COVID 19 Disease Detection and Classification based on ResNet50 Deep Learning Technique

Dissertation

Submitted in partial fulfilment for the award of Post Graduate Degree ofMaster of Technology in Computer Science Engineering

Submitted to

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SESSION: 2022-23

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RECOMMENDATION

This is to certify that the work embodied in this dissertation entitled – "**Covid 19 disease detection and classification based on ResNet50 Deep learning technique"** being submitted by **HIMANSHI SOLANKI (0850CS18MT06)** in partial fulfilment of the requirement for the award of degree of Master of Technology in **Computer Science** discipline to **Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal (M.P.)** during the academic year 2022- 23 is a record of bonfire piece of work, carried out by him under my supervision and guidance in the Department of Computer Science Engineering

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The dissertation entitled–**Covid 19 disease detection and classification based on ResNet50 Deep learning technique"** being submitted by **"HIMANSHI SOLANKI [0850CS18MT06]"** has been examined by us and ishereby approved for award of degree of Master of Technology in **Computer Science Engineering,** for which it has been submitted. It is understood that by this approval the undersigned do not necessary endorse or approve any statement made, opinion expressed or conclusion drawn therein, but approve the dissertation only for the purpose for which it has been submitted.

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I hereby declare that the work, which is being presented in the dissertation, entitled **"Covid 19 disease detection and classification based on ResNet50 Deep learning technique"** partial fulfilment of the requirements for the award of degree of **Master of Technology in Computer Science** submitted in the department of Computer Science Engineering, **BM College of Technology, Indore (M.P.)**, is an authentic record of my own work carried under the guidance of **Prof. Mohit Jain** I have not submitted the matter embodied in this report for award of any other degree.

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(0850CS18MT06)

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Signature of the Guide

The M.Tech (Dissertation Viva –Voce Examination of **Himanshi Solanki** has been held on_____)and accepted.

Signature of H.O.D. **Signature of Director**

ACKNOWLEDGEMENT

It gives me immense pleasure to acknowledge my deep sense of gratitude to my respected guide **Prof. Mohit Jain**, Asso. Professor of Computer Science Engineering Department for his valuable guidance, complete technical assistance, critical interruptions and offering many innovative ideas and helpful suggestions, which led to the successful completion of this dissertation work. It is really fortunate that I got such an opportunity to learn everything of research from him, which will definitely go a long way in my professional career. I shall always grateful to his guidance and supervision. It has indeed been a privilege to carry out this research work under his supervision. I am thankful to **BMCT** INDORE for providing necessary support resources and possible facilities for successful completion of the work.

I am also thankful to **Dr.Ashish Joshi, Director BMCT Indore**. Their blessings are the most important strength which always lights not only my path towards success, but also source of inspirations to all the students of our Institute. I am grateful to all teaching and Non-teaching staff of **Computer Science Engineering Department** for their timely help and co-operation as well as valuable academic support. I would like to showmy sincere gratitude to my family for their constant support, love, guidance, and motivation throughout my life. Last but not least, special regards to all who helped me in any form to complete my work.

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Date 27 APR 2023

:: शपथ - पत्र ::

मैं उक्त शपथग्राहीता हिमांशी सोलंकी पिता श्री महेन्द्र सोलंकी आयु- 27 साल, निवासी- 614 जनता क्वार्टर, नंदा नगर इन्दौर म.प्र. का होकर निम्न शपथपूर्वक कथन करती हूँ कि :------

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इन्दौर दिनांक- 27/4/2023

हस्ता- शपथग्राहीता

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Abstract

The COVID-19 disease caused by the SARS-CoV-2 virus has become a global pandemic. Early and accurate detection of COVID-19 is crucial to control its spread. In recent years, deep learning techniques have shown great potential in medical image analysis tasks, including disease detection. In this regard, a study was conducted to detect COVID-19 from chest X-ray images using the ResNET50 deep learning model. The ResNET50 model was trained on a dataset of chest X-ray images, which included normal and COVID-19 infected cases. The results of the study showed that the ResNET50 model achieved an accuracy of 92 % in detecting COVID-19 from chest X-ray images. The study concluded that the ResNET50 model has the potential to be a valuable tool for the early and accurate detection of COVID- 19, which can aid in the effective management of the disease.

CHAPTER 1
INTRODUCTION

1.1 Overview

The Worldwide Health Regulations Emergency Committee of the WHO declared a "public health emergency of international concern" on January 30, 2020. This was because the newly discovered COVID-19 coronavirus was causing an outbreak of a disease. (COVID-19), which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has become an unprecedented public health problem. It has spread to every continent where people live. In October 2020, the Corona virus Re-source Centre at the Johns Hopkins University School of Medicine [1] said that more than 40 million people around the world had been infected with COVID-19. More than a million people died as a result of this. This virus is very easy to spread from one person to another through coughing, sneezing, and breathing droplets. This virus moves quickly from person to person, which is why it has spread so quickly. The condition usually causes fever, coughing, and shortness of breath. It can also cause pneumonia, organ failure, and death.

As of today, a final answer has not yet been found for COVID-19. Most of the steps that have been taken, both on a national and a personal level, have been made to stop this infection from spreading to more people. It makes sense that the first steps taken to stop SARS-CoV-2 from killing people were harsh ones, like movement bans and closings. Due to the uncertainty about how SARS-CoV-2 spreads and the high certainty about how dangerous it is, the SARS-CoV-2 outbreak began in 2003.

Because the number of cases is going up, there is an immediate need to improve both medical and economic skills to fight this life-threatening disease. So, the job of the scientific community right now is to find, through inference and simulation, ways to protect people as well or better than the current system, but at a lower cost to society as a whole (Cobey, 2020). Many medical fields are putting more and more emphasis on machine learning strategies. This could create an environment that is good for growth and progress.

WHO, scientists, and doctors in the medical field are looking for new ways to screen infected patients at different stages, find the best clinical trials, stop the spread of this virus, make a vaccine that will cure infected people, and find their contacts. This is being done to help stop the global pandemic of novel diseases that is happening right now. In this case, the job ofdata science is to help speed up the process.

On March 16, 2020, the White House, in collaboration with other research institutes and technology businesses, issued a call to artificial intelligence researchers located all over the world, asking them to submit their ideas for improving AI.asking them to come up with new ways to mine text and data to help with COVID-19 research.

The COVID-19 Open Research Dataset is an open-source dataset that is updated every week. It was made by the Allen Institute for Artificial Intelligence and other well-known research organizations. This dataset keeps track of articles about COVID-19 so that new research projects that need real-time data as soon as possible can move faster. Every day, hundreds of research teams work together to gather information and look for possible answers.

Since the start of the pandemic, we've been able to use machine learning's ability to predict, which has been very helpful in many situations, including the fight against the viral epidemic. People in every part of the world are gathering and sharing information about the virus at a rate that has never been seen before.

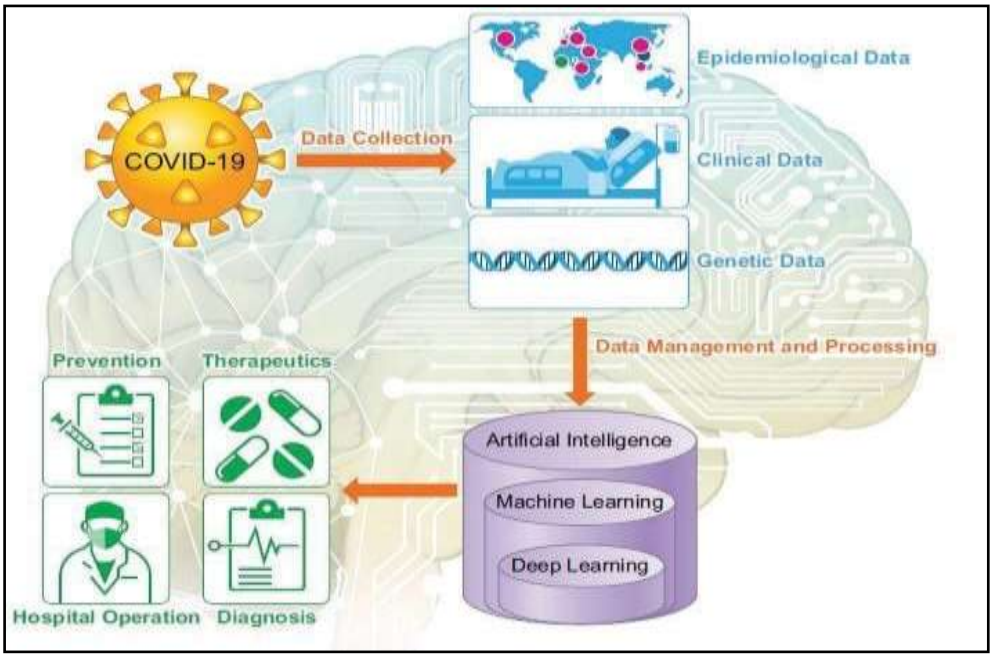

Figure 1.1: Role of AI in COVID-19[8]

It's also important to talk about the work being done in Europe, especially by the ELLIS Society [4], whose goal is to boost economic growth in Europe by making the most of the fact that AI technologies are used by a lot of people. Bringing

together the best minds in academia in Europe and the basic researchers in industry. The ELLIS network helped with

this paper by putting together their research projects related to COVID-19, some of which aredescribed below.

1.1 Background

In general, COVID-19 can be diagnosed using a number of methods, such as those based on nucleic acids and using polymerase chain reaction (PCR). In addition to next-generation sequencing, CT scans, chest X-rays, and paper-based methods can be used to find cancer (Harris et al., 2013). Patients may have to go through these pathological tests so that doctors can keep an eye on the changes that are happening in their organs. The most common of thesepathological tests are the CT scan and the chest x-ray (D). The CT and X-ray chest methods used to diagnose COVID-19 each have their own benefits that make them different from each other. For example, compared to other technologies, the CT gives more information about the patient's condition in a very short amount of time. If you use a chest X-ray to find out the results, you can get them for less money and with less radiation. But these technologies have some problems that can make them less useful or effective. For example, nearby bone can mess up CT scans of the brain, and X-ray chest scans don't show information in three dimensions.

Unfortunately, COVID-19 has not yet been diagnosed with a method that is both accurate andquick. Medical images like CT scans and X-rays are often used to figure out what COVID- 19.An expert looks at these pictures and makes a diagnosis based on what he or she already knows and how much experience they have. In general, doctors have to work long hours, which can make them tired, which can cause them to make a wrong diagnosis. Patients with COVID-19 may have abnormal CT or CXR results, and COVID-19 is a symptom that is similar to many other lung diseases.

Also, a normal result from a CT scan or CXR does not mean that the patient does not have a COVID-19 infection. Because of this, the health care industry has to use tools to help make sure that the diagnosis is correct. Based on the ideas of AI, new ways of finding COVID-19 have been put forward. DL and machine learning are two of these methods. The results of these methods are expected to be both faster and more accurate (ML).

Different scholars came up with the ML and DL methods that have been used for a long time to help medical professionals make accurate diagnoses. Using these methods, X-rays or CT scans of the chest can be separated into two groups: those that show an infection and those that show normal anatomy. A conclusion is reached after a number of steps have been taken, such as interpreting an X-ray image, preprocessing and extracting unique features from input photos, and then feeding these features into a machine learning or deep learning model to make a final prediction. COVID-19 data can be used to predict how an outbreak will spread,and artificial intelligence can be used to predict where red zones will be and how many people will get sick. These are two of the other reasons why these techniques are used. Based on X-rays and CT scans, COVID-19 patients are examined using a number of AI techniques, such as DL and ML.

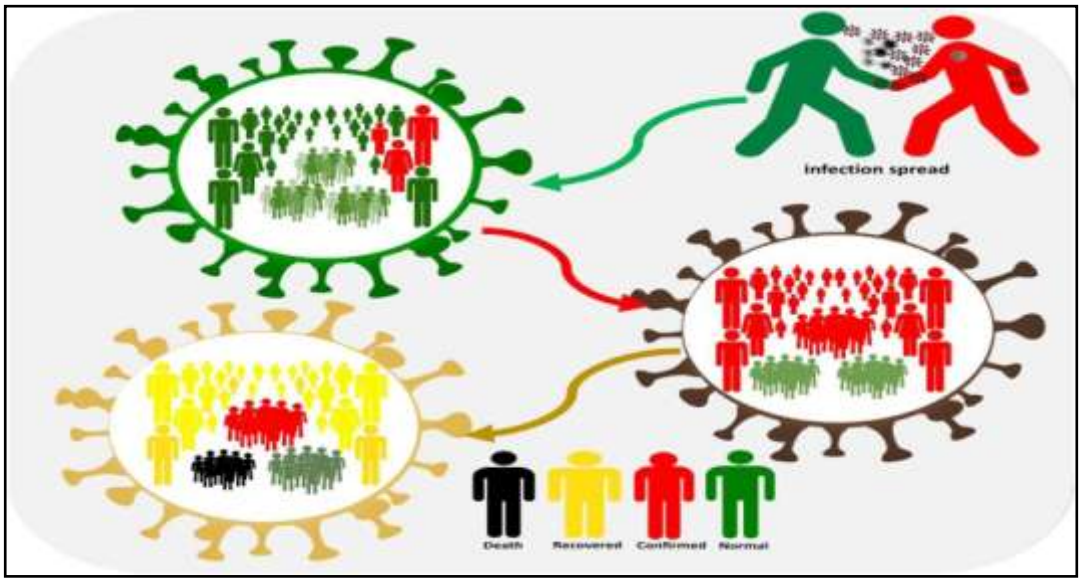

Figure 1.2 COVID-19 Person to person spread [5]

1.2 State of the Art

Recent research has shown that machine learning (ML) is a promising technology that is usedby many healthcare sources because it is more scalable, speeds up processing power, is reliable, and can do some healthcare tasks better than humans . Because of these benefits, ML is used by many healthcare sources.

According to the American Physiological Society, large amounts of data from COVID-19 patients can be combined and analyzed by complex machine learning algorithms to learnmore about how viruses spread, improve the speed and accuracy of diagnostics, find new ways to treat diseases, and maybe even figure out who is

most likely to get sick based ontheir genetic and physiological traits. [6]

AI is getting better at things that were once thought to be the job of humans. This is changing because of recent improvements in digital data collection, machine learning, and computer communications.

For example, the use of ML approaches in radiology is a big step forward in terms of both the quality and quantity of clinical image interpretation and the way that large amounts of data are handled for imaging research. Even though ML and DL have been shown to be effective at identifying pictures and lesions, radiologists are still hesitant to use these new apps (Noguerol et al., 2020).

The fact that machine learning could help radiologists create more efficient imaging workflows or even replace them completely shows how useful technology is in the field of radiology. The results of deep learning algorithms are about the same as those of a radiologist who has had professional training.On the next few pages, there is a comprehensive review of some of the most recent studies that have been done to deal with the new COVID-19pandemic by using ML techniques in different areas, such as screening and diagnosis, tracing contacts, developing drugs and vaccines, and predicting and forecasting for COVID-19. ML techniques have been used in different parts of these studies to help deal with the new COVID-19 pandemic.

1.3 Challenges

COVID-19 infections typically result in a high fever, a dry cough, and difficulty breathing. Some individuals may have muscle soreness, fatigue, and a loss of taste or smell (anosmia). GI (gastrointestinal) symptoms such as diarrhoea may occur in up to 10% of individuals [7]. Physical contact, as previously thought, could be one mechanism for the virus to travel from one person to another. So, avoiding persons who may be affected can reduce your chances of being unwell. A disease can spread up to six feet. As a result, one of the most important ways that the disease spreads is through the respiratory droplets that an infected person exhales when they cough or sneeze. COVID-19 symptoms may not appear at all in some persons. How may COVID-19 be transmitted from one person to another when there is no social gap between them?

1.4 Computer Vision

Computer vision is a branch of computer science that focuses on making digital systems that can process, analyze, and understand visual input in the same way that humans can. The basicidea behind computer vision is to tell a computer how to look at images pixel by pixel so it can understand what it is seeing. In a nutshell, computers try to get visual information, process it, and figure out what it means by using special software algorithms. Computer vision In contrast to artificial intelligence (AI) techniques like neural nets, which have been used a lot since the 1940s, computer vision techniques didn't really start to take off until the late 1960s and early 1970s. This paper suggests an AI model to assist hospitals and healthcare facilities in prioritizing patients for hospitalization, triaging patients when the system is overloaded with patients, and removing delays in providing the required care.

in turn, led to a huge increase in the amount of money being put into AI-based businesses andservices. In [8], an in-depth look at how artificial intelligence (AI) is changing new businesses and start-ups from the past five years is given. A way of looking at data has been shown. Systems that use computer vision can be used to:

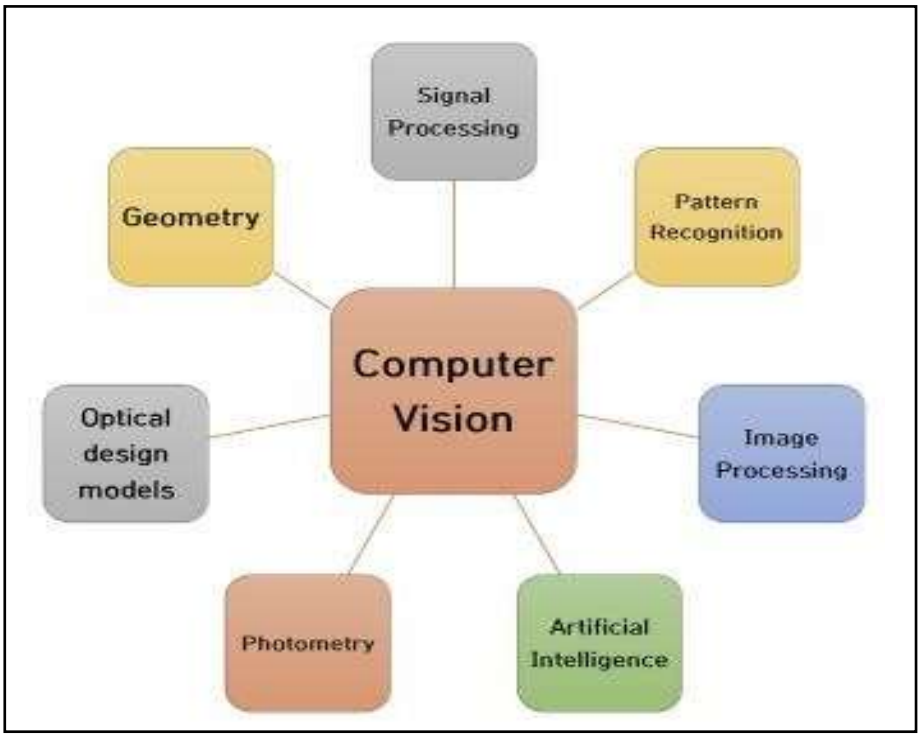

Fig 1.3 Computer Vision

Object classification. The system analyzes the visual content and categorizes the things inthe photograph or video. For example, among all the objects in an image, the algorithm can find a dog.

Object recognition. The system analyses the visual content and recognizes specific objects in the image or video. For example, the system can find a particular dog among the dogs inthe picture.

Object tracking. The system examines the footage to identify things that meet the parameters for the search and monitors their motion.

Computer vision systems (CVS) have the ability to replace manual (visual) inspection methods and have thus achieved widespread acceptance in industries as a tool for evaluating the quality of a wide variety of agricultural products. Computer Vision is a topic of study concerned with the development of systems that enable computers to "see" and comprehend the content of digital pictures such as photographs and videos. The objective of computer vision is to mimic and replicate human vision at various levels using computer software and hardware. CVS is computerized, allowing for low-cost, fully automated quality evaluation systems to replace manual inspection methods, eliminating errors and discrepancies in results. Their use can also help to reduce the tediousness of manual inspections.

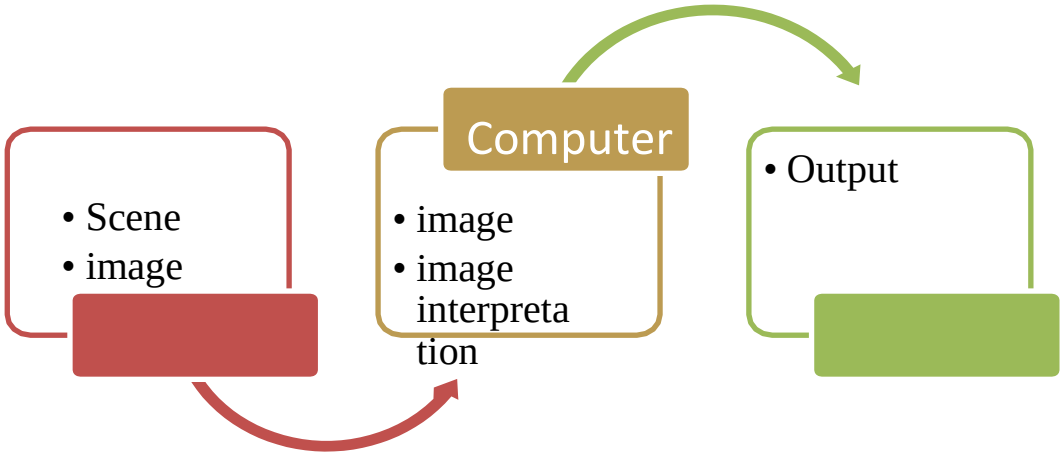

Figure 1.4 Computer vision block-diagrams

1.4.1 How Does Computer Vision Work

The technology behind computer vision is intended to function in a manner analogous to the brain. But how exactly does our brain process the recognition of visual objects? One prominent idea proposes that in order to decode specific items, our brains make use of recurring patterns. Utilizing this idea results in the construction of a computer vision system. We require a large amount of visual data in order to train the computer; the computer looks at images, marks stuff on them, and searches for patterns in the objects that are marked. In the event that we provide the computer with one million photographs of flowers, for instance, it will examine these images, identify patterns that are shared by all flowers, and ultimately create a "flower" model as a result of the process. Because of this, anytime we submit the computer a picture, the computer is able to accurately assess whether or not the picture depicts a flower.

Image Processing and Computer Vision, Golan Levin provides technical insights regarding the technique that machines use to understand images. In a nutshell, the machine sees each image as a collection of pixels, each with its own set of color values.[9] A photograph of Abraham Lincoln, for example, is shown below. Each pixel's brightness is represented by a single 8-bit value ranging from 0 (black) to 255 (white) (white). These are the numbers that the software sees when you upload an image. This information is fed into a computer vision algorithm, which does further analysis and makes decisions.

1.4.2 The Evolution of Computer Vision

Computer vision is not a new technique; it was initially used to analyze typewritten andhandwritten text in the 1950s. The computer vision analysis programmed was simple at the time, but it required a lot of manual input from human operators who had to submit datasamples for analysis.

1.5 Medical Image Analysis

One of the most talked about uses of deep learning is how it can be used to help and automate the analysis of medical images. These systems are being improved quickly and are being tested in clinical settings right now. We tell people to look at Topol's guidelines for AI clinical research, which look at what can be learned from a variety of clinical fields. [84]. The main thing we talk about when we talk about medical image diagnosis for COVID-19 is how to classify pneumonia, viral pneumonia, or healthy chest radiographs. A lot of research is done on the Semantic Segmentation challenge, which involves putting each pixel in an image into a category. We talk about how semantic segmentation can be used in our"Interpretability" section, which is about ways to make interactions between humans and AI better. For the purpose of our investigation, chest radiographs are made from either X-rays or CT scans with a higher resolution. Fang et al. (1) find that CT detection is 98% sensitive, while RT-PCR is only 71% sensitive. This finding shows that radiographs are a good way to make a diagnosis. did chest CT and RT-PCR tests on a total of 1014 people for this study. The researchers came to the conclusion that "chest CT may be thought of as a major method for identifying COVID-19 in areas where it is currently spreading." There are many reasons why chest X-rays are better than CT scans, and it's important to point out some of them. Some of these reasons are that chest X-rays are cheaper, easier to get, and give off less ionising radiation than CT scans do.

1.5.1 COVID-19 Diagnoses Using Deep Learning

Machine learning, which is also known as ML, is being used more and more in many different fields, such as finding malware. There are mobile apps that can find malware ,get medicine, and give information. Deep learning is a cutting-edge machine learning method that was first shown in 2012 and is based on the idea of a (CNN). It won the ImageNet classification contest, which is thought to be the most important computer vision contest in the world. Deep learning algorithms let computer models learn how to represent data by moving through different layers of abstraction. These models are made up of several layers of processing. They teach a computer model to do classification tasks directly from images, texts, or sounds. Large numbers of people can do this. Says that deep learning models are very accurate and have the potential to make people more productive in certain situations.

1.5.2 X-Ray Diagnosis Using Deep Learning

X-ray machines can look at parts of the body that have been damaged by lung cancer, broken bones, or other illnesses. They do this by using either light or radio waves as a source of radiation. This makes it possible to make better diagnoses. During this procedure, CT scans, which are very advanced X-ray machines, are used to look at the soft structures of working body parts in order to get a clearer picture of the organs and soft tissues themselves. The point of this process is to find out if the person has cancer or not. X-rays are better than CT scans because they can be done in less time and are less difficult, dangerous, and complicated than CT scans. A CNN-based model was made to find COVID-19 patients by looking at a total of 100 chest X-rays, 50 of which were from people with COVID-19 and the other 50 from healthy people. This was done by looking at the chest X-rays of people who had the virus and people who were healthy. These pictures were used by the model to find COVID-19 patients. Deep learning was used to pull out features from chest X-rays, and a support vector machine was used to decide whether the images were healthy or sick.did a study just like this one, and the images were put into categories using deep learning.

1.5.3 CT Scan Diagnosis Using Deep Learning

Godfrey Hounsfield and Allan Cormack were the ones who thought of the CT scan in 1972. It uses cutting-edge X-ray technology to give a full look at the sensitive organs inside the body. CT scanning is fast, doesn't hurt, doesn't hurt the patient, and is accurate. It can also make (3D) images. When it comes to internal organs, muscles, soft tissues, and blood vessels, conventional X-rays aren't as clear as CT scans. This is especially true for soft tissues and blood vessels. Standard X-rays are not as clear as CT scans. The biggest problem with CT scans compared to X-rays is that they are much more expensive. Concerns have been raised by several studies about how sensitive and specific RT-PCR is when it comes to identifying COVID-19. (RT-PCR) is the best method for this, but it gives a high number of false negatives for a number of different reasons. Some of these reasons are problems with the methods, the stages of the disease, and the ways in which the samples are collected. This makes it take longer to findand treat diseases. Because of this, RT-PCR tests are not good enough to tell how the disease is doing right now. Recent research has shown that testing with nucleic acids is not reliable and can only be accurate between 30 and 50% of the

time. Paired RT-PCR with CT scans and looked at 51 people (29 men and 22 women) who had been to or lived in endemic areas and had severe respiratory and fever symptoms for which the cause was unknown. All of the patients had severe breathing problems and fever, but no one knew why. Scientists found that a non-contrast chest CT scan can find COVID-19 98% of the time. This is a big improvement over RT-PCR, which could only find COVID-19 71% of the time at first. Since there aren't enough RT-PCR kits and the number of COVID-19 cases keeps going up, an automated detection system is needed as an alternative way to diagnose the disease to stop it from spreading. In the meantime, [15] used a deep-learning strategy to automatically find COVID-19 patients and look at CT scans to figure out how much disease they had. They did this by looking at CT scans from 157 patients from China and the US. Radiology professionals can use X-rays or computed tomography (CT) to get useful images that can help them figure out what COVID-19 is. But CT by itself may not be able to rule out SARS-CoV-2 infection very well. This is because, in the early stages of the disease, some people may have normal radiological results.The World Health Organization (WHO) says that the most accurate way to find out if someone has COVID-19 is to use RT–PCR to look for nucleic acid in secretions from a throatswab.

1.6 Data

There are two different kinds of images in the data: those of patients who were found to have no signs of disease and those of patients who had signs of a COVID-19 infection. People who have been diagnosed with the coronavirus disease are called "positive," while people who have not been infected with the disease are called "negative." I will use this terminology to talk about the two different kinds of patient photos. The pictures of happy people were taken in hospitals in Spain, Italy, and other European countries. The negatives were taken in the United States and Canada, and they were once used to diagnose pneumonia in X-ray imagesin the United States and Canada. Figure 1.5 shows a patient whose COVID-19 test comes back positive, as well as a patient whose test comes back negative. As can be seen, it is not easy to tell which X-rays of patients show that they are sick and which show that they are healthy.

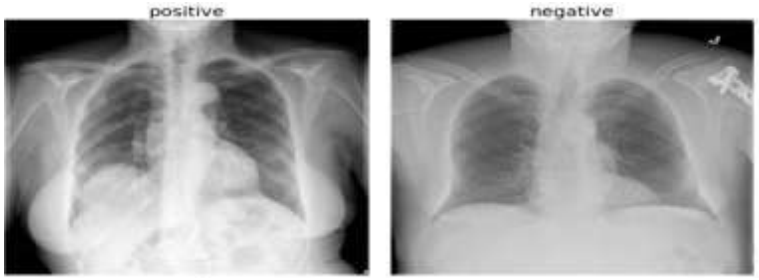

Figure 1.5 X-ray Images of COVID-19 Positive and Negative Patients [16]

After looking at the photos to see how good they were, it was found that most of them were fine, but some of them couldn't be used. Figure 1.5 shows a good example of this type. The real X-ray only makes up a small part of the picture; most of it is just empty space. The fact that X-rays are made up of 299 by 299 arrays of pixels can be used to filter these images. The value of each pixel can be between 0 and 255. Because of this filtering, images with more than 35% of their pixels set to 0 were taken out of the dataset.

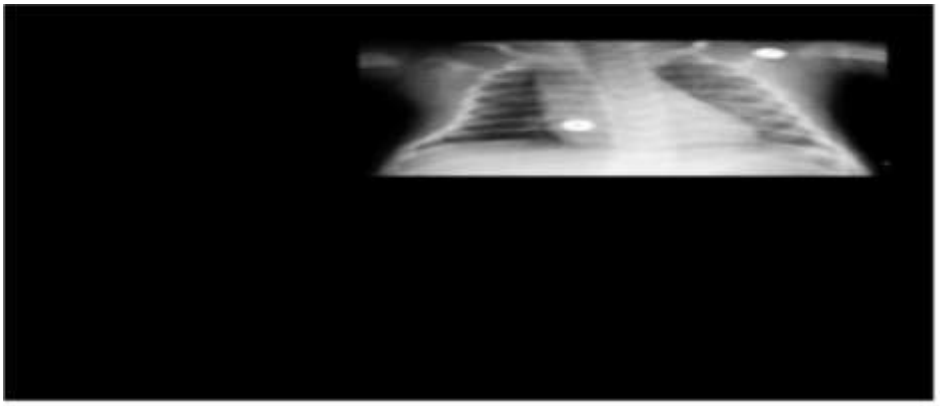

Figure 1.6: Example of Unusable Image [16]

The total number of photos in the final collection is 13,767, of which 3,605 are positive and 10,162 are negative. Figure 1.5 illustrates this by showing that around 74% of the images are negative and 26% are positive. This suggests that there is a class imbalance in the data. Since the prevalence of an illness might sometimes be low in a population, there will frequently be an imbalance in some classes of medical data. The performance of a model can frequently be hampered by this imbalance; hence precautions are taken to reduce the impact when developing the model.[17]

1.7 Deep Learning

People have been interested in the idea that computers could have intelligence like

that of humans since ancient times. In Greek mythology, the home of the god Hephaestus was

accompanied by a pair of golden maidens made to look like humans and given the ability to see, speak, and think. The passage of time and the development of new technologies have made it possible to make things that are close to these old dreams. [18] Artificial intelligence has been around since the 1950s, when computer programmers were written with hard-coded rules to make them act like they were smart.

By the 1990s, a branch of artificial intelligence called "machine learning" had become one of the most popular kinds of AI. Using machine learning models, input data can be turned into useful outputs. These models do this by learning ever more meaningful representations between inputs and outputs that they already know. One part of machine learning has becomeuseful because of changes in computer technology and a huge increase in the amount of data that is now available. This subfield, which is often called "deep learning," is "deep" because ituses increasing levels of abstraction to learn how to represent data. A popular way to put this theory into practise is with a neural network that is set up as a hierarchy of layers.

Corona viruses can make you sick with things like the common cold. Both MERS and SARS are caused by corona viruses called MERS-CoV and SARS-CoV, respectively. In 2002, the first case of SARS was found in China, and in 2012, the first case of MERS was found in Saudi Arabia .[19] SARS-COV-2 is the most recent strain of the SARS-COV virus to be foundin Wuhan, China. It causes corona virus.

Since then, both the number of people infected with the Corona virus and the number of people who die from it have been steadily going up. The Corona virus went from one city to the whole country in just 30 days . On February 11, this year, the World Health Organization (WHO) gave it the name COVID-19.).[20]

1.8 Dataset Description

CORD-19 is a database with more than a million scientific papers about COVID-19, SARS- CoV-2, and other corona viruses that are similar. Over 400,000 of these sites have the full text of the articles. The global research community has been given access to this public dataset so that they can use recent advances in natural language processing and other AI techniques to come up with new ideas that will help the fight against this infectious disease. Because of how quickly new corona virus research is

being published, making it hard for the medical research community to keep up with what's going on, these approaches are becomingmore important.

1.9 Motivation

This thesis uses machine learning approaches to determine whether a person has COVID-19 or not. Utilizing the patients' clinical data, the prediction is made. The objective is to determine whether a patient might be diagnosed with COVID-19.
Therefore, DL models are competent to handle challenging problems in the sophisticated clinical field. In terms of forecasting COVID patients' outcomes, DL is becoming more and more in demand. Start by considering concepts like mimicking the operation of the human visual system by comprehending the various ways that camera schematics, projections, and photogrammetric work.

1.10 System Requirements

MATLAB® is a state-of-the-art communication language and communication environment for the development of algorithms, graphics, data processing, and numerical calculations. Technical programming problems can be solved faster with MATLAB than with traditional languages such as C, C++.

MATLAB is a data analysis and visualization programme that heavily favors matrix and matrix functions in its design. MATLAB not only has good graphics and a powerful programming language. MATLAB‘s use of Matlab assemblies to support such tasks may be explained by the fact that they are such a powerful tool. These assemblages are known as tool boxes, and the image processing box is the one that draws our attention. In addition to discussing all of Mat Lab's work, we only discuss aspects of image processing. We will inform our jobs, orders, and techniques if necessary. MATLAB functions are keywords that accept a variety of parameters and generate a variety of products, such as matrices, strings, and images. Such works include, for example, sin, illness, and exile. We find it easy to write our own methods in MATLAB, which has a lot to do with its (sometimes necessary). The regular MATLAB data structure is matrix all. The information is viewed as a matrix. The image is clearly a matrix, with the pixel grey values as its constituents (or possibly RGB values). MATLAB treats a single value as a matrix, but a character matrix is a series. It's the length of the string.

1.11 Aim and Objectives

The datasets of COVID-19 patients can be integrated and analyzed by deep Learning (ML) algorithms to improve diagnostic speed and accuracy better and potentially identify the most susceptible people based on personalized clinical and laboratory characteristic

Objectives:

This work discusses the scenarios for providing vaccination to the people based on the following issues:

1. Collect and curate COVID-19 patient data from kaggle website
2. To preprocess the data to ensure that it is clean, standardized, and in a format suitable fordeep learning model.
3. Train deep learning model such as ResNet50 on the COVID-19 patient data to identifypatterns and insights.
4. Evaluate the performance of the deep learning models using various metrics such asaccuracy, precision, recall, and F1 score.
5. Analyze the results and identify actionable insights that can inform the diagnosis,treatment, and management of COVID-19.

CHAPTER 2
LITERATURE SURVEY

A short review of AI application for covid-19 is presented. In a review on the potential of using AI in developing countries is performed. A review on automatic detection and forecasting of covid-19 using DNN algorithms is performed. Survey on AI- based algorithms for combating the pandemic is performed. A review on machine learning algorithms in processing medical images regarding the disease can be found a review on AI approaches on management of covid-19 can be found in. In a review on data- driven methods for monitoring, modeling and forecasting the pandemic is presented. In a survey on epidemic models for the disease is presented. [21] A discussion on how big data can help better manage the pandemic is presented in a review on the data science approaches to combat the disease is presented. An overview of recent studies using machine learning in tackling the disease is presented in. A review on the research on using machine learning algorithms in predicting the number of cases is presented in. [22] A review on the application of AI in discovering drugs can be found in I review is performed that covers the research on application of AI is managing critical covid-19 patients.

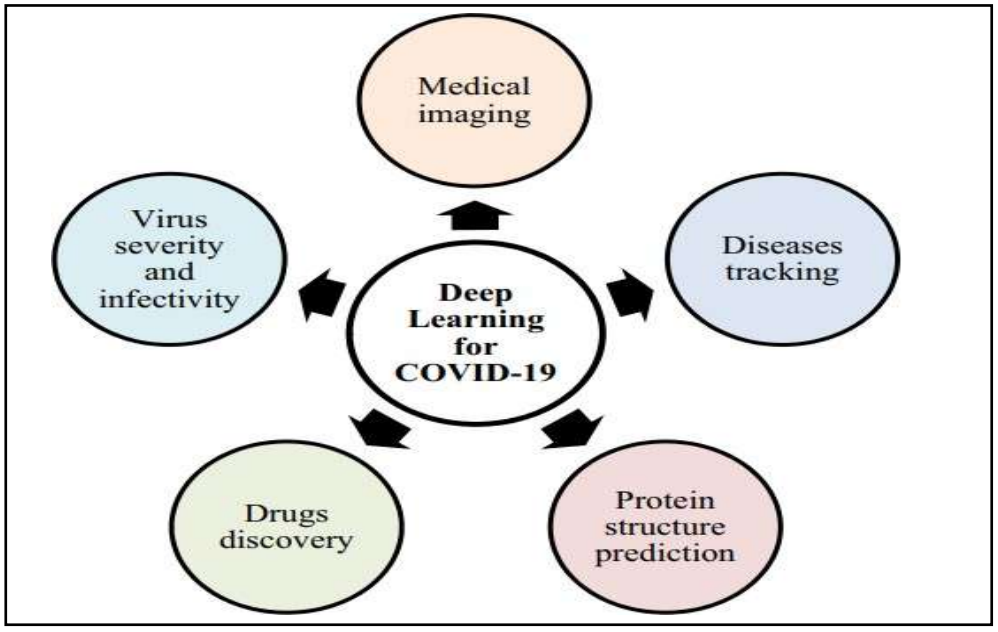

Fig 2.1 deep learning techniques to control COVID

In December 2019, the COVID-19, were found for the first time in Wuhan, China . On March 11, 2020, the WHO said that there was a pandemic .Based on what we know now, at the end of December 2019, a cluster of patients showed signs of

pneumonia with an unknown cause and respiratory symptoms. These symptoms were caused by a new virus.[23] the name of the market in question was "Huanan Seafood Wholesale Market." At first, the new virus was called "2019 novel Corona Virus" (2019-nCoV), but it was later renamed "Severe Acute Respiratory Syndrome Coronavirus type 2." (SARS-CoV-2). Patients with the virus may or may not have any symptoms, which can range from mild .Patients who have the virus can either have no symptoms or show symptoms. The SARS-CoV-2 virus caused a contagious illness called COVID-19, which is short for "coronavirus disease."

The COVID-19 pandemic has had a big effect on many parts of global society, such as the economy, education, transportation, politics, and many others. People who have COVID-19 usually get sick with a respiratory illness, but they can get better if they get treatment that is both effective and right for them. The main reason why the COVID-19 Corona virus family is The COVID-19 Corona virus is so much more harmful and contagious than other Corona virus families that it has proven exceedingly effective at transmitting from person to person. Since the disease has spread to 210 countries and territories around the world, it is known thatmore than 2 million people have it. The disease was first found in India on January 30, 2020, in the state of Kerala. It was found in a student who had just come back from Wuhan.

In light of the current worldwide health crisis, the medical field is looking into new ways to track and control the spread of the Corona virus pandemic. Artificial intelligence (AI) is one of these technologies, and it can easily track how the virus spreads, find people who are at a high risk of getting it, and help control the infection in real time. It can also estimate the risk of death by looking at the data of patients who have died in the past in the right way. AI can help us fight this virus by scanning the public, giving medical help and warnings, and makingsuggestions for stopping the spread of the virus [24]. Since it is a medical tool based on evidence, this piece of technology could improve the COVID-19 patient's treatment planning,treatment, and the results that are reported.

Recent advancements in computational techniques and information and communication technologies (ICTs) have made it possible for artificial intelligence (AI) and big data to assist in managing the enormous and unprecedented volume of data generated by public health surveillance, real-time monitoring of epidemic outbreaks, trend now casting and forecasting, regular situation briefings and updates from government institutions and other organizations.

2.1 Background and Motivations

The principles of COVID-19, AI, and big data are covered in this part. This section also explains the rationale for using AI and big data to combat the COVID-19 epidemic.

2.2 COVID-19 Pandemic

There are no signs that the number of people getting sick or dying will go down or that the situation will be resolved. According to the European Centre for Disease Prevention and Control's most recent data [25], there have been 1,853,265 confirmed cases and 118,854 deaths. About 46.2% and 66.7% of the total cases have been in European countries (accurate as of April 14 2020). In a more alarming way, the CoronaBoard1 says that the number of new cases is still very high: between 83,039 and 6,295 infected and dead patients each day, while the death rate is 6.34 percent. Because the COVID19 situation is so serious, the Organization WHO has raised the risk assessment to the highest level and called it a pandemic. We would like to point any interested readers to the publication [26] so that they can learn more about the COVID-19 virus, including its structure, where it came from, how it causes disease, what it looks like, and what is being done to treat it now. Because COVID-19 has had such a big effect all over the world, many people have tried to find ways to stop it from spreading. The main thing that will determine whether or not the pandemic will be stopped is what the government does. These efforts include locking down the (partially infected) area to stop the disease from spreading, making sure that the health care system can handle the outbreak, putting together a crisis package to help the economy and people, and making sure that policies are flexible enough to deal with the COVID-19 situation. At the same time, people are told to stay healthy and protect others by doing things like wearing a mask in public, washing their hands often, keeping to the social distance policy, and telling the regional health centre about their most recent symptoms [27]. [Needs citation] On the other hand, research and development projects related to COVID19 have recently become a top priority, and they have gotten a lot of help from a wide range of groups, such as governments, businesses, and academic institutions. Some early steps have been taken by computer scientists to fight the COVID-19 coronavirus. All over the world, people are also working on making an effective vaccine and treatment for the COVID-19

coronavirus. We offer cutting- edge AI and big data-based strategies and techniques for fighting the COVID-19 coronavirus

disease. This work was done because AI and big data have been so successful in a lot of different fields.

2.3 Artificial Intelligence

Artificial intelligence (AI) is a technology that is developing quickly and has many smart uses in many different fields. Some important uses of artificial intelligence include self- driving cars and drones in the auto industry, medical diagnosis in the health care industry, cyber security systems (like finding malware and botnets) in the financial industry, artificial intelligence banking in the financial industry, image processing, natural language processing, and modulation classification in wireless communications are included in computer vision's image processing and natural language processing. AI is a powerful tool that can be used to fight back against the COVID19 pandemic.

For example, the researchers in [28] made a deep learning model to find commercially available drugs for the "drug-repurposing" process, which is also called "drug repositioning." This process involves finding a quick drug strategy that uses already-made drugs and can be used right away on people who have a disease. This research was started because it usually takes a few years for new pharmaceuticals to be tested and approved before they can be put on the market. Even though the results of this study haven't been proven to be useful in clinical settings yet, they do suggest new ways to treat COVID-19. Insilico Medicine said in

[29] DL was utilized for image processing to accomplish this. This work shows a quick wayto find out which COVID-19 patient is infected. This could be a big help in making sure that the patient gets medical care and is quarantined as soon as possible. The last example shows how AI can be used to predict in real time how many people in China are infected with COVID-19 . The AI-based strategy proposed in is useful for improving health and policy measures and keeping an eye on the COVID-19 outbreak because it is so accurate. In addition to the uses listed above, the participation of big technology companies is important because it lets researchers, clinicians, and scientists get the kind of effective support they need to speed up COVID-19 viral research and development. Recent news from IBM [30] showed that

the company is now offering a research resource that is hosted in the cloud and was trained using the CORD-19 dataset. IBM has also used their proposed AI technique for drug discovery, which has led to the creation of 3000 unique COVID-19 compounds, as shown in an official publication [31].

2.4 Applications COVID-19 Epidemic

The COVID-19 outbreak presents the Artificial Intelligence (AI) Community with a variety of issues. Among these difficulties are:

–Can AI help track and predict the spread of the infection?‖

- –Can AI help in making diagnoses and prognosis?‖
- –Can it be used in the search for treatments and a vaccine?‖
- –Can it be used for social control?‖

This study attempts to present an early evaluation of the contributions made by AI in this area to date and to highlight any drawbacks, limitations, or difficulties. The Covid-19 outbreak is being fought off using a few exemplary applications of AI in this area.[32]

2.5 AI for Screening, Detection and Diagnosis of COVID-19

Countries with rising COVID-19 infection rates face a big problem because they don't have enough screening, detection, and diagnosis facilities. People with mild symptoms often don't know they have the disease, which makes capacity management and social isolation even harder. The creation of tools for remote computational diagnosis is an important use case. Some of these ideas already exist and could be made even better. For example, Babylon is an app for smartphones that gives medical advice in the form of questions. Other methods could use important data from wearable or other monitoring devices, like the mobile app COVID- 19 Sounds, which records sounds of breathing symptoms to help doctors figure out what's wrong [33]. Our idea is that this kind of research will be especially helpful in developing countries that don't have enough medical facilities [34]. Automated technologies can also be made to make screening larger groups of people easier (for example, at airports). For example, thermal imaging based on computer vision can be used to spot fever. One way to do this is to look at pictures of people's skin temperatures with computer vision.AI can quickly analyse unusual symptoms and other so-called "red flags" to

warn both the patient and the right healthcare professionals. It helps people make decisions faster, which is better from a financial point of view [35]. By using a number of relevant algorithms, it helps to come up with a new way to diagnose and treat COVID 19 patients. Parts of the human body are scanned using computed tomography (CT) and magnetic resonance imaging (MRI) techniques.AI can help doctors figure out what's wrong with people who are sick. This is possible because medical imaging technology has come a long way.AI can make it easier to figure out what's wrong with people with COVID-19. For instance, Infervision is a start-up company that uses deep learning medical imaging platforms to help COVID-19 cases be quickly identified by recognising certain lung features.

2.6 Assessment of Risk and Patient Prioritisation

The world's health care systems are being pushed to their limits in ways that have never been seen before .Because of this, it is important to quickly figure out and deal with the risks that patients pose while also allocating resources well. During times of high demand, this has to be done quickly and accurately, which is hard for doctors and nurses who sometimes don't even have access to patient information from before. Researchers have already made algorithmic risk assessments for diseases like cancer, diabetes [36], and heart disease by using Artificial Neural Networks. (ANNs). Because COVID-19 patients may have a wide range of symptoms and illness progressions, it would be helpful to do research on technologies that can perform data-driven risk assessment and management of the condition in each patient. For example, things like age, gender, or the current state of health could be used to make an estimate of the chance of dying. This is very important when there aren't enough resources, like when there aren't enough supplies for the ICU and patients have to be put in order of importance [37].

2.7 Monitoring the Treatment

AI makes it possible to build an intelligent platform that can automatically watch for and predict how a virus will spread. It is also possible to make a neural network that can identify the visual signs of this disease. This would help doctors keep track of and treat patients with this disease more accurately [38,]. It can give day-to-day updates on the patients and suggest treatments that can be used if a COVID-19 pandemic happens.

Contact tracing of the Individuals-AI could help figure out how many people are infected by this virus by finding clusters and "hot spots," as well as by successfully tracking down people's contacts and keeping an eye on them. It can predict how the disease will change in the future and if it will come back.

2.8Automated Patient Care

People may benefit from getting information from these networks about the outbreak, its symptoms, ways to stop it, and other related topics. For example, the World Health Organization (WHO) and Rakuten Viber have worked together to create an interactive chatbot that can answer questions about COVID-19 in a number of languages [39]. There's also a chance that automated health care technologies could be used to help keep an eye on COVID-19 patients who are getting emergency care.

2.9 Controlling Rumours, Misinformation & Online Harms

Incorrect information could hurt efforts to improve public health, so it should be avoided . As an example, mobile phone masts in the UK were attacked after rumours spread online that 5G deployments caused the COVID-19 pandemic. Wikipedia keeps wrong information about COVID-19 up to date. This gives credibility to a number of dangerous myths, such as the idea that vinegar is better than hand sanitizer for fighting COVID19. It makes sense that people who believe this kind of false information could harm public health. So, one important application would be to make classifiers and other ways to stop this flow. The CoMuNe lab at the Fondazione Bruno Kessler (FBK) institute in Italy has created an infodemic observatory that analyses digital responses to COVID-19 in online social media and makes the results public [40]. The observatory uses Twitter data to show in how a visual way how people feel as a group, much social bot pollution.

2.10 Identifying Potential Drugs, Vaccines & New Treatments

At the moment, there isn't a single treatment option for COVID-19 that has been officially approved. Before a doctor gives a patient a prescription for medicine, he or she must offer supportive care and check the patient's nutritional status. In the end, COVID-19 does not yet have a treatment that has been shown to work.

One way that AI is used in drug research is to look at the data that is now on COVID-19. It helps with designing and making new ways to give medicines. This technology

is used to speed up drug testing in real time. Regular drug testing takes a long time, so this helps speed up the process a lot, which may not be possible for a person . It's possible that this will help find medicines that will help COVID-19 patients. It has become a powerful tool that can be used to make diagnostic tests and vaccines [41]. AI makes it possible to make vaccines and therapies much faster than usual, and it also helps make sure that clinical trials are successful while a vaccine is being made.

Before COVID-19, a lot of work was done in data science that can help the international effort to find new drug therapies and vaccines or to find new ways to use ones that already exist. For example, computer tools can cut down on the time it takes to analyse data, predict protein structures, and study genomes. In addition, it can help find patients who are eligible to take part in clinical trials, which is a phase of drug development that can take a lot of time and cost a lot of money. Also, there is a lot of room for improvement when it comes to using advanced methods to run clinical trials, like using Bayesian clinical trials to change treatments based on the information gathered during the trial [43]. We think that this is another area where data scientists might be able to help, because it could be very important for speeding up the delivery of pharmaceutical treatments.

2.11 Disease Prevention with AI

AI and Big Data might be able to give us up-to-date information that can help us fight this disease. This is possible because of how real-time data is looked at. During this emergency, it can be used to predict where the virus is likely to spread, how many new cases there will be,

how many hospital beds will be needed, and how many doctors and nurses will be needed. AIcan help stop viruses and diseases in the future by using data that has been taught to it in the past and data that was important at different times. It talks about the characteristics, causes, and factors that help an infection spread. In the not-too-distant future, this will become a big step forward in technology that is used to fight more epidemics and pandemics. It has the potential to both keep people from getting sick and treat a wide range of illnesses. [44] In the not- too-distant future, artificial intelligence will be a key part of making sure that medical care is more accurate and preventative.

2.12Future Challenges

2.12.1 Lack of standard datasets

A lot of ideas have been put forward for AI algorithms and big data platforms, but not all of them are tested with the same set of data. For example, the algorithms described in and
[45] have been tested and found to be accurate 82.9% of the time and specific 97.60% of the time and sensitive 84% of the time. But because we are using two datasets with different numbers of samples, we can't say which algorithm works better when trying to find viruses. Also, most of the datasets in the published research were made by individuals. For example, the authors might get a few datasets that are easy to find on the internet, combine them to make their own dataset, and then use it to test their proposed algorithms. Because they can work together to make large, high-quality datasets, the government, large corporations, and health organisations (like WHO and CDC) all play an important role in finding a solution to this problem. These organisations have access to a wide range of data sources, such as X-rays and CT scans from hospitals, satellite data, personal information and reports from self-diagnosis apps, and so on.

2.12.2Government Rules & Regulation

Lockdowns, social isolation, mass screenings, and testing have been implemented as a response to the outbreak's rapid growth, which is resulting in an increasing number ofconfirmed cases every day (both of those infected and those who have died). They also play a key role in harmonizing the approaches taken by various entities. Additionally, regulatory agencies play a significant role in developing regulations that can engage citizens, researchers, industry, large tech corporations, and scientists in the fight against COVID- 19.Between the first confirmed case of COVID-19 and the current situation, there have beena lot of attempts to deal with this problem. This is shown by the fact that Korea will start putting people in quarantine on April 1, 2020. To be more specific, anyone who enters Korea must stay in quarantine for 14 days at a registered home or a place that has been officially designated for that purpose. Also, every passenger is required to do self-exams twice a day and report their results using the self-exam apps that have already been installed on their phones.
The Seoul Metropolitan Government has set up a "AI monitoring calling system" to

automatically check the health of people who don't have cell phones or who haven't downloaded self-diagnosis apps [45]. People who don't have cell phones will get a call from this system to check on their health. A partnership between the government of Zhejiang Province and the Alibaba DAMO Academy is working on another project. The goal is to build an artificial intelligence platform that will automatically test and analyse the COVID-19virus [60].

2.12.3 Privacy and Security

Right now, the most important things are keeping people healthy and taking charge of the situation as soon as possible. Even though this is the case, research should still be done on how to keep personal information safe and private. This issue was brought to light by the controversy over the videoconferencing software Zoom and the privacy and security problems it had [46]. In the event of a pandemic, the government may ask people to share personal information like their GPS location, CT scans, diagnosis reports, travel plans, and daily activities. This information is needed to stay in charge of the situation, come up with current policies, and choose the best ways to act. Data is important for the success of AI and big data platforms, but most people don't want to give out personal information unless the platform specifically asks for it. Performance comes at the cost of either privacy or security. During the COVID-19 epidemic, there are a number of technologies, such as Blockchain, thatcan help solve privacy and security problems.

2.12.4 Different Techniques for Prediction and Forecasting

Early identification of patients who are likely to die soon can help a lot with triage, bed assignment, timely care, and maybe even outcome. The goal of this project is to create and validate personalized mortality risk scores based on clinical and laboratory data at admission, and to figure out how likely it is that a person will die. Different methods are used for different purposes, depending on how accurate the results need to be. During the process of evaluating

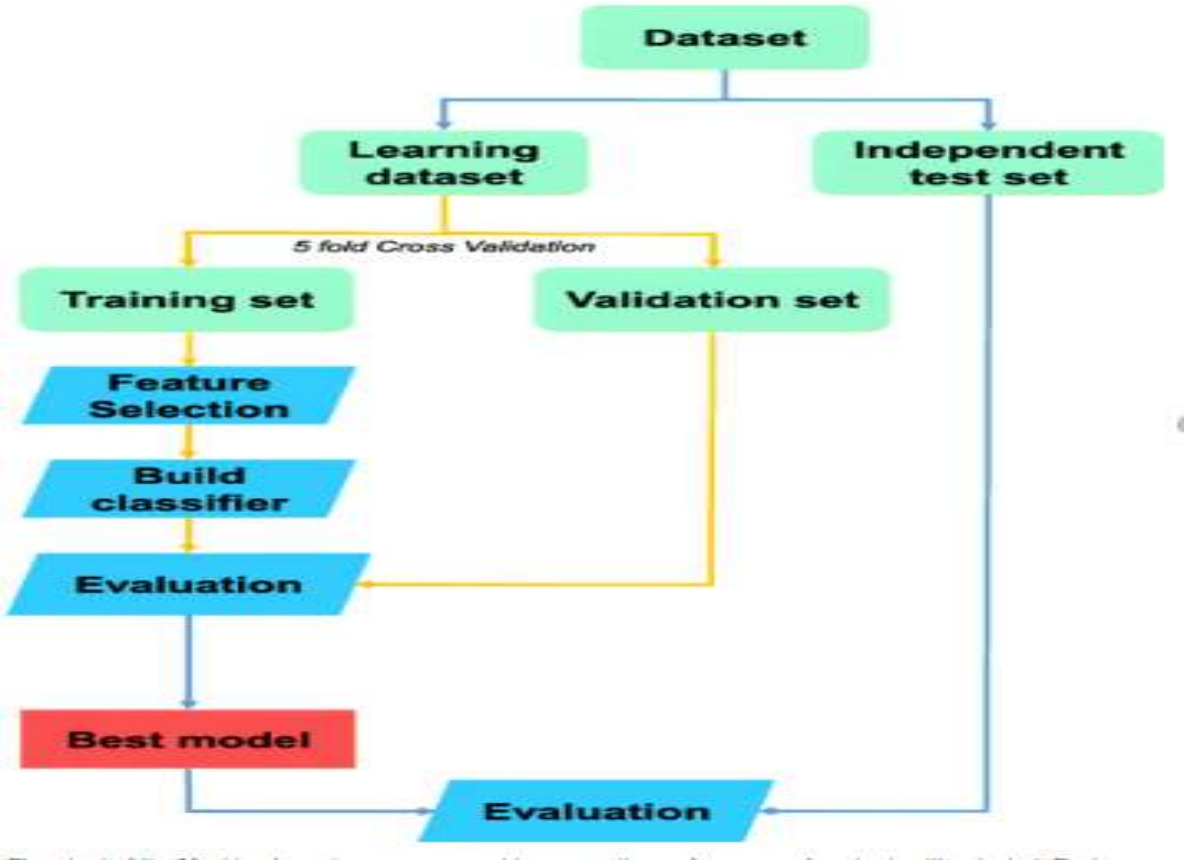

Figure 2.2 Machine learning (ML) process flowchart [47]

Models, the most accurate model is chosen to be used to make predictions or forecasts in the future. After looking at a lot of different classifiers and forecasting methods, we decided to use the ETC to predict COVID-19 based on its symptoms and the ARIMA forecasting model to predict the number of confirmed COVID-19 cases in India. ML is shown in Fig. 2.2 as a process flowchart. It shows how to gather and clean data, as well as how to make a training dataset and a testing dataset. [47]

2.13 Relevant dataset

Because of the nature of our work, we used text mining to find clinical notes and results. The text in clinical notes is what makes up the content. The finding attribute is the name of the related text. For this analysis, a total of 212 reports were looked at. For review, all reports must be written in English. The clinical reports have been given labels that tell how they should be put together. Our data falls into four groups:

Clinical text is broken up into several categories, and each one has a length of report that goeswith it. The following datasets have something to do with Coronavirus and fit into the above category.

- This is the method that Deep mind employed for predicting the structures of proteins, and it is also the source from which Zhang et al. obtained their RNA sequences. (A).
- Kaggle's Version of the Coronavirus Genome (A)
- Open Research Dataset Competition, also Known as COVID-19 (CORD-19) (B, C, D) Today, March 16th, 2018, Kaggle made available an intriguing new dataset for users to explore. It includes more than 29,000 scholarly articles on COVID-19, SARS, MERS, and other viruses in the same family. The competition is broken up into ten distinct segments, and each of those parts has its own winner. I won't post them all here, but if you follow this link, you can view them all. The primary objective of the competition is to identify and glean from the vast dataset the data that is most pertinent to the study of this disease. You are now permitted to participate in the competition on Kaggle.

2.14 Medical Imaging for Diagnosis

As COVID-19 spreads quickly, people are becoming more interested in using medical imaging to find other ways to find corona virus infections. Deep learning strategies have been used to process and analyze computed tomography (CT) scans and X-rays to help doctors predict COVID-19 infections. Several pieces of research that use deep learning to figure out how to identify corona viruses are presented. looked at X- rays of lung diseases to come up with a system they called COVID-Net. It was made up of convolution neural networks. The goal of the system was to tell COVID-19 cases apart from other types. Here, an updated version of the Inception model is given so that the feature of COVID19 can be extracted from CT scans with 89.5% accuracy. Using CT images, a location-attention mechanism-based 3D deep learning system has been built. The goal of this system is to find out where COVID19 patients are sick. When COVID-19 pneumonia was compared to influenza-A viral pneumonia, the system was able to tell the difference between the two 86.7% of the time. In order to find corona virus, CT images are used to train a deep neural network [48]. This network is used to tell the difference between parts of the lung that are

infected and other lung diseases made a Resent architecture so that CT samplescould be used to find complicated features. For the classification of COVID-19, they also put together a feature pyramid network and an attention module. CT scans can be used to find corona virus symptoms that can be used to tell COVID-19 cases apart this is a new way to diagnose COVID-19 cases. Suggested using a combination of CNN and LSTM to find people with corona virus from chest X-rays.

2.15 Disease Tracking

As the COVID-19 outbreak continues to spread quickly, more and more people are interested in using medical imaging to find other ways to spot coronavirus infections. Deep learning algorithms have been used to process and analyze computed tomography (CT) scans and X- rays in order to help doctors diagnose COVID-19 infections and figure out how bad they are here are several pieces of research that use deep learning to figure out how to identify corona viruses. looked at X-rays of people with lung diseases to come up with a system they called COVID-Net. From the beginning to the end, it wasmade up of convolution neural networks. The goal of this method was to set COVID-19 cases apart from cases in other categories. In this article, an updated version of the Inception model is given so that CT scans can be used to find out about COVID19 with an accuracy of 89.5%. A 3D deep learning system based on a location-attention mechanism has been built, and CT images have been used to build it.[48] The goal of this method is to find out where people who are sick with COVID19 live. 86.7% of the time, the system could tell the difference between pneumonia caused by COVID-19 and pneumonia caused by the influenza-A virus.

This was found by comparing pneumonia caused by COVID-19 to pneumonia caused by the influenza-A virus. CT images are used to train a deep neural network, which is then used to look for corona virus. With the help of this network, doctors can tell the difference between infected parts of the lung and other lung diseases. In order to put COVID-19 into a group, they also made a feature pyramid network and an attention module. CT scans can find the symptoms of corona virus that can be used to tellCOVID-19 patients apart from each other. This is a new way to figure out if someone has COVID-19. With the help of a CNN and a LSTM, chest X-rays could be used to find people who have the Corona virus came up with this idea.[49]

2.16 Machine Learning Methods to Aid in Coronavirus Response

Many people in the ML community are thinking about how they can help, since everyone is worried about the Coronavirus and almost everyone is stuck at home because of it. Even though there have been articles about using AI to fight the coronavirus before, very few of them have given a really complete view. So, [50] make a list of datasets and examples of how machine learning could be used to solve the coronavirus problem. He can understand the complaint that "when you have a hammer, every problem looks like a nail." To put it another way, to a person who works with machine learning or is a data scientist, it can seem like ML is the answer to every problem. Even so, [50] author think that machine learning and data analytics, along with all the other great research and planning that is going on, can help speed up the process of finding answers and limit the virus's effects.

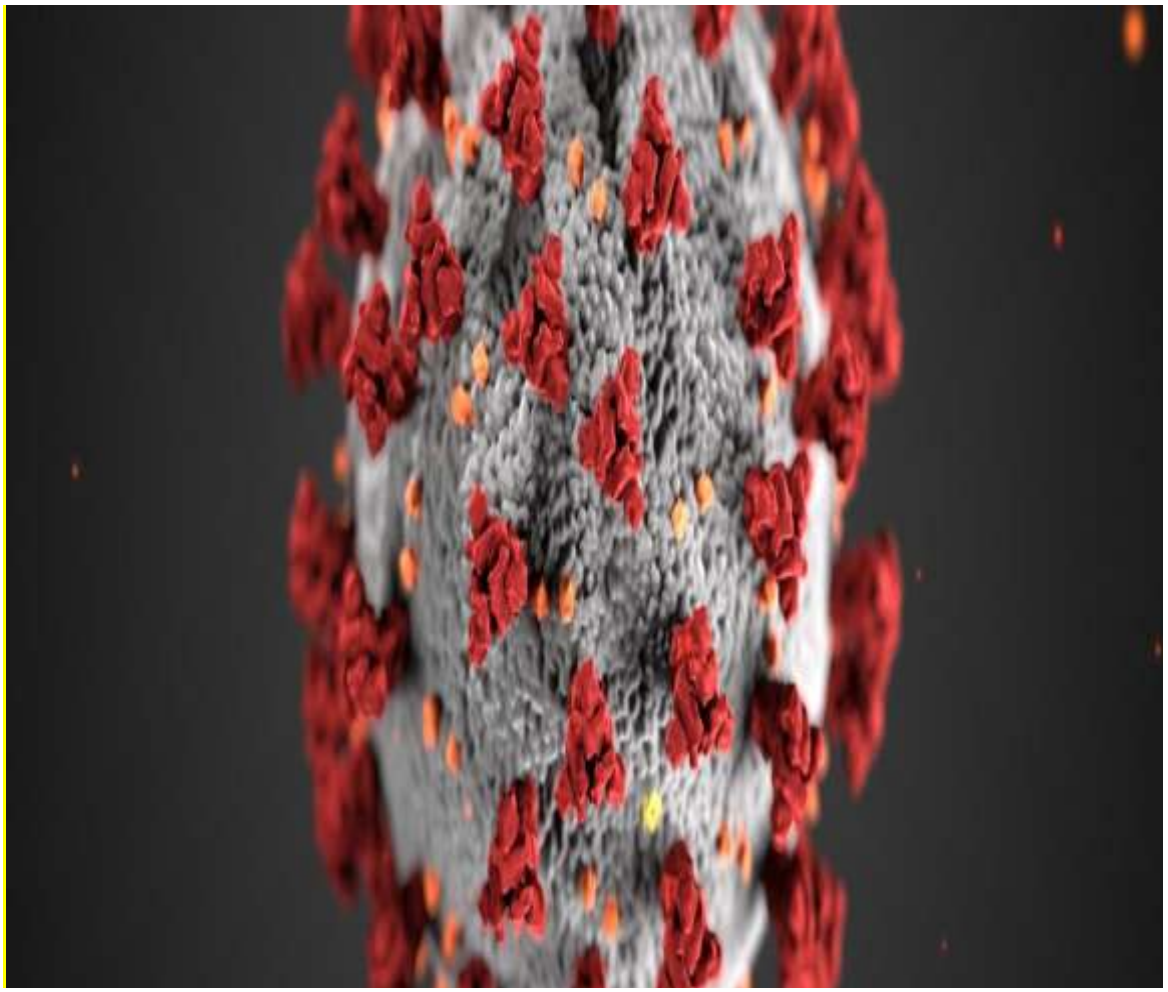

Fig 2.3 Coronavirus Response [50]

machine learning can speed up the process of making new drugs, help figure out if existing antiviral can help, estimate infection rates, and help screen patients more quickly. Also, more research isn't being done right now, but I think there are several other areas where this could be useful. Still, there are a lot of problems with the lack of limited training data, the inability to add complicated structures to DL models, and, probably most importantly, the inability to access the data that is available. the methods used below but there are many resources available. And set up a central repository on GitHub with resources forusing AI to fight the coronavirus.

Help diagnose if a medical image like an X-Ray or CT shows coronavirus. If a patient haspneumonia caused by a coronavirus, a CT scan could cut down on the time it takes to figure out what's wrong and make treatment more effective. Since more and more people are being admitted to intensive care units, radiologists could end up being too busy. Deep learning can be used to improve imaging to help ease some of the stress. Also, knowing how a disease shows up on a CT scan can help you learn more about the disease itself.

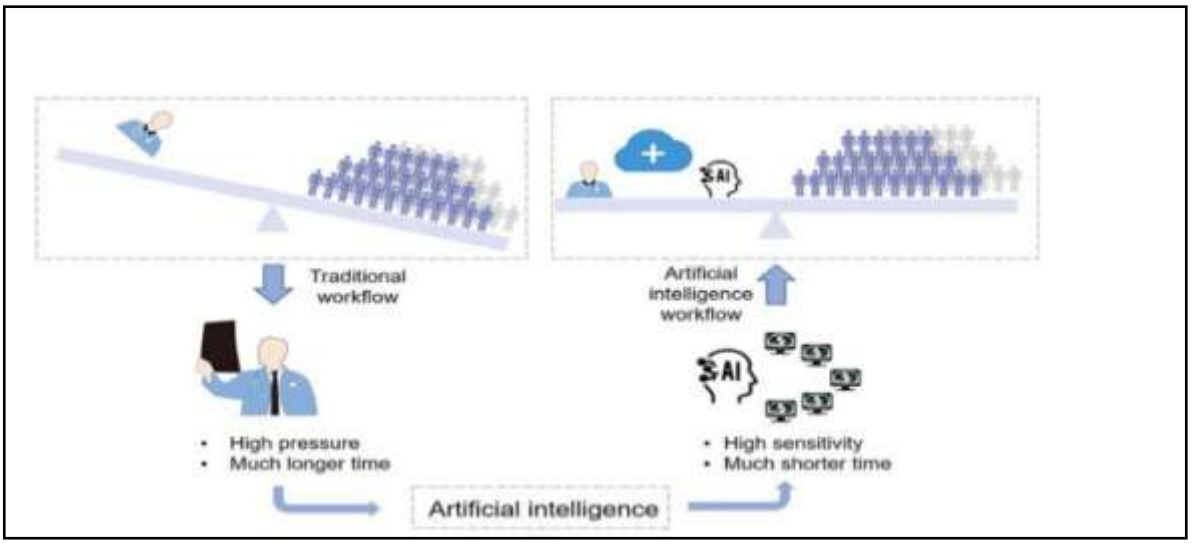

Figure 2.4 from deep learning-based model for detecting 2019 novel corona virus pneumonia[50]

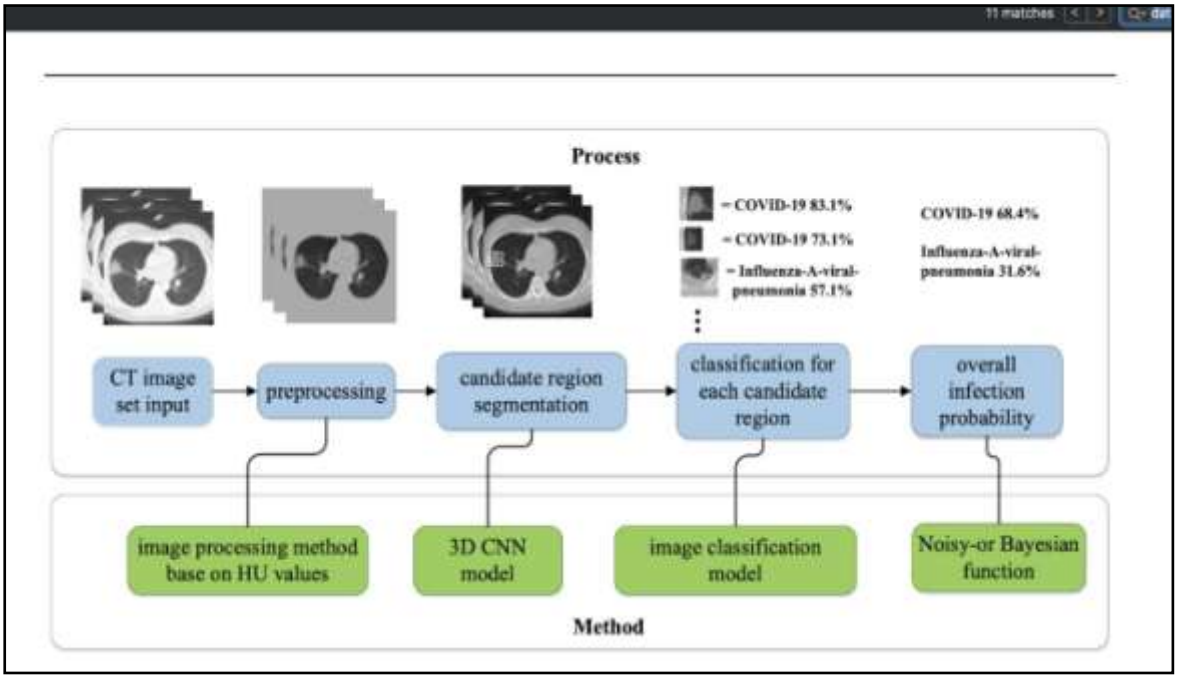

Fig 2.5 An algorithm that uses CT images and deep learning to check for (COVID-19) [50]

In the dataset as a whole, there were more patients than before. They got cases from about 509people in three hospitals in China. Only 175 of those people were healthy. It's interesting to note that their ratings for accuracy and recall were much lower than those of Chen et al. One possible reason for this is that they trained the model with a much smaller number of scans, even though they had more patients.[50]

B. Zahid Hussain (2022**) [51]** The novel coronavirus infection (COVID-19) is still continuing to be a concern for the entire globe. Since early detection of COVID-19 is of particular importance, there have been multiple research efforts to supplement the current standard RT- PCR tests. Several deep learning models, with varying effectiveness, using Chest X-Ray images for such diagnosis have also been proposed. While some of the models are quite promising, there still remains a dearth of training data for such deep learning models. The present paper attempts to provide a viable solution to the problem of data deficiency in COVID-19 CXR images. We show that the use of a Wasserstein Generative Adversarial Network (WGAN) could lead to an effective and lightweight solution. It is demonstrated that the WGAN generated images are at par with the original images using inference tests on an already proposed COVID-19 detection model.

Truong Hoang (2022)[52]. This paper presents a deep learning framework for

detecting COVID- 19 positive subjects from their cough sounds. In particular, the proposed approach comprises two main steps. In the first step, we generate a feature representing the cough sound by combining an embedding extracted from a pre-trained model and handcrafted features extracted from draw audio recording, referred to as the front-end feature extraction. Then, the combined features are fed into different back-end classification models for detecting COVID-19 positive subjects in the second step. Our experiments on the Track-2 dataset of the Second 2021 DiCOVA Challenge achieved the second top ranking with an AUC score of 81.21 and the top F1 score of 53.21 on a Blind Test set, improving the challenge baseline by 8.43% and 23.4% respectively and showing deployability, robustness and competitiveness with the state-of-the-art systems.

Ayesh Meepaganithage (2022)[53] The COVID-19 pandemic has caused devastating effects on global health, the economy, and people's daily lives, and timely diagnosis is crucial to control the spread. The need for additional testing methods has increased due to the limitations in current testing methods. This study focused on applying deep learning methods to classify chest X-rays as COVID-19 pneumonia, normal, and non-COVID pneumonia. We developed two deep learning models to ascertain COVID-19 using Posteroanterior (PA) andAnteroposterior (AP) view Chest X-rays. Two datasets of 300 chest X-rays for PA and AP views were used. As the first deep learning model, a new Convolutional Neural Network from scratch was built. Then, VGG16, VGG19, and ResNet50 transfer learning models were used. Finally, the transfer learning models were extended by adding more layers to the top of the existing model. As the first part of this study, we used PA view X-rays and obtained 98% overall accuracy, and 98% precision, 99% recall, and 99% f1-score for the COVID-19 class. In the second part, we used AP view X-rays and obtained 79% overall accuracy, and 96% precision, 83% recall, and 89% f1-score for the COVID-19 class. Finally, gradient-based class activation maps were generated using the proposed extended VGG19 model to visualize the areas that helped the model in detecting COVID-19. This research showed that high performance could be obtained in detecting COVID-19 using extended transfer learning models. In PA view X-rays, the proposed extended VGG-19 model performed the best, andin AP view X-rays, the proposed extended ResNet50 model performed the best.

Zihao Lu(2022) [54] Since the global outbreak of COVID-19, the epidemic has had a

great impact on people's lives and the world economy. Diagnosis of COVID-19 using deep learning has become increasingly important due to the inefficiency of traditional RT - PCR test. However, training deep neural networks requires a large amount of manually labeled data, and collecting a large number of COVID-19 CT images is difficult. To address this issue, we explore the effect of Pretext-Invariant Representation Learning (PIRL) using unlabeled datasets to pre-train the network on classification results. In addition, we also explore the prediction effect of PIRL combined with transfer learning (TF). According to the experimental results, applying the TF-PIRL prediction model constructed in this paper to COVID-19 diagnosis, the accuracy and AUC are 0.7734 and 0.8556 respectively, which outperform the network training from scratch, transfer learning-based network training and PIRL-based network training.

Yutong Yao(2022) [**55**] Computer-Aided Diagnosis (CAD) is applied in the medical analysis of X-ray images widely. Due to the COVID- 19 pandemic, the speed of COVID-19 detection is slow, and the workforce is scarce. Therefore, we have an idea to use CAD to diagnose COVID-19 and effectively respond to the pandemic. Recent studies show that convolutional neural network (CNN) is an appropriate technique for medical image classification. However, CNN is more suitable for datasets with many images, such as ImageNet. Medical image classification relies on doctors to label medical images, so obtaining large-scale medical image data sets is a time-consuming, costly, and unrealistic task. The method of dataaugmentation for a limited medical dataset can be used to increase the number of images. However, this technology will produce many repeated images, which will easily lead to the overfitting problem of CNN. In the case of a limited number of radiological images, transfer learning is a practical and effective method which can help us overcome the overfitting problem of ordinary CNN by transferring the pre-trained models on large datasets to our tasks. The proposed model is DenseNet based deep transfer learning model (TLDeNet) to identify the patients into three classes: COVID-19, Normal or Pneumonia. We then analyzed and assessed the performance of our model on COVID-19 X-ray testing images by performing extensive experiments. It is finally demonstrated that the proposed model is superior to other deep transfer learning models according to comparative analyses. The Grad- Cam method is finally applied to interpret the convolutional neural network, revealing that our

proposed model focuses on the similar region of the X-ray images as doctors.

Rashiduzzaman Shakil (2022) [56] COVID-19 is a virus-borne malady. A clinical study of infected COVID-19 patients found that most COVID-19 patients suffered lung infection after contracting the disease. Consequently, chest X-rays are a more effective and lower-cost imaging technique for diagnosing lung-related problems. This study used deep learning models, including MobileNetV2,DenseNet201, ResNet50, and VGG19, for COVID-19 prediction. For the study, we used chest X-ray image data for binary classification of COVID-19. 7207 chest X-ray image data were obtained from the Kaggle repository, with 5761 being utilized for training and 1446 being used for validation. A comparative analysis was conducted among the models and examined their accuracy. It has been determined that the DenseNet201 models achieved the highest accuracy of 93.02% for detecting COVID-19 in the lowest compilation time of 27secs. The models, MobileNetV2, ResNet50, and VGG19 had the accuracy rate of 77.28%, 65.86% and 74.92%, respectively. The research indicates that the DenseNet201 model is the most effective in detecting COVID-19 using x-ray imaging.

Mohamed Almansoor et.al (2020)[57] COVID-19 is a global pandemic that hit the world in2019-2020 and caused massive losses. Every day, hundreds of thousands of tests are being done on possible infected cases. It usually takes several hours to get the results of virus test in advanced countries, whereas in other countries might take days. The aim of this study is to investigate whether normal blood medical tests help in detecting covid-19 using various machine learning approaches. If true, this would give an indication to people who should undergo the virus test. In this paper we independently use machine learning algorithms including support vector machines, adaptive boosting, random forest and k-nearest neighbors. These algorithms are then merged to form ensemble learning which leads to the classification. The results show that the ensemble learning is having the highest true positive rate of 30%. The obtained results show that normal blood tests do not help much in giving right indications about detecting COVID-19

In this research, a quantitative model is built to predict people's susceptibility to COVID-19 based on their genomes. Identifying people vulnerable to COVID-19 infections is crucial in stopping the spread of the virus. In previous studies,

researchers have found that individuals with co morbid diseases have higher chances of being infected and developing more severe COVID-19 conditions. However, these patterns are only observed through correlation analyses between patient phenotypes and the severity of their COVID-19 infection. In this study, genetic variants underlying the observed co morbidity patterns are analyzed through machine learning of COVID-19 data from GWAS studies, which may reveal biological pathways underlying COVID-19 contraction that are essential to the development of effective and targeted therapeutics. Furthermore, through combining genetic variants with the individual's phenotypes, this study built a Neural Network model and Random Forest classifier to predict an individual's likelihood of COVID-19 infection. The Random Forest Classifier in this study shows that on-going symptoms are generally better predictors of COVID-19 condition (higher impurity-based feature importance) than diseases or medical histories. In addition, when trained with genomic data, the co morbid disease impact ranking deduced by the resulting RF model is highly consistent with phenotypic co morbidity patternsobserved in past studies.

J. Muhammad et.al.[58] Novel coronavirus (COVID-19 or 2019-nCoV) pandemic has neither clinically proven vaccine nor drugs; however, its patients are recovering with the aid of antibiotic medications, anti-viral drugs, and chloroquine as well as vitamin C supplementation. It is now evident that the world needs a speedy and quicker solution to contain and tackle the further spread of COVID-19 across the world with the aid of non-clinical approaches such as data mining approaches, augmented intelligence and other artificial intelligence techniques so as to mitigate the huge burden on the healthcare system while providing the best possible means for patients' diagnosis and prognosis of the 2019-nCoV pandemic effectively. In this study, data mining models were developed for the prediction of COVID-19 infected patients' recovery using epidemiological dataset of COVID-19 patients of South Korea. The decision tree, support vector machine, naive Bayes, logistic regression, random forest, and K-nearest neighbor algorithms were applied directly on the dataset using python programming language to develop the models. The model predicted a minimum and maximum number of days for COVID-19 patients to recover from the virus, the age group of patients who are of high risk not to recover from the COVID-19 pandemic, those who are likely to recover and those who might be likely to recover quickly from COVID-19 pandemic. The results of the present study have shown that the model developed with decision tree data mining algorithm is more efficient to

predict the possibility of recovery of the infected patients from COVID-19 pandemic with the overall accuracy of 99.85% which stands to be the best model developed among the models developed with other algorithms including support vector machine, naive Bays, logistic regression, random forest, and K-nearest neighbor.

Xinggang Wang et.al (2020)[59] Accurate and rapid diagnosis of COVID-19 suspected cases plays a crucial role in timely quarantine and medical treatment. Developing a deep learning-based model for automatic COVID-19 diagnosis on chest CT is helpful to counter the outbreak of SARS-CoV-2. A weakly-supervised deep learning framework was developed using 3D CT volumes for COVID-19 classification and lesion localization. For each patient, the lung region was segmented using a pre-trained UNet then the segmented 3D lung region was fed into a 3D deep neural network to predict the probability of COVID-19 infectious; the COVID-19 lesions are localized by combining the activation regions in the classification network and the unsupervised connected components. 499 CT volumes were used for training and 131 CT volumes were used for testing. Our algorithm obtained 0.959 ROC AUC and 0.976 PR AUC. When using a probability threshold of 0.5 to classify COVID-positive and COVID-negative, the algorithm obtained an accuracy of 0.901, a positive predictive value of 0.840 and a very high negative predictive value of 0.982. The algorithm took only 1.93 seconds to process a single patient's CT volume using a dedicated GPU. Our weakly-supervised deep learning model can accurately predict the COVID-19 infectious probability and discover lesion regions in chest CT without the need for annotating the lesions for training. The easily-trained and high-performance deep learning algorithm provides a fast way to identify COVID-19 patients, which is beneficial to control the outbreak of SARS-CoV-2.

Richard F. Sear et.al (2020)[60] a huge amount of potentially dangerous COVID-19 misinformation is appearing online. Here we use machine learning to quantify COVID-19 content among online opponents of establishment health guidance, in particular vaccinations (“anti-vax”). We find that the antivax community is developing a less focused debate around COVID-19 than its counterpart, the pro-vaccination (“provax”) community. However, the anti-vax community exhibits a broader range of “flavors” of COVID-19 topics, and hence can appeal to a broader cross-section of individuals seeking COVID-19 guidance online, e.g. individuals wary of a mandatory fast-tracked COVID-19 vaccine or those seeking alternative remedies. Hence the antivax community looks better positioned to attract fresh support going forward than the provax community. This is concerning since a widespread lack of adoption of a COVID-19 vaccine will mean the world falls short of

providing herd immunity, leaving countries open to future COVID-19 resurgences. We provide a mechanistic model that interprets these results and could help in assessing the likely efficacy of intervention strategies. Our approach is scalable and hence tackles the urgent problem facing social media platforms of having to analyze huge volumes of online health misinformation and disinformation.

Ekta Gambhir et.al (2020)[61] the outbreak of the Novel Coronavirus or the COVID-19 in various parts of the world has affected the world as a whole and caused millions of deaths. This remains an ominous warning to public health and will be marked as one of the greatest pandemics in world history. This paper aims to provide a better understanding of how various Machine Learning models can be implemented in real-world situations. Apart from the analysis done on the world figures, this paper also analyzes the current trend or pattern of Covid-19 transmission in India. With the help of datasets from the Ministry of Health and Family Welfare of India, this study puts forward various trends and patterns experienced in different parts of the world. The data to be studied has been obtained for 154 days i.e. from January 22, 2020, till June 24, 2020. For future references, the data can be further analyzed, and more results can be obtained.

CHAPTER 3
RESEARCH METHODOLOGY

The main goal of this thesis is to create a deep learning model that can tell if a patient has COVID-19 or not. In order to make this kind of model, a literature review and an experiment will be done to find the right algorithm. To figure out which parts of the prediction model are important. The main goal of this study is to use machine learning techniques to build a model that can predict COVID-19 in patients. In addition, we are trying to figure out which parts of a patient's clinical information might have an effect on the predicted outcome of COVID-19. This study doesn't look at things like the weather or other things in the environment that might have an effect on the results. Models based on deep learning can reach the highest level of prediction accuracy in their standard form, without having to select features or fill in missing values. [62] This means that models that have been trained can be easily checked against new data sources. We made sure that our trained models worked by applying them to datasets from many different sources. This shows that our models are transferable. Our system for making models is flexible enough to be used for other things, like training and testing predictive models for a wide range of clinical events. Our research could give clinical practitioners, who are on the front lines of the fight against COVID-19, two things that could be useful.

3.1 Implementation module

3.1.1 Residual Networks (Res Net)

If we construct deeper and deeper networks, we must understand how layering increases the complexity and capabilities of network representation. It is important to have the ability to plan the network. As a result, the network is able to express more meaning than variety. If we want to go a little further, we'll need to do some math. [63]

3.1.2 Function Classes

Consider the function F, which is a set of functions occupied by a specific network structure (as well as learning rate and other hyper parameter locations). In other words, by training in the required data sets, a set of parameters for all f / F can be obtained (e.g. weight and bias). Assume that f is the "truth" function that we adore. If I'm in F, I'm in good shape, but we aren't all so lucky. Instead, we're looking for f F, which is the best choice in F. If we have a

database of X and Y-characteristics, for example, we can try to find it by solving the refining problem:

$$f_{\mathcal{F}}^{*} \stackrel{\text{def}}{=} \underset{f}{\operatorname{argmin}}\, L(\mathbf{X}, \mathbf{y}, f) \text{ subject to } f \in \mathcal{F}.$$

It's reasonable to believe that if we build a new and stronger F's architecture, we'll get better results. In other words, we expect the f bis F'to be "better" than the f bis F, but the f F 'might actually be "better" than the f bis F.

In non-nestled job classes, the larger class does not move closer to the "real" f. F3 is closer to F than F6, and there is no guarantee that the difference between f and F can be decreased by agreater increase in difficulty. We may avoid the above issues for the F1-character class by notusing nests. Examine the proximity of the "right" feature (f). This will not happen in a nestingclass. As a result, if there are no smaller classes with larger classes, we can guarantee that increasing the network's representation power would increase. If we can train the newly laid layer as a function (f) x (x) = x, the current model is as effective as the original model for deeper neural networks. More layers can help reduce training errors since the new model can provide a better solution for matching the training data. This was a question asked by him andothers. This was taken into account while researching deep computer vision models (He et al., 2016a). The central concept of its proposal for Res Net (Res Net) is that one of its elements, identity, should be integrated with another layer. Such research is extensive, but it often leads to a simple, unexpected solution, which solves the remaining problem. Res Net won the main award for Visua lNet visualisation in 2015. This architecture has a big influence on how deep neural networks are built.[63-64]

3.1.3 Residual Blocks

Concentrate on the local region of the network, as seen in Figure 3.8. Use x to designate the use. The requisite base plate for the analysis is assumed to be f (x), which is used for the top operation's input. The part of the trampled box that is on the left hand side of Figure 3.2 must clearly study map f. (x). On the right side of the broken box, the remaining f(x) -x, as the remaining stone is known, is examined. The profile can be learned more easily if the f (x) = x profile is used as the base plate: the weight and inclination of the higher weight layers should not be forced (e.g., fully

connected layers and structures). In the broken box, form zero. the Res Net gap when there is a solid line that includes the bandwidth of the x-layer of the additional operator called the residual (or a shortcut) connection. Via residual interaction with the residual barrier, the insert can spread faster through the ground.

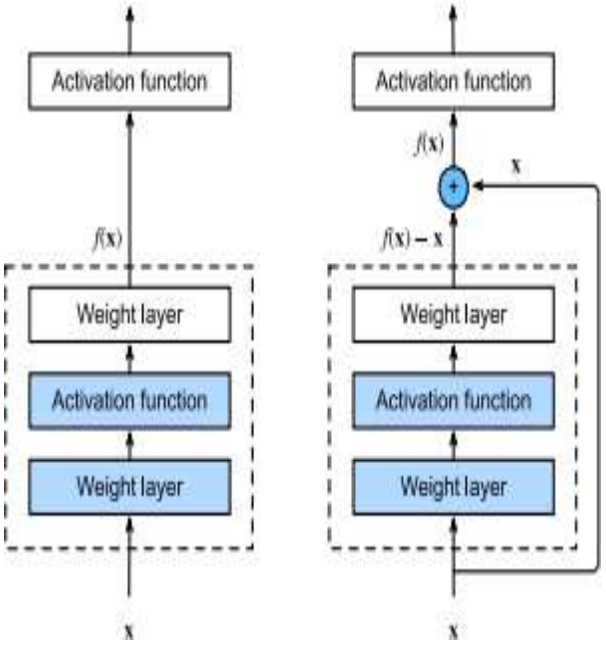

Fig. 3.1 A regular block (left) and a residual block (right).[64]

Res Net uses the VGG 3 to 3 compliant layer architecture. The remaining barrier is made up of two 3-3 layers of similar outlet conduits. Each bill thread has an integrated decorationlayer as well as ReL U features.

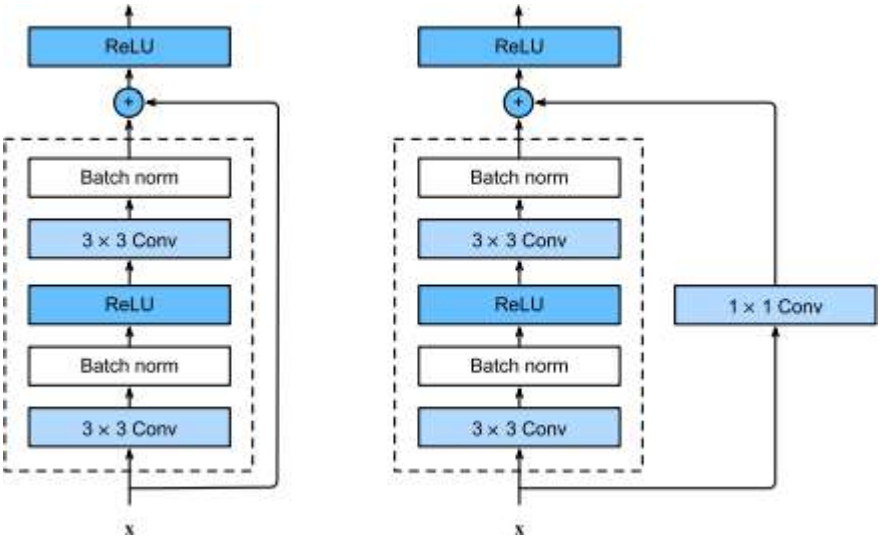

Fig. 3.2: ResNet block with and without 1 × 1 convolution[65]

The two routing features are then removed, and the input is placed directly before the final ReLU function. The product of the two matching layers of the bill must have the same formas the inserted one in order to incorporate them. If you want to modify the number of channels so that the input can be adjusted to that format, you'll need to add an extra 1 x 1 layer.

3.1.4 ResNet Model

The first two layers of ResNet are the same as the first two layers of GoogLeNet: a 7/7 layer that matches 64 production channels with two widths, followed by a 3/3 layer array. The maximum distance is 2. The ResNet differs in that it adds a single batch layer to each convolutional layer.

Nn.Sequence = Net () nn.Conv2D(65), kernel Size=3, strides=2,

padding=2); net (),nn.MaxPool2D(pool size=3), Nn.Actualisation('relu')

GoogLeNet makes use of four modules, including the Inception Block. ResNet, on the other hand, employs several residual blocks and uses four residual block modules, each with the same output channel. The number of channels in the first model is the same as the number of input channels. Phase 2's height and width cannot be reduced because it is already used for the largest composite board. The number of pipes is doubled from the previous version, and the length and width of each subsequent model are cut in half. We're currently in this mode. Please keep in mind that customization is done in the original mode. Each modern bill has four layers (not including the one layer). There are 18 layers in all, with the first 7 to 7 layers fully linked and the last one completely disconnected. ResNet-18 is another name for this model. By improving the various information channels and barriers left behind in the model, we can create a variety of ResNet models, including the more advanced ResNet-152. ResNet's core architecture is similar to GoogleNet's, but it is much easier to modify ResNet's structure. All of these variables have made ResNet a popular and widely used tool.[65]

3.2 Methodology Workflow

The workflow of the diagnostic model used in the present study has four main

components - Pre-processing, Feature Extraction, Feature Selection, and Classification. The proposed model is applied to each COVID disease dataset, and the performance of the model isassessed using various performance metrics. The proposed method deals with presenting a deep learning approach for COVID disease diagnosis,

Because of the COVID-19 outbreak and the fact that the Corona virus is very contagious, automated illness detection has become an important part of modern medical research. [66] The main goal of this study is to create a comprehensive framework of transfer learning models

for early prediction of COVID-19 based on each patient's chest X-ray image. For this study, a dataset was used that was found in the Kaggle repository. COVID-19 Positive and COVID- 19 Negative were the two groups in the dataset. On the test sample, the suggested model was able to achieve a high level of accuracy while reducing the number of false positive predictions. It can help medical professionals like doctors and technicians find COVID-19 infections earlier.

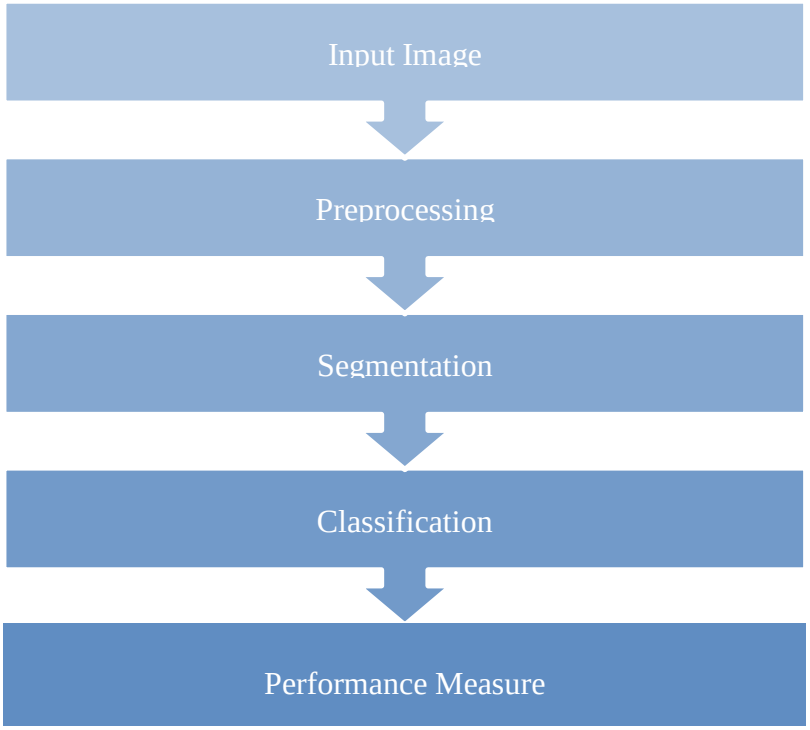

Fig. 3.3 Proposed flow diagram

3.3 Implementation Models

- Input Image.
- Pre-processing.
- Segmentation.
- Feature extraction
- Classification

3.3.1 Input Image:

The main type of data structure in MATLAB is a matrix, which is made up of a set of elements that can be either real or complex. As you might expect, arrays are a great way to show ordered sets of images, real-value data, and information about colour or intensity. (Arrays are good for images with a lot of detail.) Most images in the MATLAB workspace are shown as two-dimensional arrays, with each matrix element representing a single pixel in the image. As an example, a matrix can be used to store an image with 256 columns on the left and 256 columns on the right and dots of different colours.

3.3.2 Pre-processing

The RGB photos are changed so that the HSV colour system can be used to describe them. In the RGB model, each colour is made up of three main spectral parts: red, green, and blue. The model is based on a Cartesian scheme for coordinating colours. Even though the RGB model is useful for analyzing people, it is not a very good way to show colours. The RGB image is then changed to the HSV format, which lets us get around these limits. After the RGB to HSV conversion is finished, the hue and saturation components are used for further analysis because they are the most common.[67] The conversion from RGB to HSV is done one pixel at a time. "Data pre-processing" is a technique for data mining that involves putting raw data into a format that can be understood. The real-world data are always missing, inconsistent, or not enough to fully understand some patterns and behaviors. As part of preparing the data for our thesis, we got rid of any records that might have had Null, INF, or Nan values. This made the data look better.

RGB to HSV color transformation: The RGB photos were then changed so that the HSV colour system could be shown. The RGB model is based on a Cartesian coordinate system, and each colour is shown by its red, green, and blue primary spectral components. Even though the RGB model matches how the human eye sees primary colors, it is not a good way to describe colours in a way that people can understand. This is because the primary colours are very clear to the human eye.[67-68] In order to get around these rules, the RGB images that were found were changed into HSV files.

Features Selection Feature selection is a way to find the most important parts of the original set of characteristics. This method cuts down on the number of unnecessary iterations in the dataset. This makes the process run more smoothly and uses less memory to store the information. The process of choosing features helps make sense of the data, reduces the effect of the "dimensional curse," reduces the number of measurements that need to be done, improves the accuracy of learning, and tells the difference between features that may or may not be right for a given problem. [68] There are different ways to

choose which features to use, and this thesis uses three of them: the are information gain attribute evaluation, the chi-squared feature selection, and the mutual information feature selection. You can also choose features in more ways. In the sections that come next, we'll talk in detail about each of these algorithms.

3.3.3 Segmentation (Masking & Threshold based segmentation):

Segmentation is a two-step process. The first step is called masking, and the second step is called threshold segmentation. I masking of green pixels when the value of a certain pixel in an image is changed or set to zero, this is called pixel masking. As much as possible, sick parts should not be cared for more in the green part of the plant. This is because the green part of the leaves is the healthiest. If the intensity of the green pixels is higher than the default value, all of these settings will be reset to zero.

After masking, the pixels that had a value of 0 are taken out. After the masking step in the masking process, the values in the H and S planes are used to find the sick part of the blade and give it the number "1." The rest of the areas have all been given the value "0." The end result is a binary image made up of only ones and zeros. After that, the part of the leaf that is sick can be cut off.

Threshold segmentation- Using equivalent segmentation, which is based on how dark or light the image is, the image is broken up into sections. This simple and effective method is used to separate photos based on where they were taken. It depends on the threshold and works well. When working with a dark or black background that has light artefacts, this method is often used. The threshold algorithm chooses a value for the threshold T that is good for dividing image pixels into different groups and telling the object from thebackground. If a picture is said to be binary, it shouldn't be a surprise that it can have both 0 and 1 value. After this step, the first value of the RGB picture is added to the binary image. This will fix the part of the leaf that was sick. Both the knife mask and the resultant damaged region mask were used for this investigation. After the processing phase, change the RGB values of the image and multiply the mask for the "damaged" area. Since the mask only has the numbers 1 and 0, the part of the blade that is infected has the number 1. When this image is added to an RGB image, only the sick part of the image is shown.[69]

3.3.4 Feature extraction (GLCM)

For functions to be derived, the number of resources needed to represent huge amounts of data needs to be cut down. If the necessary tasks are to be done, the important information that was taken from the input data should be shown in a simplified version of the starting data, not in the whole set of starting data. Counting the building materials that make up the site can help you understand it better. Texture descriptors include things like smoothness, roughness, and regularity as examples of qualities. In this study, statistical methods are used to explain texture. In this process, the grey level co-occurrence is used to figure out how to evaluate the leaf image matrix.69 The GLCM matrix is a kind of matrix that is made by starting with an image of a certain picture I. This matrix makes a GLCM by deciding that a pixel with the value of grey will be shown next to a pixel with the value of colder j. In each I j) feature that GLCM has, the number of times that the pixel level with the I number is close to the pixel level with the j number is given. GLCM shrinks the image down to eight different shades of grey, but it is still a strong image. With the GLCM value, it is possible to get rid of textures. [69]

3.3.5 Classification Techniques

Neural networks help with the process of putting things into categories. During the phaseof "supervised learning," the "backscatter" method is taken into account. A neural network that uses feed-forward propagation usually has three layers: the input layer, the hidden layer, and the output layer. With the help of the data that was given, the neural network will be trained. Using neural networks, the method can tell the difference between two different diseases. Fusarium and Berry Place disease cause wilt. A fungus that attacks pepper plants causes berry place disease. Fertilizing plants that have been found to have this type of disease could be a good way to fix the problem. Different types of fertilisers, like Pseudomonas, can be used to feed these plants. A lack of nitrogen, magnesium, and potassium in the mineral makes the skin turn red quickly.[70] Because of this, the device can tell exactly what kind of disease it is, and if the disease is found, it can tell which plants need to have certain minerals added.

You can see the results of the tests that were done. The process of putting things

into categories is based on a method called "deep learning." One of the supervised learning methods that are taken into account is the back propagation method.

A backpropagation neural network usually has three layers: the input, the hidden, and the output. This is called a feedback loop going backwards. The information will be used to tell the neural network how to work properly. [71] Convolutional neural networks are made up of several important layers. The most important are the input layer, the convolution layer, the pooling layer, the fully connected layer, the activation functions, and the frequently rectified units (ReLUs) layer. Architectures are different in terms of how many layers they have, how those layers are set up, and how many extra image processing units (if any) theyhave.

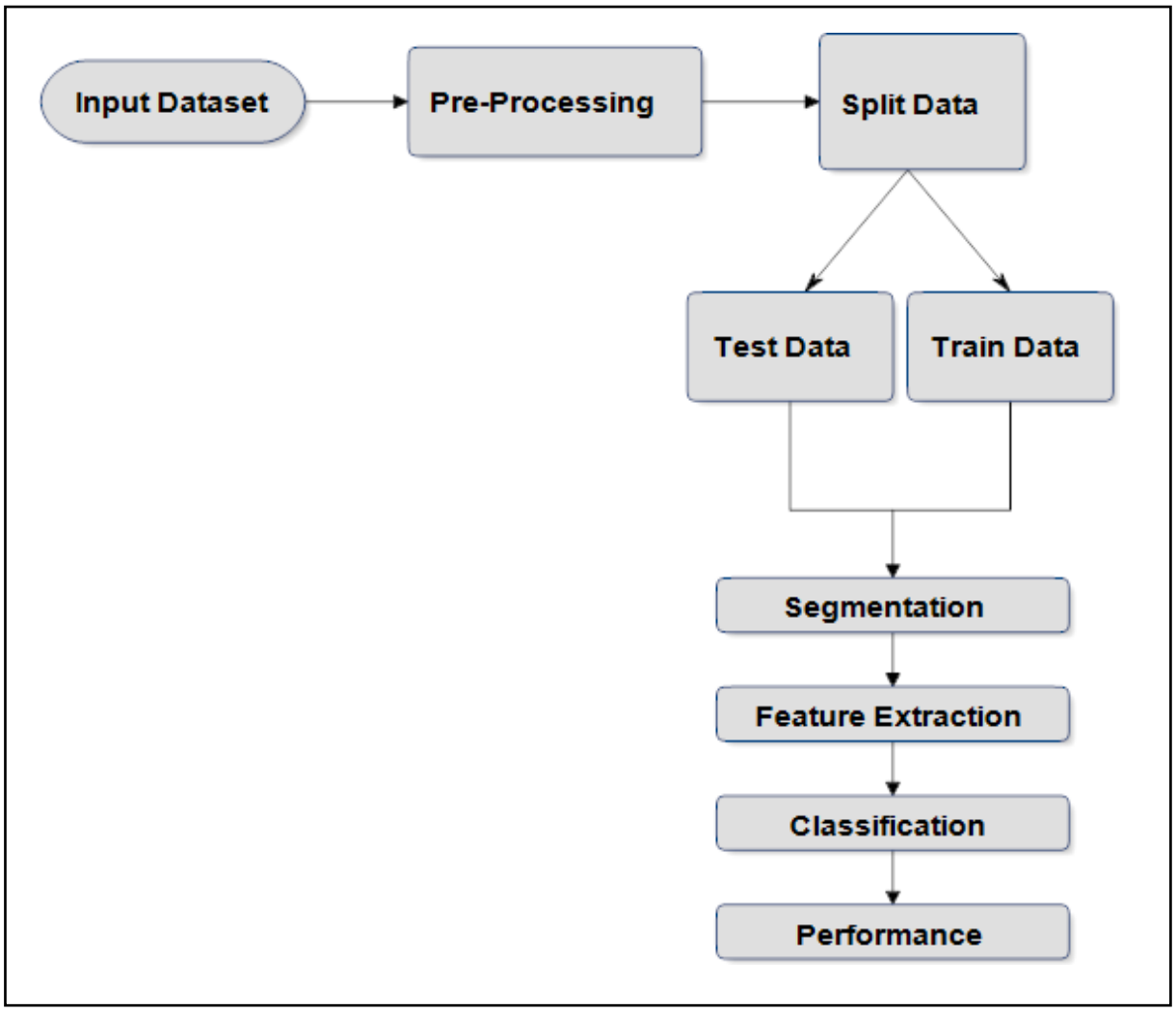

Figure 3.4 Architecture Diagram

3.4 ResNet50

ResNet50 is a model that has one MaxPool layer, 48 Convolution layers, and one Average Pool layer. Experts agree that as the number of convolutional layers in the model goes up, the model's performance will steadily get better. On the other hand, it has been pointed outthat overfitting and problems with vanishing gradients make the model's real performance worse.[72] ResNet gets around this problem by adding skip connections to the process that happens before the ReLu activation function is used. A problem with a gradient that goes away can be fixed with skip connections, which let the gradient flow through a different, shorter path. They also let the model learn an identity function, which makes sure that the performance of the higher layer is at least the same as or better than that of the lower laye An architectural diagram is a diagram of a system that is used to abstract the overall layout of the software system as well as the interactions, constraints, and boundaries between the various components. This type of diagram is also known as an architectural blueprint. Itoffers a comprehensive perspective on the physical deployment of the software system aswell as its evolution plan, making it an essential instrument.

3.6 Use Case Diagram

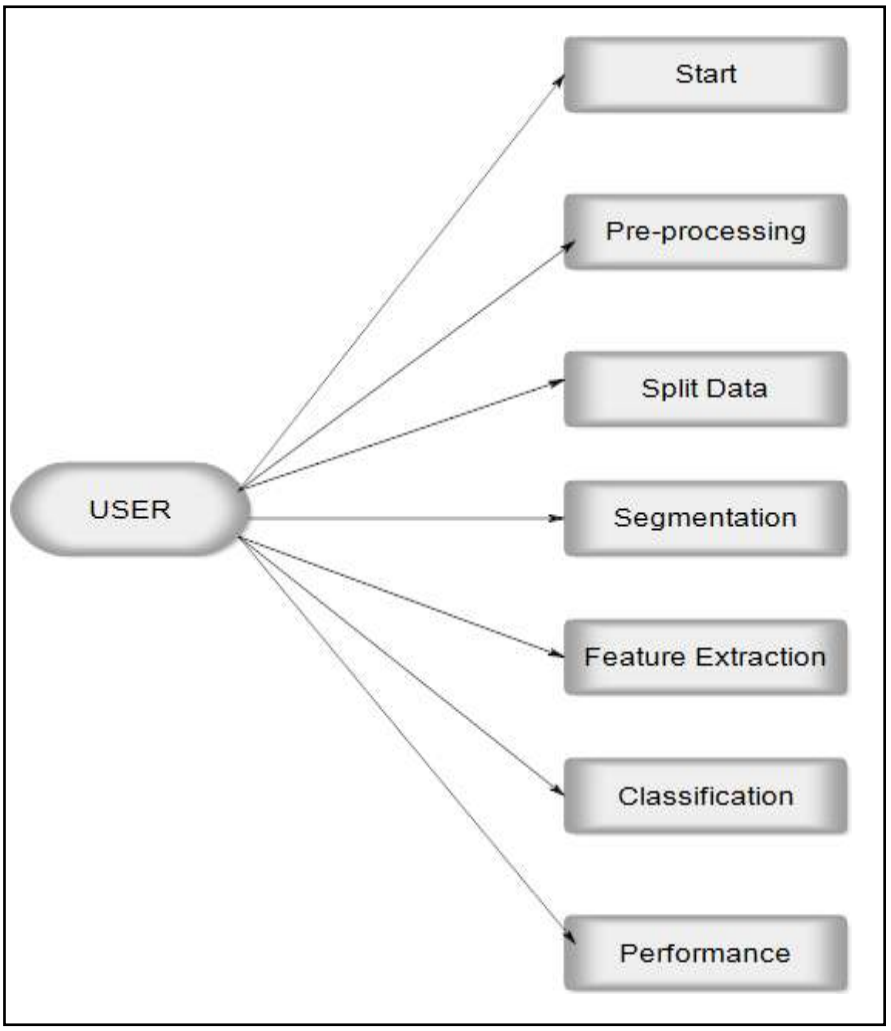

Figure 3.5 Use Case Diagram

A use case diagram is a kind of diagram that can be used to sum up information about a system and the people who use it. Most of the time, it looks like a picture of how the different parts of a system interact with each other.

3.7 Sequence Diagram

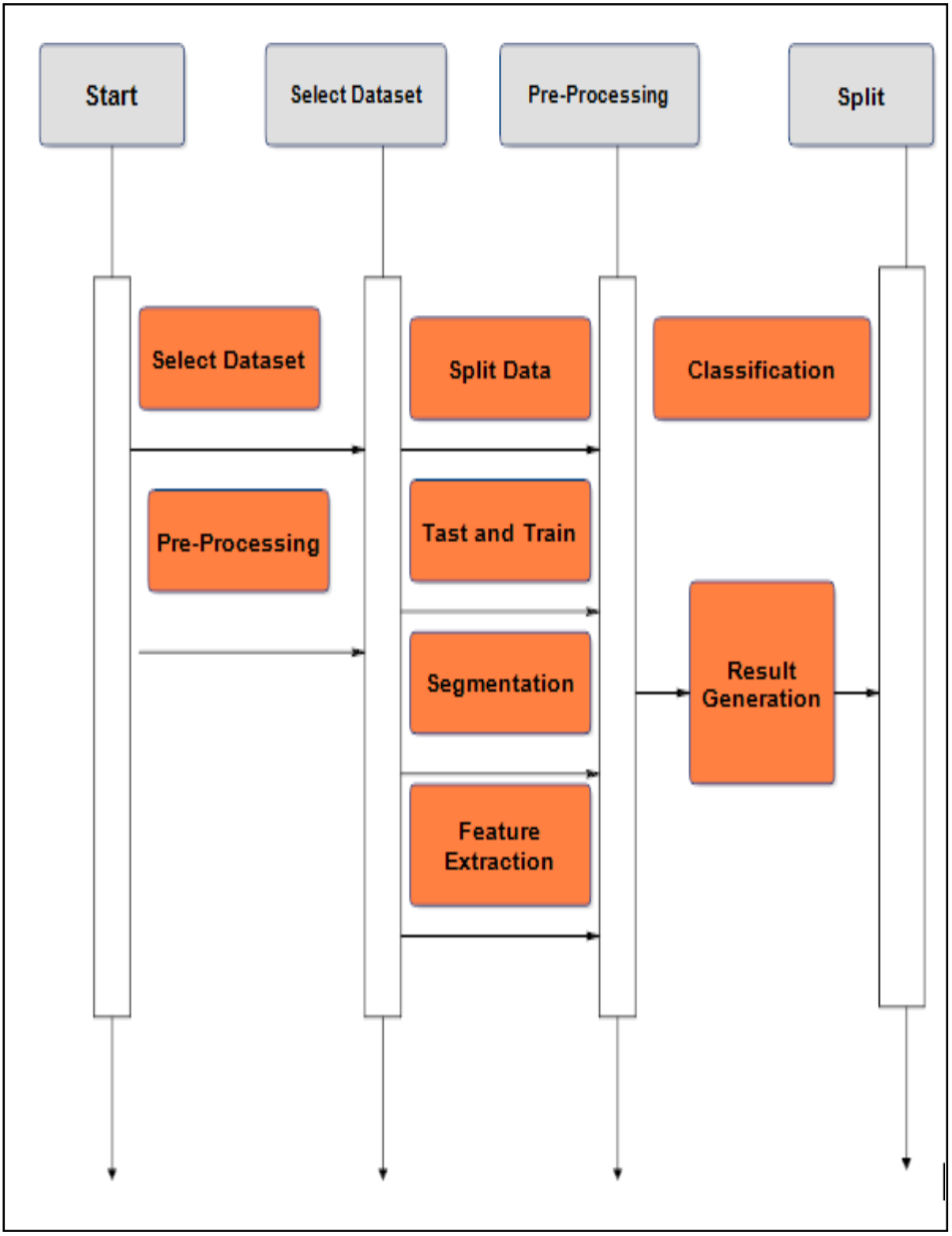

Figure 3.6 Sequence Diagram of the Model

A sequence diagram is a form of interaction diagram because it illustrates the interactions between a collection of items and the order in which they occur.

3.8 E.R. Diagram

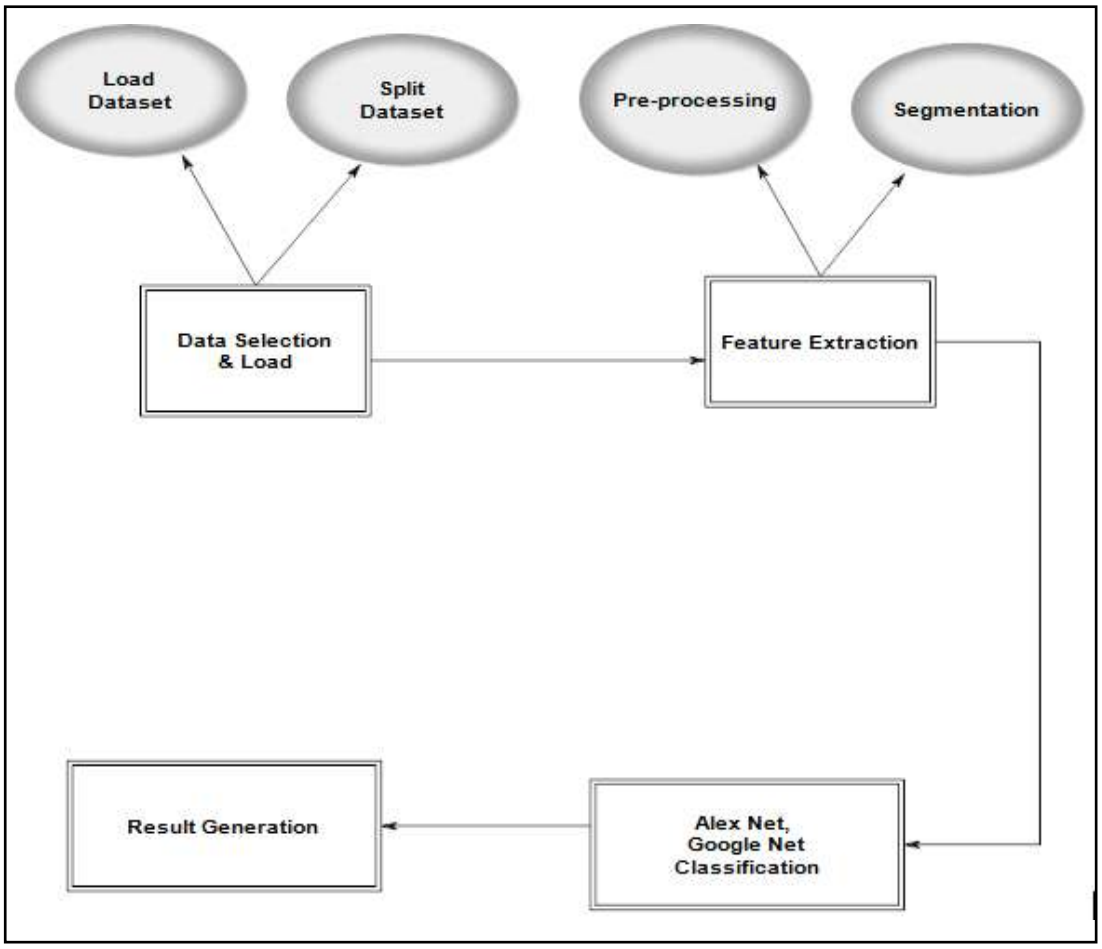

Figure 3.7 E.R. Diagram

A graphic representation of relationships between items is called an entity relationshipdiagram (ERD), sometimes known as an entity relationship model.

CHAPTER 4
PROPOSED SYSTEM
AND
RESULT DISCUSSION

4.1 Proposed System

The goal of this study is to find a way to find people infected with COVID-19 early on while reducing the number of false positive results. Figure 4 shows a summary of the steps that were taken to make the predictive system.

The website https://www.kaggle.com/tawsifurrahman/covid19-radiography-database was used to get a dataset that was used in this study. The photos on this website came from many different places. Due to the limitations of the computers that were available, only 2000 of the photos in the dataset were used in the experiment. The model put the picture into one of two groups: COVID-19 Positive or (ii) COVID-19 Negative. There are pictures of both the good and bad results of the COVID-19 test. Predicting diseases caused by viral infections is a hard medical task that requires a lot of real data made up of many different variables. COVID-19is known to be the deadliest disease on the planet, but no one has found a cure for it yet.

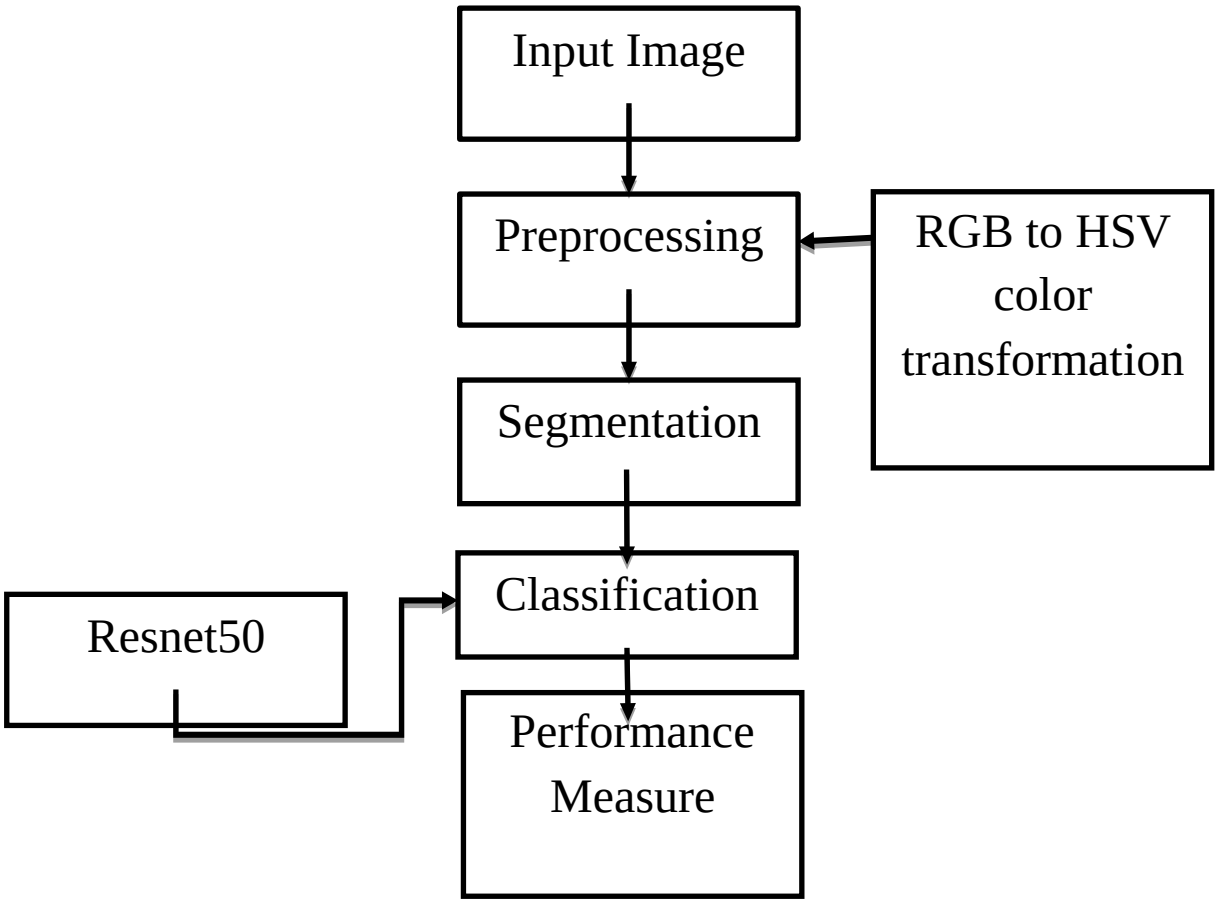

Fig.4.1 Proposed Flow Diagram

To stop the spread of this virus, it is important to find a logical way to show how it spreads by using data from a large number of people who have been infected. An algorithm was made that uses the ResNet50 functions of three different artificial neural networks to predict COVID-19. We put DL algorithms to work on the extracted dataset of COVID-19 patients to find out how bad the symptoms were. It was checked to see how well this model worked. used the programming language MATLAB to put DL techniques into use.

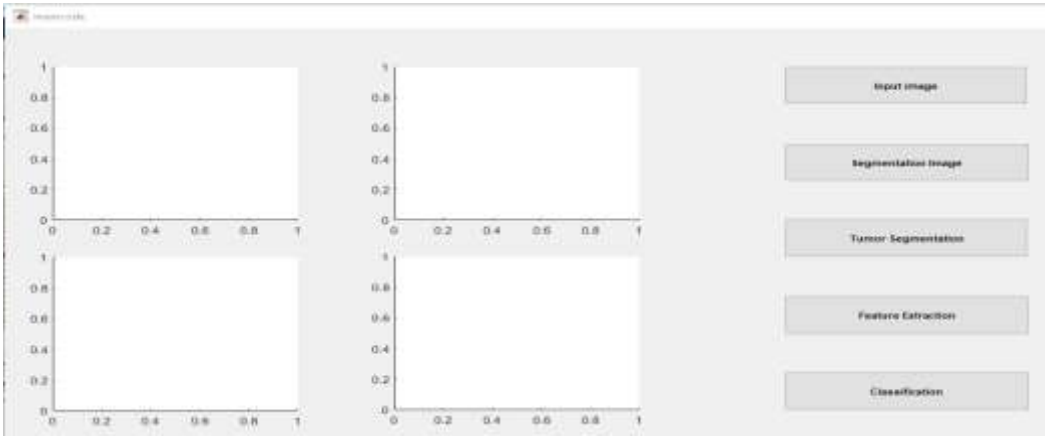

Fig.4.2 GUI Window

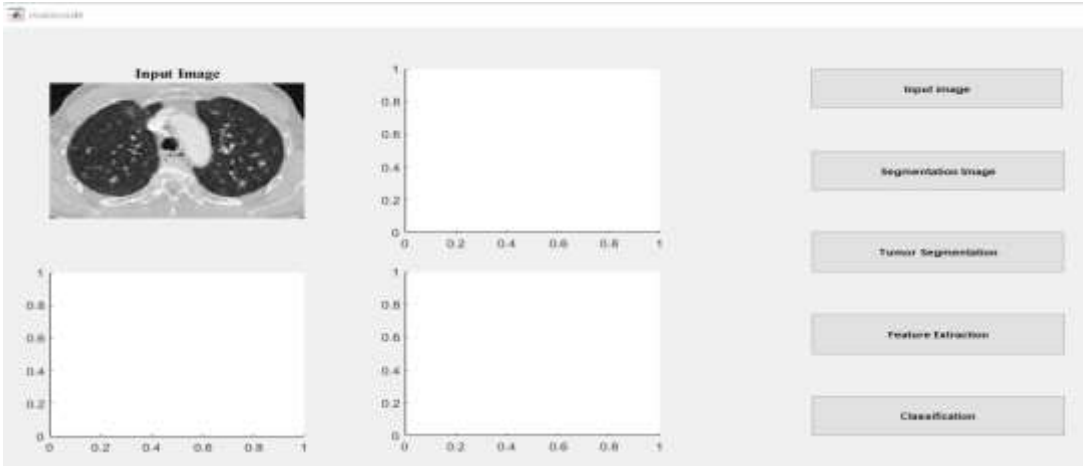

Fig. 4.3 Input Image

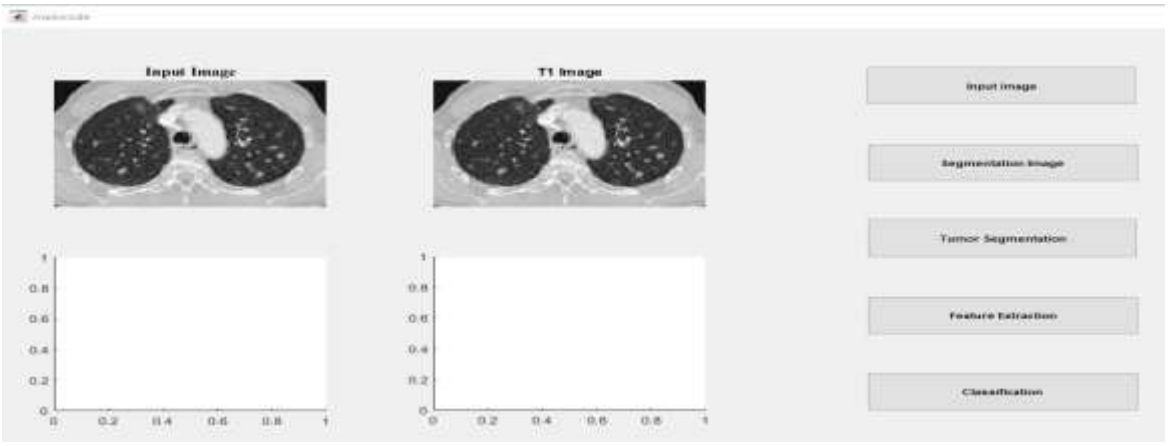

Fig. 4.4 Pre-Processing Image

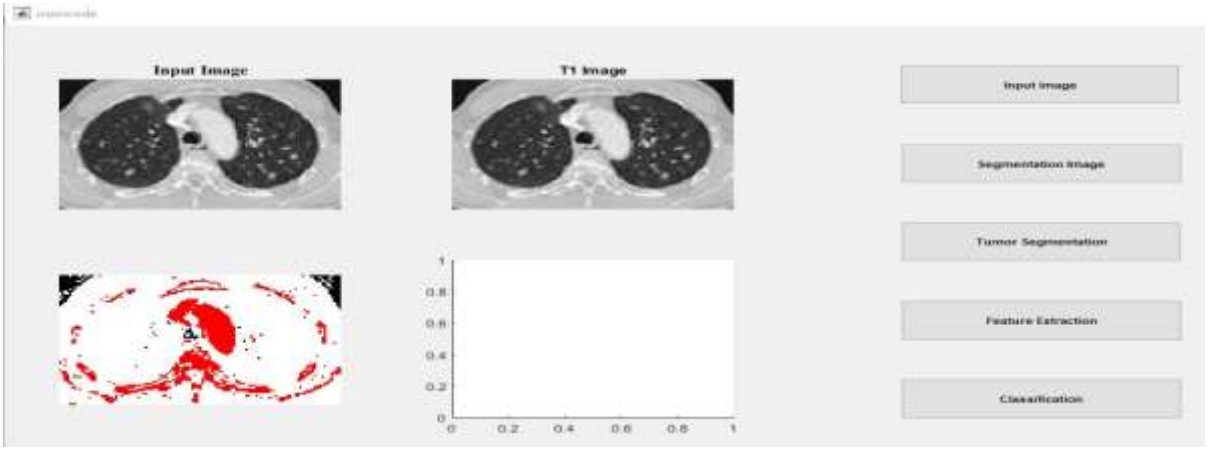

Fig. 4.5 Segmentation Image

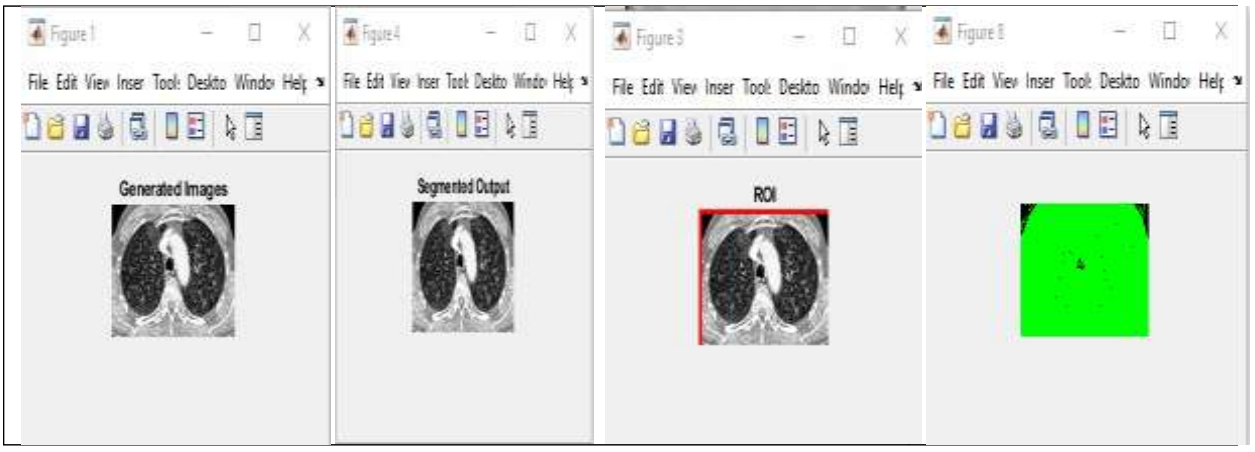

Fig.4.6 Generated Image, Segmentation, ROI,Feature Extraction

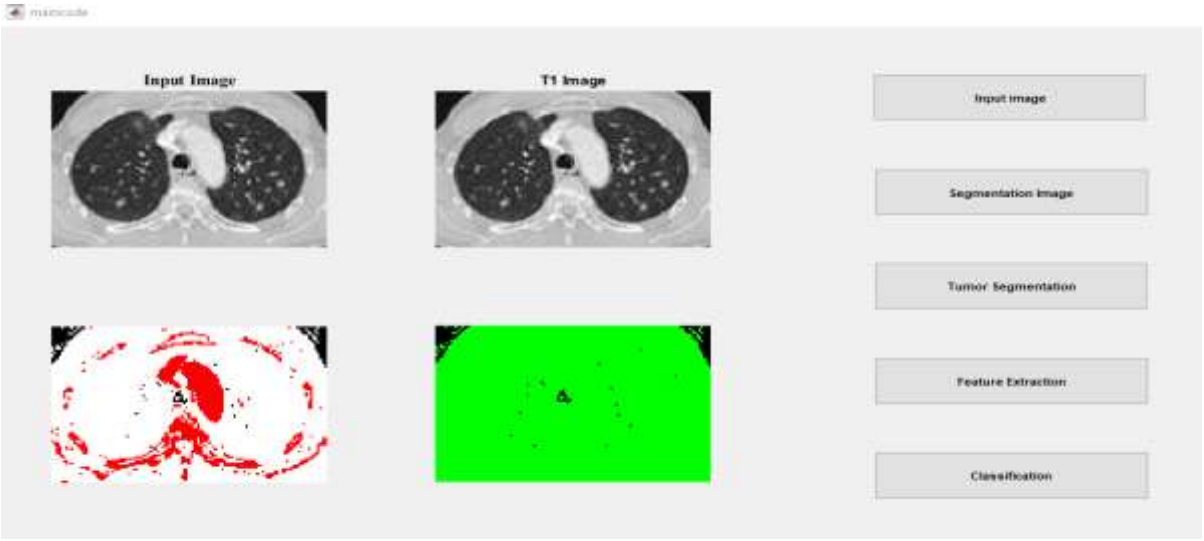

Fig.4.7 Feature Extraction

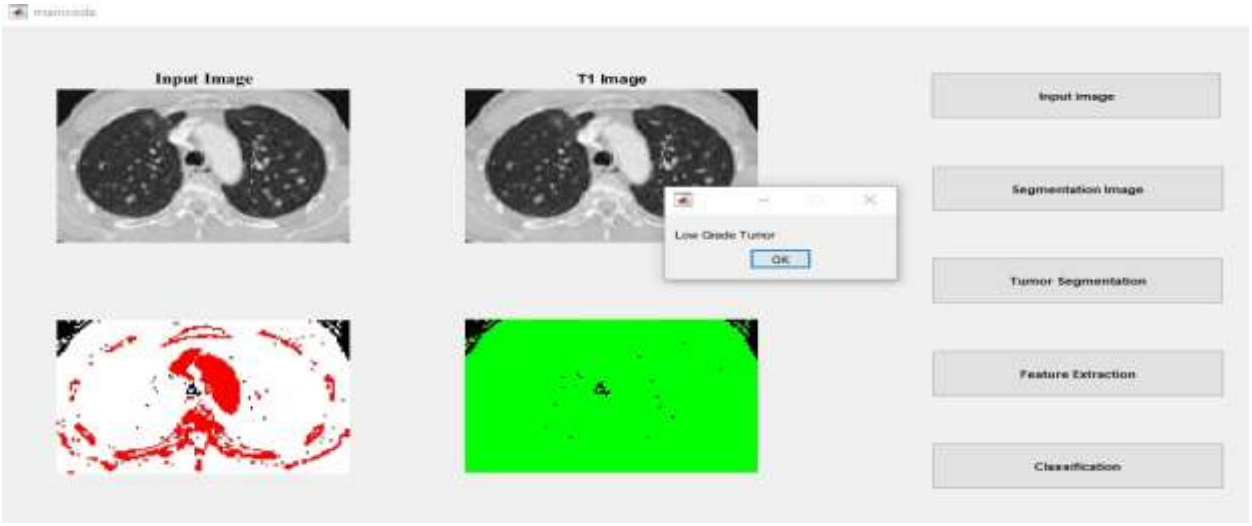

Fig 4.8 Classification image

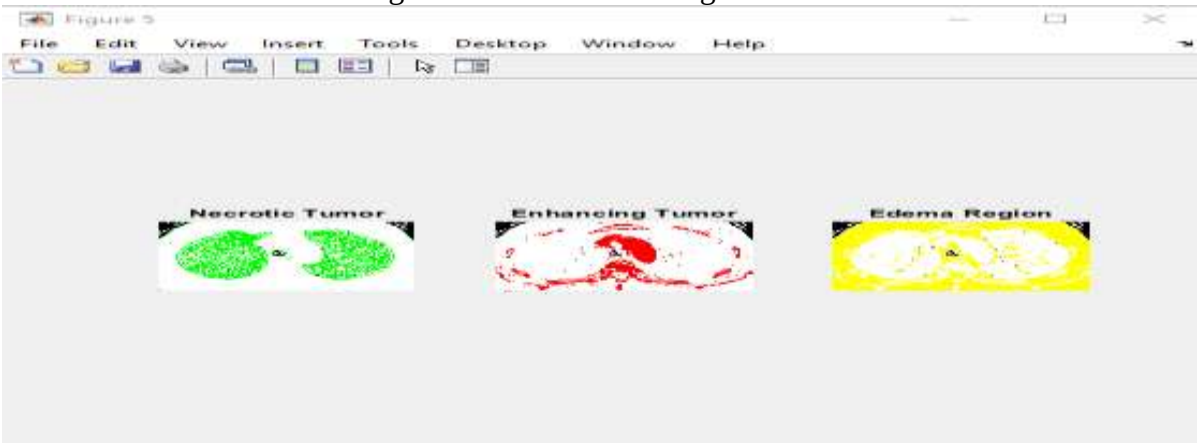

Fig.4.9 Classification image

4.2 Result Discussion

4.2.1 Performance Evaluation Matrix

The confusion matrix is important because it shows how many predictions based on knowntrue values are right and how many are wrong. This data is used to figure out how well the classifier works. True Positive (TP): When both the actual value and the model's predictionof that value are right; True Negative (TN): When both the actual and expected numbers are off by the same amount; False Positive (FP): When the actual value is false, but the model thought it would be true. False Negative (FN): When the actual value is true, but the model expected it to be false. [73] The **letters FP and FN stand for "False Positive" and "False Negative," respectively.**Intersection over Union (IOU): The IOU, which is sometimes called the Jaccard Index, is a good way to measure how much two bounding boxes or masks in a segmented image overlap. IoU is the area where the ground truth segmentation and the predicted segmentation overlap, divided by the area where the ground truth segmentation and the predicted segmentation meet. This metric goes from 0 to1, which is the same as 0% to 100%. When the value is 0, there is no overlap, and when thevalue is 1, there is perfect segmentation overlap. Our goal is to get an IOU value of 97% or higher while following a guideline of 0.5.

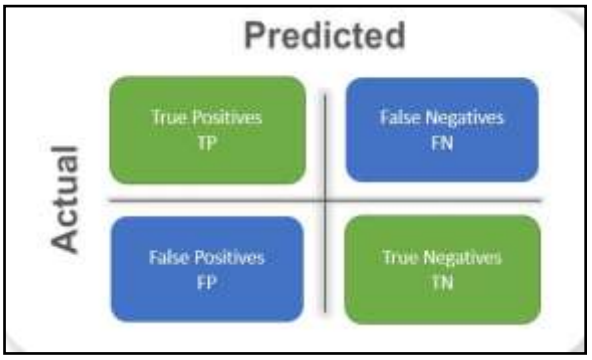

Figure 4.10 Model evaluation parameters

Green region: Our model estimates 1 (lesion mask) and the ground truth is 1. (True Positive, TP)

Blue region: Our model estimates 1 (lesion mask) but the ground truth is 0. (False Positive, FP)

Our model estimates 0 (absence of lesion) but the ground truth is 1. (False Negative, FN) Our model estimates 0 (absence of lesion) and the ground truth is 0. (True Negative, TN)

Table 4.1 Model Evaluation Parameters

Technique	TP	TN	FP	FN
ResNet50	68.6503	70.7625	31.3497	29.2375

Evaluation Metrics

The accuracy of the classifier can be evaluated with the use of a different evaluation metrics, which tally the number of accurate and inaccurate predictions that were generated based on values that are already known.

TP-A True Positive, abbreviated as TP, is one in which the model properly predict correct class.

TN -True Negative (TN) is a situation in which model properly predicts negative class.

FP -It is possible to have a False Positive, also known as an FP is one in which the model erroneously predict correct class.

FN-False Negative also known as a FN is a situation in which model erroneously predicts negative class

In the proposed work, following evaluation metrics are used for performance assessment.

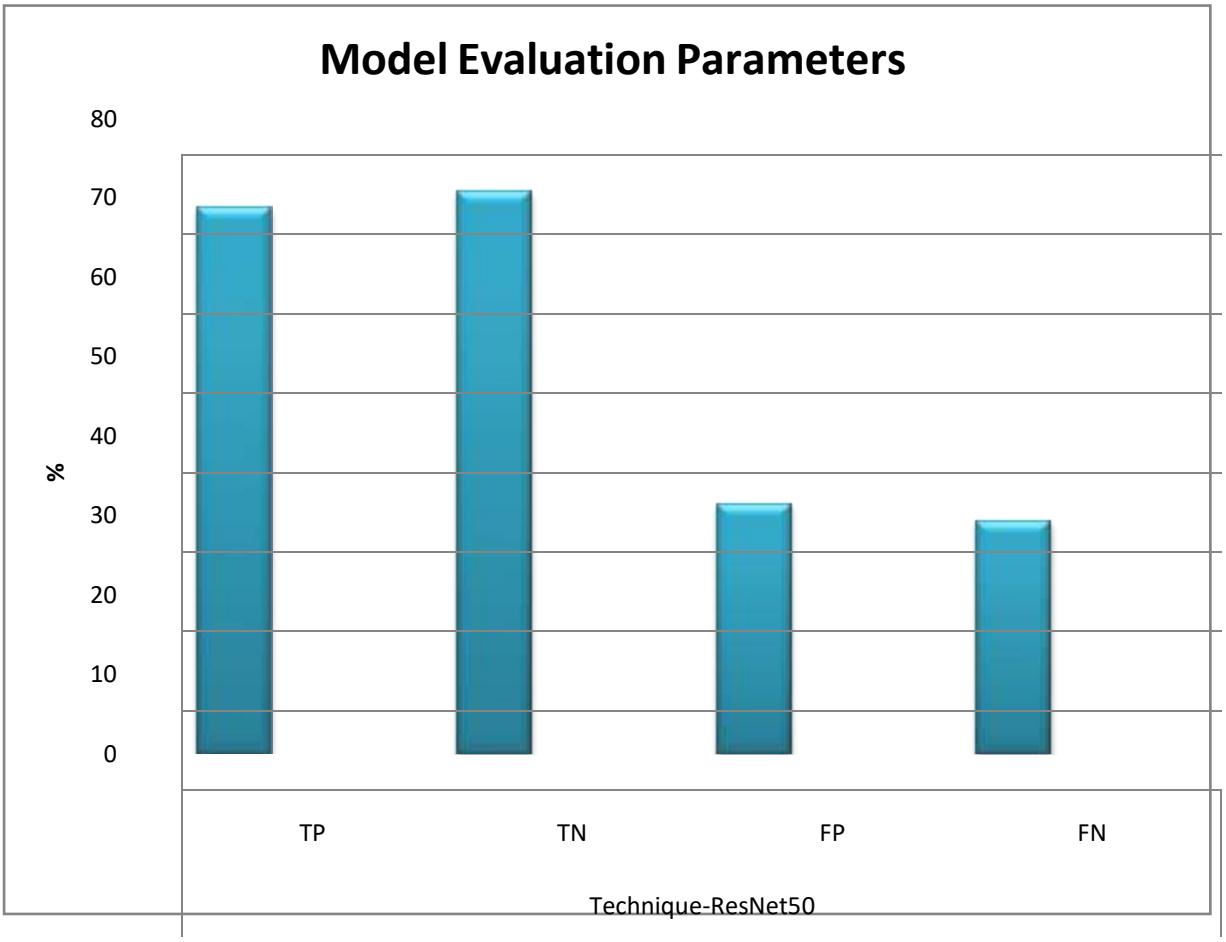

Fig.4.11 Model Evaluation Parameters

Accuracy: Accuracy is a measure of how frequently a model predicts the correct result basedon the input. However, it does not provide specific information on FP and FN. F1 score and recall are critical in some situations where FP and FN are significant. The formula in equation
4.1 is used to calculate accuracy.

$$\text{Accuracy} = \frac{\text{True Positive} + \text{True Negative}}{\text{True Positive} + \text{True Negative} + \text{False Positive} + \text{False Negative}} \quad (4.1)$$

Precision: This assessment parameter indicates how often a model predicts genuine

positives. A low accuracy rating implies a large number of false positives. Equation 4.2 presents a formula for calculating precision.

$$\textbf{Precision} = \frac{\textbf{TP}}{\textbf{TP+FP}} \qquad (4,2)$$

Recall: This parameter gives information about how often a model makes wrong negative predictions.[74] The fact that the recall value is low suggests that the model was wrong about a large number of true positives. Equation 7, which can be found below, shows how to figure out the recall.

$$\textbf{Recall} = \frac{\textbf{TP+TN}}{\textbf{TP+FN}} \qquad (4,3)$$

Dice Coefficient (F1 Score): The dice coefficient is a way to measure how much two masks overlap each other. 0 means there isn't any overlap, while 1 means there is a perfect overlap. You can figure out the Dice Coefficient by dividing the Area of Overlap by the total number of pixels in both images by two. There is a link between this number and the IOU. The most important goal is to get a score of at least 95% on the F1 test.

$$\textbf{Dice} = \frac{|\boldsymbol{A}\cap\boldsymbol{B}|}{|\boldsymbol{A}|+|\boldsymbol{B}|} = \frac{\mathbf{2*\,TP}}{\mathbf{2\,*(TP+FP+\,FN)}} \qquad \textbf{(4.4)}$$

F1 Score: Precision and recall are combined to calculate the F1 score. That is, a high F1 score suggests a low number of false positives and false negatives,[74,75] implying that the model detects true elements accurately and is unaffected by false alarms. Equation 4.3 shows the formula for determining the F1 score.

$$\textbf{F1 score} = 2 * \frac{\textbf{Precision*Recall}}{\textbf{Presiion+Recall}} \qquad \textbf{(4.5)}$$

Jaccard Similarity - Paul Jaccard created the term "Jaccard Similarity," which is defined as the size of the intersection divided by the size of the union of two sets. In basic words, wemay calculate the Jaccard similarity as the number of items shared by the two sets divided by the total number of objects. The similarity term will be 1 if two datasets have the same members. In contrast, if the two sets share no members, the term will be 0. Equation 4.4 shows the formula of it.

$$\textbf{J(A, B)} = \frac{|\boldsymbol{A}\cap\boldsymbol{B}|}{|} \qquad \textbf{(4.6)}$$

$|A \cup B|$ $|A|+|B|-|A \cup B|$

Specificity - Specificity can be thought of as the ability of the algorithm or model to correctlypredict a true negative for each of the given categories.[76] In some places, it is also called the "real negative rate," which is a more straightforward name. In math terms, you can figure it out by using the equation that is given below.

$$\textbf{Specificity} = \textbf{Recall} = \frac{TN}{TN+FP} \quad \textbf{(4.8)}$$

Table 4.2 Classification and Segmentation Evaluation Parameters

Technique	Accuracy	Sensitivity	Specificity	Recall	F-Score	Jaccard Coefficient	Dice Coefficient
ResNet50	92	70.1316	69.2987	70.1316	0.6938	0.5312	0.6938

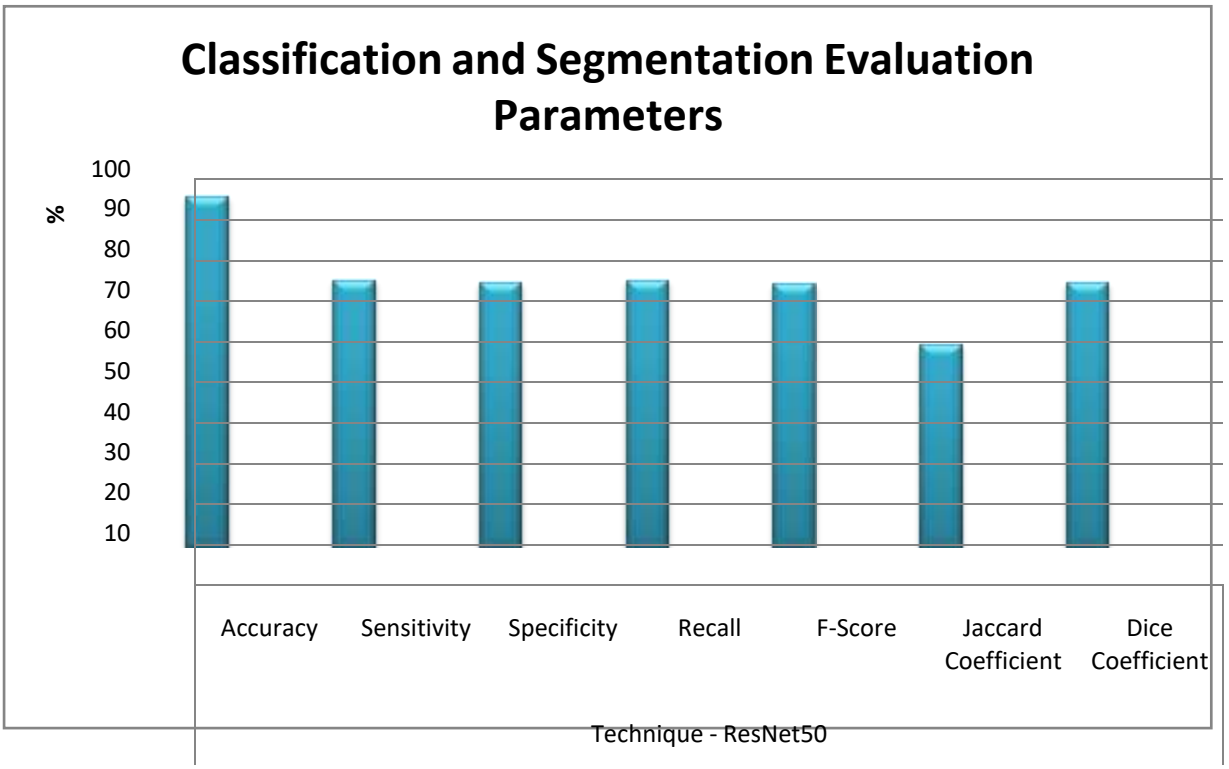

Fig.4.12Classification and Segmentation Evaluation Parameters

Positive Predictive Value (PPV) and Negative Predictive Value (NPV) - It is the number of patients who had positive test results divided by the number of patients who had a positive diagnosis (including healthy subjects who were incorrectly diagnosed as patient). [77] If the test works, you can figure out how patient a person is likely to be in real life based on whether they have this trait or not. Both the positive predictive value (PPV) and the negative predictive value (NPV) are directly related to how common a disease is and tell you how likely it is that a patient has a certain condition.

Positive Predictive Value (PPV) =

100xTP/(TP+FP) Negative Predictive Value

(NPV) = 100xTN/(FN+TN) Table 4.3 Predicted

value Results

Technique	PPV	NPV
ResNet50	68.6503	70.7625

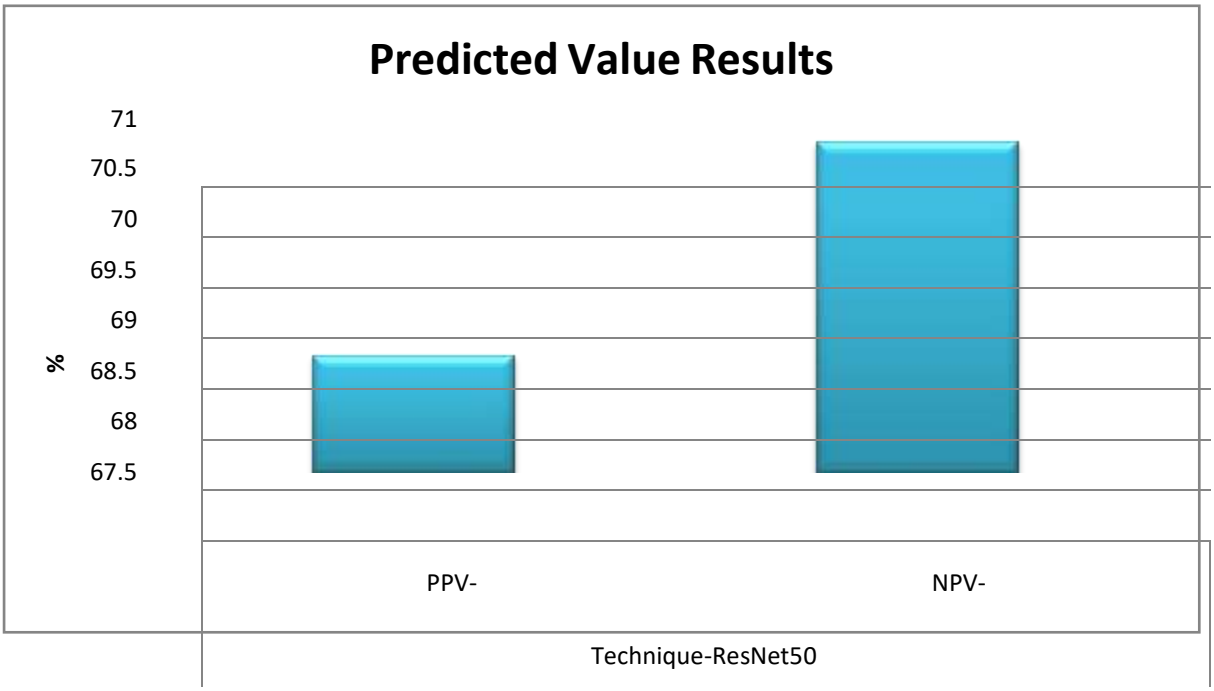

Fig 4.13 Predicted value Results

CHAPTER 5
CONCLUSIONS

5.1 Conclusions

This work is a state of the art that gives an overview of some of the most important digital solutions that have been used around the world for COVID-19 disease screening and diagnosis, contact tracing, drug and vaccine development, prognosis and forecasting, and contact tracing. There is also separate information about each scientific contribution, such as the nature of the application, the used machine learning techniques and the findings from a data science perspective. It will be demonstrated that the rapid development of automated diagnostic systems based on machine learning not only protects healthcare personnel by reducing the number of times they interact with COVID-19 patients, but also saves money, expedites the process, and improves the accuracy of diagnoses. All of these benefits will be discussed.

5.2 Future Scope

There is a lot of potential for using deep learning for the prediction of the spread and impact of future pandemics, including COVID-19. Deep learning algorithms can analyze large datasets and identify patterns that may be difficult for humans to discern. Here are a few examples of how deep learning could be used in this area:

Predicting the spread of the virus: Deep learning algorithms could be trained on data from previous pandemics and outbreaks to predict the spread of COVID-19. They could take into account factors such as population density, travel patterns, and public health interventions to make accurate predictions.

Identifying high-risk areas: By analyzing data on factors such as age, pre-existing health conditions, and location, deep learning algorithms could identify areas that are at higher risk of experiencing severe outbreaks of COVID-19. This could help public health officials to target their resources and interventions more effectively.

Developing treatments: Deep learning could be used to identify potential treatments for COVID-19 by analyzing large datasets of medical research and patient data. It could identify patterns in the data that might not be apparent to human researchers and suggest novel treatments or drug combinations.

the future scope of corona prediction using deep learning is promising. With continued research and development, we may be able to use these technologies to better predict, prevent, and treat pandemics like COVID-19 in the future.

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Covid 19 disease detection and classification based on RESNET50 Deep learning technique

Dissertation

Submitted in partial fulfillment for the award of Post Graduate Degree of Master of Technology in Computer Science Engineering

Submitted to

RAJIV GANDHI PRODYOGIKI VISHWAVIDYALAYA, BHOPAL (M.P.)

Submitted by

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Prof. Mohit Jain

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

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