preprocessing of the data-specific features of the covid infections will be extracted. This process is done on the training and testing of both datasets. After that machine learning classification or models will be run. The models we are using are CNN. After the classification result will be predicted.

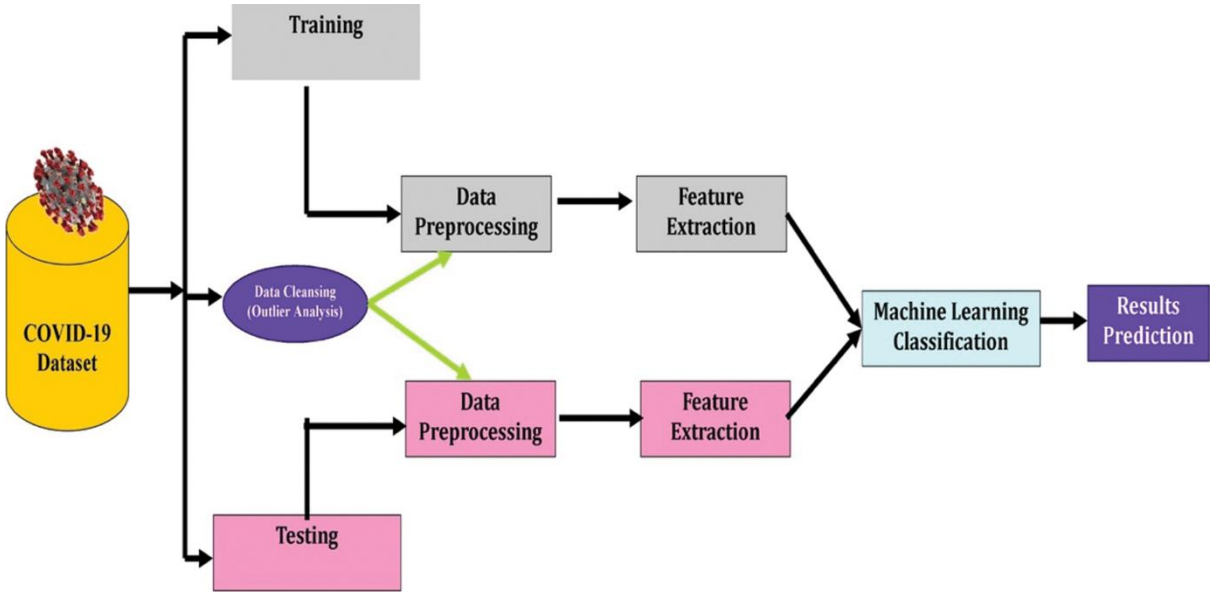


Fig. 4.1 System design

4.1 System Architecture

The following image is showing the architecture of the system. In which dataset will be added to the system and that dataset will process in the deep learning method and after the process, we get our desired output. The output will be in three-class form.

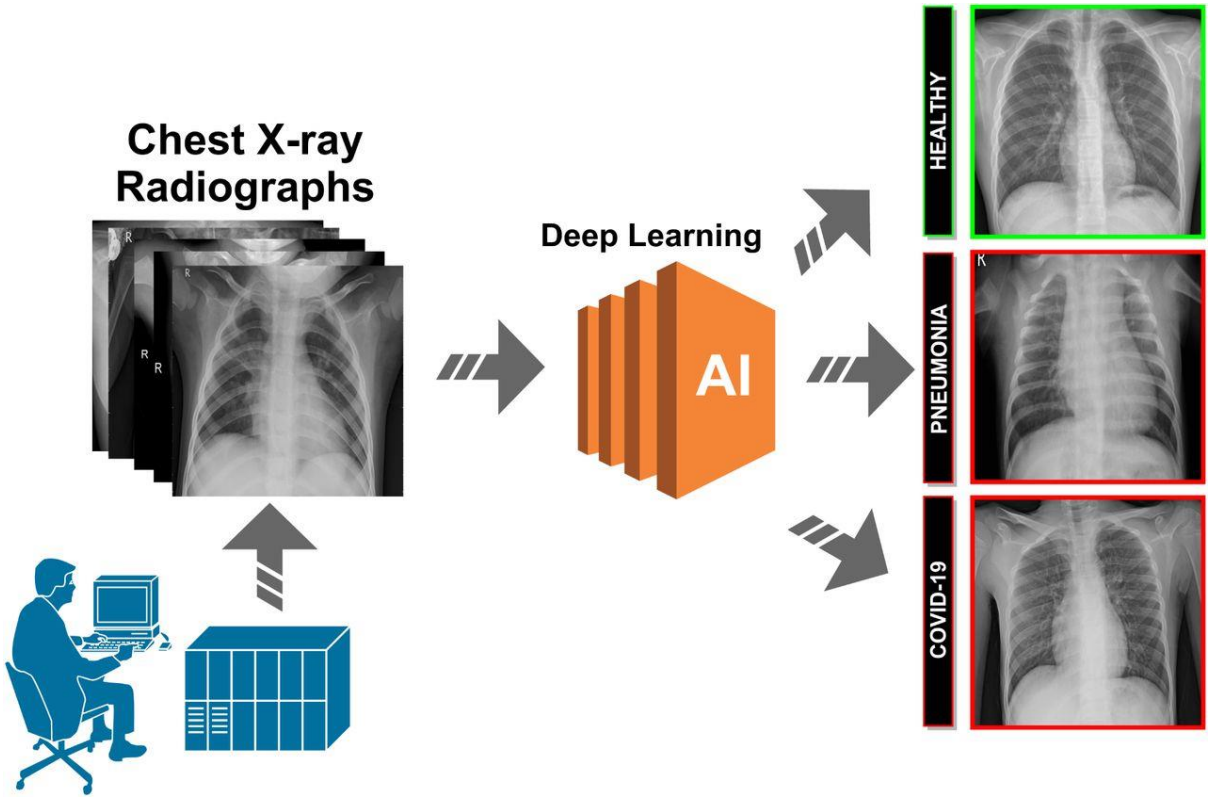


Fig. 4.1.1 System architecture

Following fig. 4.1.2 is showing the working model of a convolutional neural network. Given figure shows that CNN will take the image as an input then the convolution layers are started in which we can give as many layers as we want. The image will be passed through that layer. Each layer will perform feature extraction of the image and the output of the first layer will be an input of the next layer. Then the max pooling will be performed on the output in the form of pixels. In which a maximum number of the pixel will be collected from the matrix and a new matrix will be generated which will contain only max pixels of the image. The image will pass through fully connected layers, and we will get the outputs in the form of 0's and 1's.

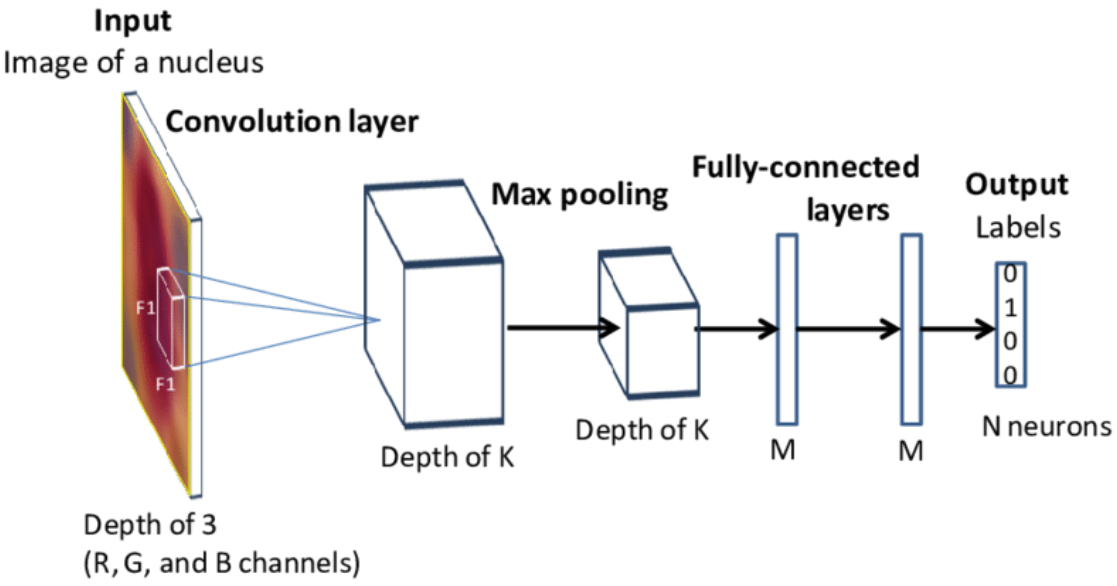


Fig. 4.1.2 system architecture

4.2 Data Flow Diagrams

Following fig.4.2.1 is showing the data flow diagram of the system. Data will be added to the system as an input or a single image will be added as an input. Then the validation of the image and resizing and augmentation of the image will be performed. Then implemented model will be trained and validation will be performed. Then converged or max. epochs will be added, and a final model will be generated. Input image will be passed through the trained model and classification will be performed. We will get the final prediction after the classification. After the final prediction, the final output will be generated. The output will be either covid-19 positive or normal or viral.

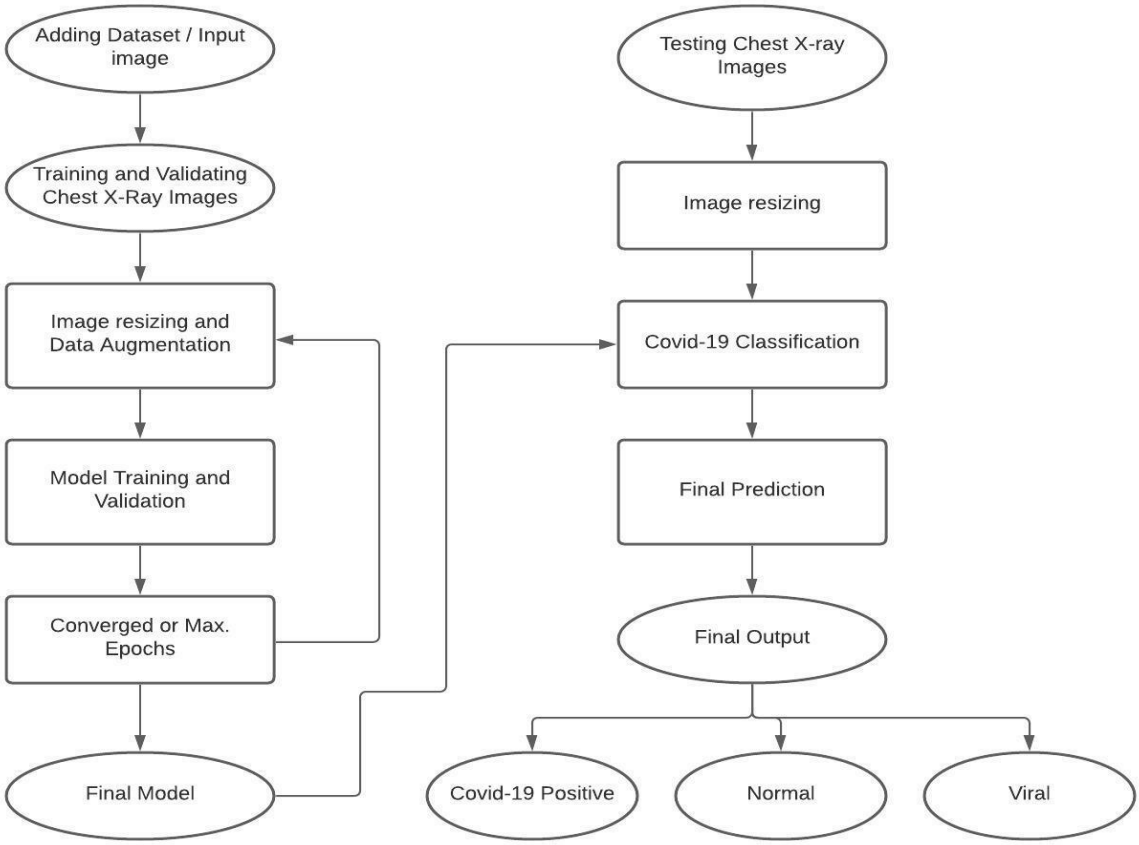


Fig.4.2.1 Data flow diagram

4.3 Entity-Relationship Diagrams

The following diagram represents the entity-relationship. In which different relationship is represented. One user can upload many images to the system. Preprocessing, model and visualization can be done for many images at the same time and there will be only one result per image.

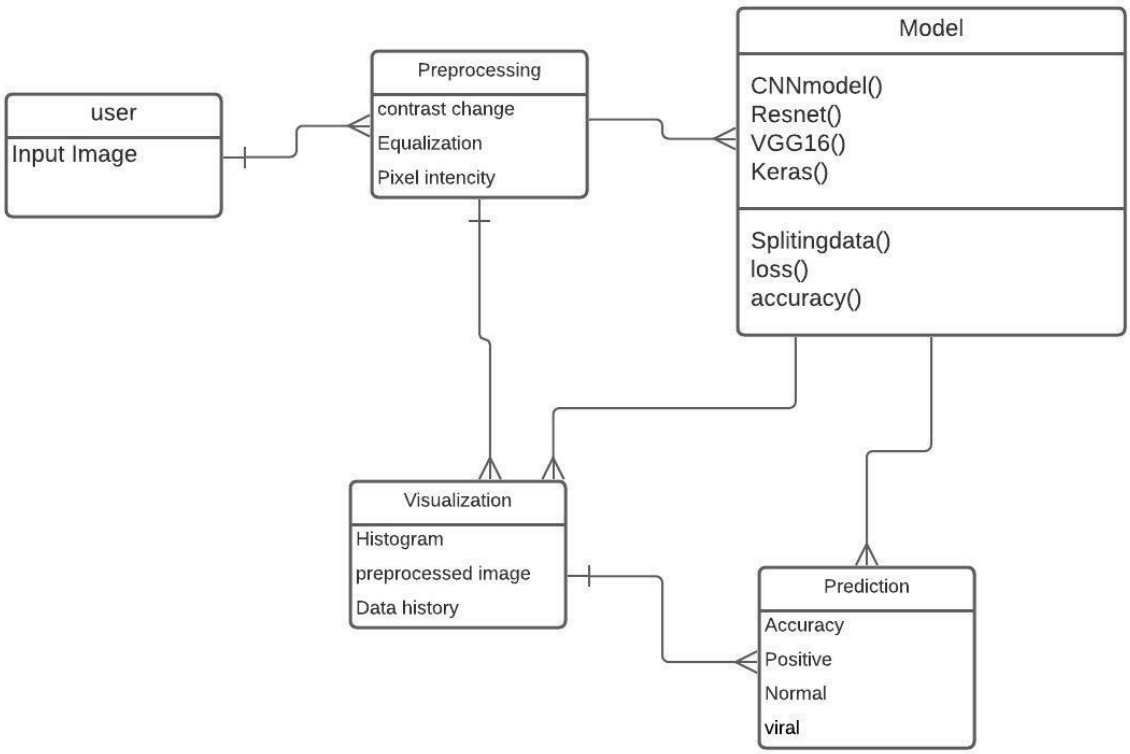


Fig. 4.3.1 Entity relationship diagram

4.4 UML Diagrams

Following fig. are showing the UML diagrams of the proposed systems. With the help of these diagrams, we can see the design and implementation of the system. The user will give an image as input. Pre-processing will be performed on the input image. The image will be passed through the trained model. After the processing image through trained model output will be generated. The output will be in three-class covid positive, normal, viral.

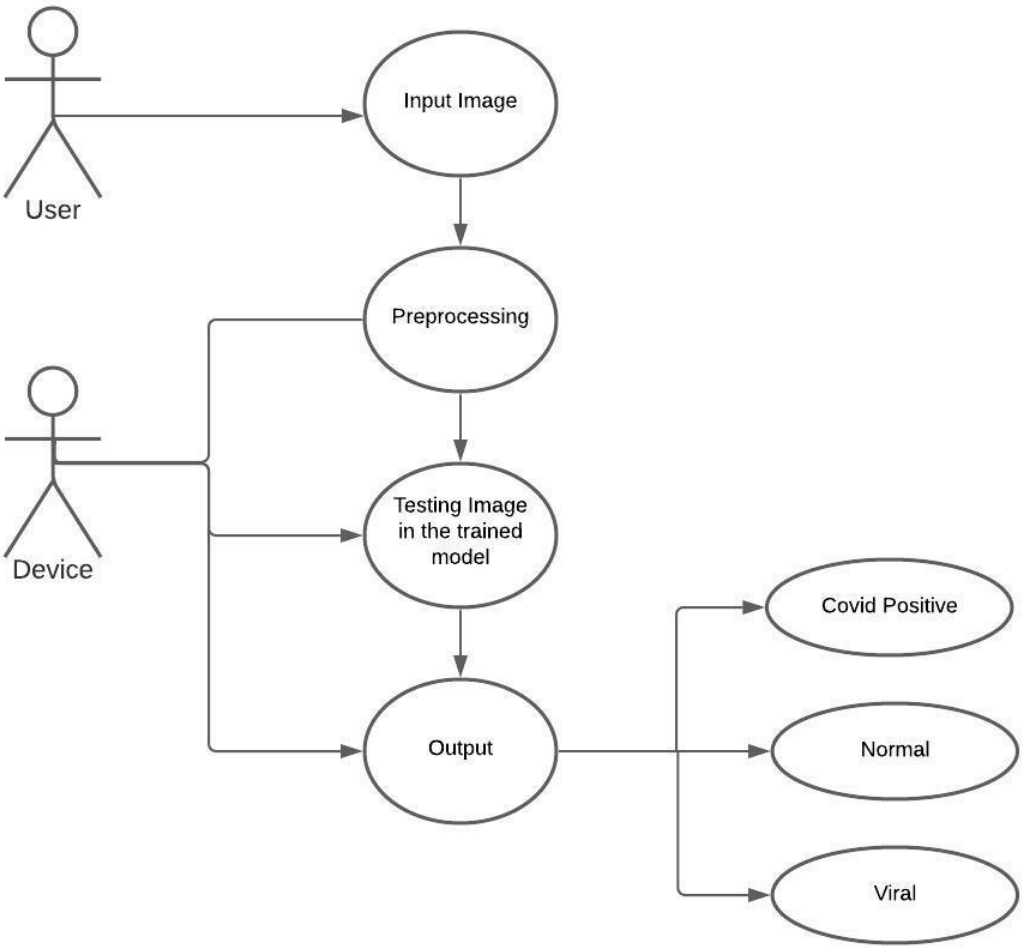


Fig. 4.4.1 UML diagram

Fig.4.4.2 is an activity diagram of the system. Input will be an image. The image will be unprocessed if the image gets accepted it will go through pre-processing, then the image will be tested through trained model output will be predicted and we will get final output and it will reach to end. If the image gets rejected it will reach to end.

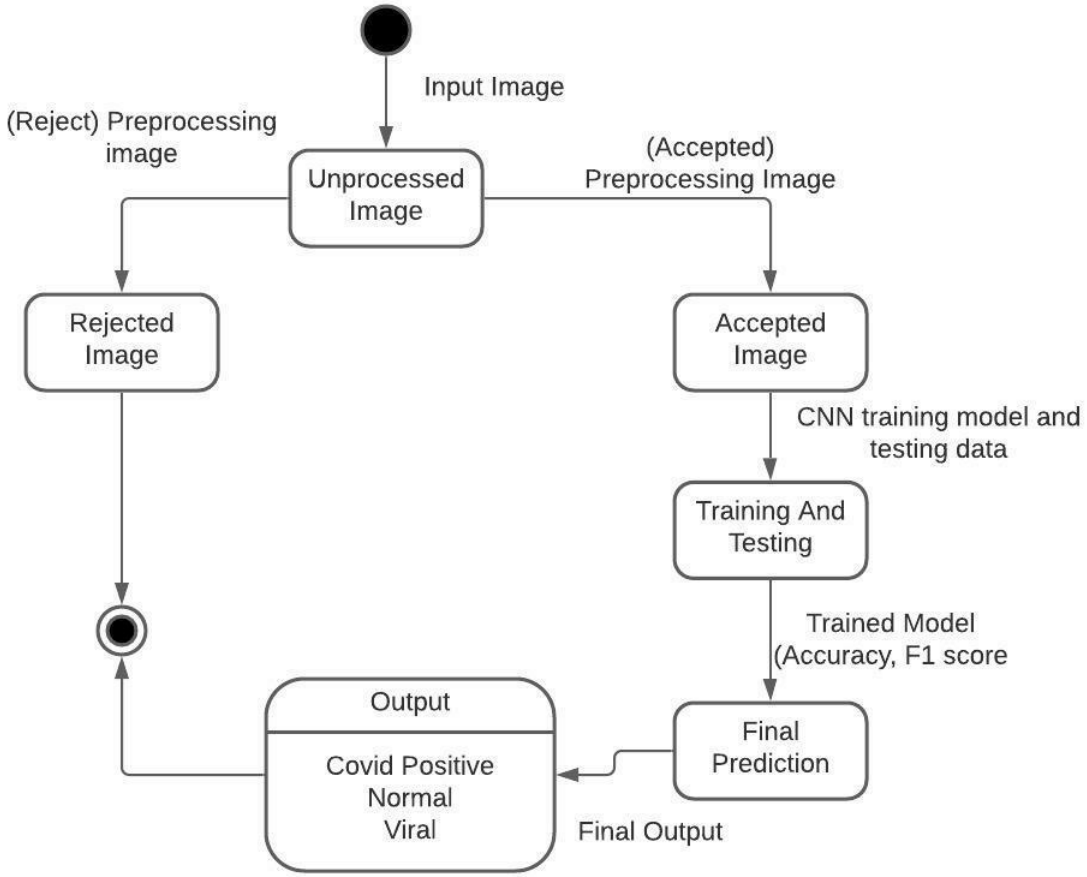


Fig. 4.4.2 Activity diagram

Following fig. 4.4.3 shows the sequence diagram of the system. The user will give the image as input. The image will be pre-processed for better understanding. In pre-processing image sharpening, image resizing, image equalization will be performed. Then the deep learning model will be trained. The pre-processed image will be passed through that trained model. A trained model will process this image and predict the output and show it to the user.

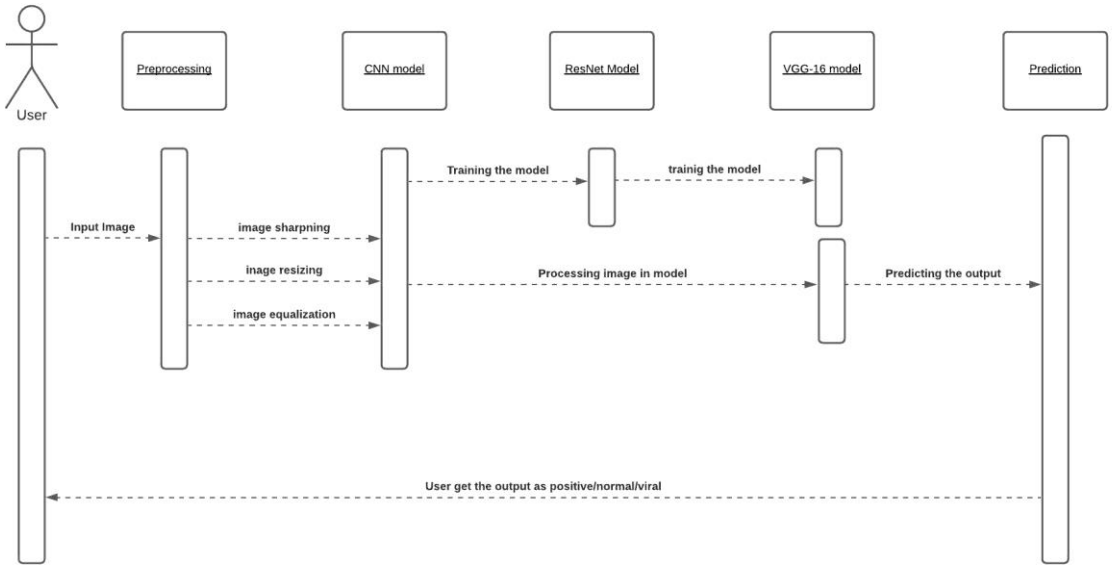


Fig.4.4.3 Sequence diagram

05 OTHER SPECIFICATION

In the proposed system we used CNN, RES-net, VGG-16, and transfer learning. With help of these models, we will be predicting user has a covid infection or not. the covid dataset will be divided into two different datasets training dataset and testing dataset. Meanwhile, the dataset will be cleansed. In which image will get cleared and sharp for training. In the next phase, data will be preprocessed after the preprocessing of the data-specific features of the covid infections will be extracted. This process is done on the training and testing of both datasets. After that machine learning classification or models will be run. The models we are using are CNN. After the classification result will be predicted. The system will be user-friendly, easy to use.

The proposed system is only predicting the infection is present or not. It will not give any kind of diagnosis for the infection. If the user has covid then he/she must visit the doctor as early as possible. And he/ she needs to take medication which the doctor will provide.

5.1 Advantages

- People can scan their chest x-rays at home.
- Doctors and hospitals can detect the infection at an early stage.
- Patients who have high risks can get medical attention on time.
- There won’t be any delay in the results of covid-19 testing.
- This system will be very helpful for healthcare professionals.
- It can be used as a second opinion for doctors and to help doctors to detect patterns in medical images.

5.2 Future Scope

- The proposed system will be able to help doctors and hospitals to detect covid cases in less time.
- People have to give less money for the covid testing.
- In the future, we could build a mobile app for the people to test their x-rays at home for the covid detection
- We could install the system in every hospital-like x-ray machine or CT scan machine for fast result generation.

5.3 Applications

We can use this system in our day-to-day life, but the main application of this project is in the medical industry. The medical industry will make better use of this system. The hospital will use this system to check mass images to reduce their workload. Ana many people will get their results on time and doctors can save many lives.

We can use this product for business purposes. But in this people have to pay for the use of the system. This system will be made public for some amount and then they can check their x-rays at home.

06 CONCLUSIONS & FUTURE WORK

We used the deep learning model to detect COVID19 using chest x-rays automatically. The study shows the effective method of non-human-contact testing on COVID-19 patients, which can help in early and low-cost detection of COVID cases. X-ray images of the chest are presented, which shows the regions for confirmed COVID-19 positive cases, bacterial pneumonia, and healthy cases.

We believe that this project could be used as initial testing, which can help doctors to detect the COVID infection by better screening the presence of the disease. It is not only a low-cost but also an automatic non-human-contact testing method. It will help to reduce the risk of COVID-19 infection by doctors.

We are going to build the network of CNN, VGG-16, Res-Net, and transfer learning algorithms. In the system, we will be using the F1 score for accurate prediction. If possible, we will be building a web-based application for the system.

REFERENCES

[1] Coronavirus cause: origin and how it spreads[Online].

Available, https://www.medicalnewstoday.com/articles/coronavirus-causes.

[2] Rolling updates of COVID-19[Online].

Available,https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they- happen.

[3] Xu Z, Shi L, Wang Y, Zhang J, Huang L, Zhang C, et al. Pathologicalfindings ofCOVID-19 associated with acute respiratory distress syndrome.Lancet RespirMed2020;8(4):420e2

[4] Won J, Lee S, Park M, Kim TY, Park MG. Choi BY, et al. Development of alaboratory-safe and low-cost detection protocol for SARS-CoV-2 of the Coro-navirus Disease 2019 (COVID-19).Exp Neurobiol2020;29(2):107.

[5] Esbin MN, Whitney ON, Chong S, Maurer A, Darzacq X, Tjian R. Overcoming thebottleneck to widespread testing: a rapid review of nucleic acid testing ap-proaches for COVID-19 detection.RNA2020:076232

[6] Litjens G, Kooi T, Bejnordi BE, Setio AAA, Ciompi F, Ghafoorian M, et al.A surveyon deep learning in medical image analysis. Medical Image Analysis; 2017.

[7] Xu Y, Mo T, Feng Q, Zhong P, Lai M, Chang EIC. Deep learning of feature rep-resentation with multiple instance learning for medical image analysis. In:ICASSP, IEEE international conference on acoustics, speech and signal processing -proceedings; 2014.

[8] Brosch T, Tam R. Manifold learning of brain MRIs by deep learning. In:Lecturenotes in computer science (including subseries lecture notes in artificial intelli-gence and lecture notes in bioinformatics); 2013.

[9] Rajpurkar P, Irvin J, Zhu K, Yang B, Mehta H, Duan T, et al. Radiologist-levelpneumonia detection on chest x-rays with deep learning.arxiv2017.

[10] 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.

[11] Journal Article Kusakunniran, Worapan Karnjanapreechakorn, Sarattha Siriapisith, Thanongchai Borwarnginn, Punyanuch Sutassananon, Krittanat Tongdee, Trongtum Saiviroonporn, Pairash COVID-19 detection and heatmap generation in chest x-ray images 8 Journal of Medical Imaging S1 014001 2021 https://doi.org/10.1117/1.JMI.8.S1.014001 DOI 10.1117/1.JMI.8.S1.014001 SPIE

[12] SOM-LWL method for identification of COVID-19 on chest X-rays Osman AH, Aljahdali HM, Altarrazi SM, Ahmed A (2021) SOM-LWL method for identification of COVID-19 on chest X-rays. PLOS ONE 16(2): e0247176. https://doi.org/10.1371/journal.pone.0247176

[13] COVID-19 pneumonia on chest X-rays: Performance of a deep learning-based computer-aided detection system
Hwang EJ, Kim KB, Kim JY, Lim JK, Nam JG, et al. (2021) COVID-19 pneumonia on chest X-rays: Performance of a deep learning-based computer-aided detection system. PLOS ONE 16(6): e0252440. https://doi.org/10.1371/journal.pone.0252440

[14] The link for the dataset is

https://www.kaggle.com/tawsifurrahman/covid19-radiography-database

PLAGIARISM REPORT

Basic Information

Title	stage 1 report
Time	2021-12-02 18:54:30 (+00:00 UTC)
Words	5271

Overall Similarity

Overall Similarity	17%
Similarity degrees in local database	11%
Similarity degrees in internet database	8%

Similarity Calculation Formula

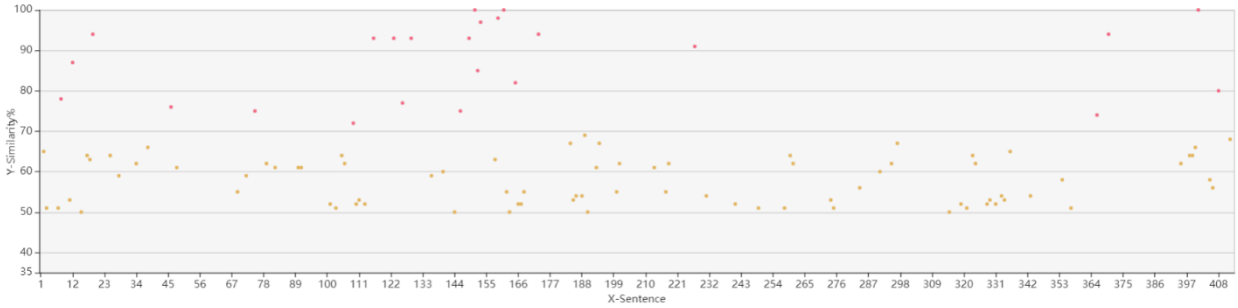
(Sentence1 similarity + Sentence2 similarity..... / n)

Sentence similarity scale from 0.0~1.0 Green sentence reprensent similarity-free

Sentences similarity distribution

≥70% 40-70% <40%

Unqualificted sentences dotted distribution map



Similar resources on local database

Highil similar resources on local has not been founded.

Similar resources on internet

1. 2.5% **Source :** Internet **Title :** COVID-19 detection and heatmap generation in chest x-ray ...
2. 1.7% **Source :** Internet **Title :** Automatic detection of COVID-19 from chest radiographs ...
3. 0.8% **Source :** Internet **Title :** SOM-LWL method for identification of COVID-19 on chest X-rays
4. 0.7% **Source :** Internet **Title :** VGG-16 | CNN model - GeeksforGeeks
5. 0.6% **Source :** Internet **Title :** COVID-19 detection and heatmap generation ... - ResearchGate