AI Based Covid19 Analysis-A Pragmatic Approach

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Abstract In this chapter, we provide detailed background about Covid-19. Then, we discuss the recent approaches of AI based techniques to prevent and predict Covid-19. We also detail about the forecasting methods for analyzing the trends of the affected patients all over the world. We highlight the main datasets utilized in the image based Covid analysis. We also provide a detailed discussion on the use cases how AI can be used in different applications for Covid-19 analysis.

1 Introduction

Wuhan, Hubei province in central china is densely crowded city with a population of 11 million, reported the earliest cases of pneumonia of unknown etiology on 17th November 2019. On 7th January, Chinese Centre for Disease Control and Prevention (CCDC) identified the causative agent from the throat swab samples of the patients and thereupon named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) which was later named as COVID-19 by World Health Organization (WHO).

At present, it has been observed that majority of the patients have developed mild symptoms such as sore throat, high fever and dry cough however fatal complications including severe pneumonia, organ failure, septic shock and Acute respiratory distress syndrome has also been noted during severe stages of disease. The scenario is much more complicated for elderly population with previous record of hypertension, diabetes or respiratory disorders.

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1.1 Motivation and Contributions

For mass prevention and protection different countries have come up with varied measures to counteract this infectious disease. Technology is being used not only for drug discovery but efforts are being done in tracing the patients and detection of Covid-19 using the advances in artificial intelligence techniques. This will ease the job of the health workers in early diagnostics without manual intervention. Even lot of traction has been seen where the data scientists are trying to model the infectious disease and find the short term forecasting of Covid-19. Nowcasting is a term where in absence of any data, one can predict the current levels. However, the AI can work or predict for these tasks if there is some data available, due to the unprecedented crisis of Covid-19 currently no much data is available. In order to mitigate this problem, lot of data scientists and researchers are creating open forums for collaboration for data curation.

Since, it is highly new problem which has emerged and become such a menace to deal with, not many works are trying to bridge the gap of the utilization of AI in dealing with Covid-19 crisis. Through this chapter, we have addressed this knowledge gap by providing holistic information to the readers in terms of (i) understanding the finer details of Covid-19, (ii) Prevention measures and efforts towards treatment being done, (iii) Role of AI in managing the crisis, (iv) Mathematical preliminaries of infectious disease modeling and (v) AI based application case scenarios. We envisage that this amalgamation of technology with real crisis situation and documentation about it will allow more collaborative works. To the best of author’s knowledge, this chapter is a unique effort which provides comprehensive knowledge on how advances in AI can be leveraged in Covid-19 disease modeling and diagnostics.

1.2 Section Organization

To this end, in the next few paragraphs, the reader is introduced to the evolution and inception of Covid-19. We believe that in order to appreciate the AI utility in mitigating and fighting the problem of Covid-19, the reader should be familiar with fundamentals of the Covid-19 disease evolution. Therefore, detailed discussion on state of the art work is deferred till the end of this chapter. Then, we go through an in-depth literature survey of the latest works in the three subjective areas including images, big data analytics and drug discovery and the role of AI in each. Lastly, we open the scope of research avenues in dealing with Covid-19.

In Sect. 2, we discuss the global scenario due to Covid-19 crisis and the pathophysiology of Covid-19. In Sect. 4, we outline the guidelines given by WHO to prevent Covid-19. In Sect. 3, we provide transmission details. In Sect. 5, we discuss the diagnostic processes. In Sect. 6, we discuss in detail the treatment processes being done by doctors and pathologists. In Sect. 7, we provide the comprehensive literature review of AI based analysis. In Sect. 7.5 gives the role of mathematical modeling
of infectious diseases and subsequently Sect. 8 gives the mathematical preliminaries behind it. In Sect. 9, we discuss the datasets related to Covid-19 image diagnostics. In Sect. 10, we give the application case scenarios for the role of AI in Covid-19 monitoring and diagnostics. Finally, we provide the conclusion in Sect. 11.

2 Global Health Emergency Declared by WHO

WHO declared the outbreak of COVID-19 as Public health emergency on 30th January 2020, however they strongly believed that virus spread could be interrupted by encouraging the countries to detect early case, quarantine them and take measures to treat them effectively. Also, contact tracing is equally mandatory along with promoting social distancing in order to prevent further cases. They also emphasized upon the need of pathogen genome sequencing to understand its pathophysiology and transmission cycle which could pave its way for the early treatment approach globally. Meanwhile, they coordinated upon the policies essential to ensure rapid development and access to potential vaccines development, diagnostics kits, antiviral medicines and other supplementary therapeutics to prepare the low-and middle-income countries to overcome the risk associated with the outbreak. Besides, it was announced worldwide to restrict travel and trade for the time being to further prevent the spread of novel corona virus. The recent update of COVID-19 infected cases and total death incurred along with other essential details is provided on corona virus worldmeter web portal [1].

2.1 Global Scenario

As of 28th March 2020, COVID-19 has affected 210 countries and territories around the world. Currently, it has been reported that more than 3 million are affected by this deadly virus, which has claimed more than nearly 2 lakh lives however more than 9 lakh were able to recover themselves from this life-threatening virus. WHO Director-General Dr. Tedros Adhanom Ghebreyesus in his opening notes stated the severity of COVID-19 (3.4%) against the seasonal flu (less than 1%). The world is coming together to combat the COVID-19 pandemic bringing all the administrators, management groups from across industries and sectors and individuals together to help respond to this global outbreak. The Strategic preparedness and response plan outlines a funding need of at least US $675 million for critical response efforts in countries most in need of help through April 2020 to encounter the current scenario. In order to effectively manage the crisis of COVID-19, EU mobilized 10,000,000 into the research fund to manage infected case along with future preparedness [2]. United kingdom (UK) government has also invested £20,000,000 to develop COVID-19 [3].
In addition, Chinese central bank also invested 150 billion to support the stability of the current market [4]. On similar lines, various countries are cutting their expenses to utilize their funds judiciously to fight battle against the novel coronavirus.

### 2.2 COVID-19 Pathophysiology

Corona virus (CoVs) belongs to subfamily Orthocoronavirinae of the Coronaviridae family (order Nidovirales) and classifies into four genera of CoVs: (i) Alphacoronavirus (alphaCoV), (ii) Betacoronavirus (betaCoV), (iii) Deltacoronavirus (delta-CoV), and (iv) Gammacoronavirus (gammaCoV) [5]. They are positive-strand RNA viruses genome contains 29891 nucleotides, encoding for 9860 amino acids with a crown-like appearance under an electron microscope due to the presence of spike glycoproteins on the envelope [6].

The Coronaviridae family virus have well established records to cause respiratory, neurological and hepatic diseases in different animal species, including camels, cattle, cats, and bats. Till date, seven human HCoVs (Human coronavirus) have been identified which are potent enough of infecting humans. The earlier HCoVs were identified in the mid-1960s, while others were only detected in the new 21st century. Approximately 2% of the entire population are the active carriers of corona virus who could make a transmission chain to infect numerous if not controlled at the right time. Around 5–10% of the respiratory diseases are the true source of these viruses infec- tion manacles [7]. The genomic isolation of this new HCoVs from Wuhan patients has shown 89% resemblance with bat SARS-like-CoVZXC21 and 82% with that of human SARS-CoV hence, the new virus was called SARS-CoV-2 [8]. Bioinformatics based genomic sequencing has also shown that probably bats and rodents are the gene sources of alpha CoVs and beta CoVs [9]. Despite the fact that, SARS-CoV-2 has resembled bat genome, it is difficult to claim upon its existence species because it’s genome is vulnerable to numerous mutations. Thus, SARS-CoV-2 belongs to the betaCoVs category.

Once the virus enters into the host body, its spike protein binds with human angiotensin-converting enzyme 2 (ACE-2) receptors which are present on the surface of the host cell. Next occurs the activation of spike protein of the virus due to the binding of type II transmembrane serine protease (TMPRSS2) to ACE-2 protein which is responsible of its cleavage. Then, this cleaved ACE-2 receptor and activated spike protein assist the viral entry into the host machinery. Host immune system is triggered by the viral entry and inflammatory cascade begins by antigen-presenting cells (APC) which further stimulated B-cell production to facilitated antigen-antibody reaction [10]. Cellular uptake of the corona virus increases by the expression of TMPRSS [11]. ACE-2 receptors are innumerably present in hypertensive and diabetic population hence these groups of individuals are advised to strict government advisories to follow all the essential norms [12].
3 Transmission of SARS-CoV-2

Huanan Seafood Wholesale Market of Wuhan, has been spotted for the first transmission case of this deadly virus from an animal to human communication [13]. Thereafter, a transmission chain was established from human-to-human through both symptomatic as well as asymptomatic transmission. Coughing, Sneezing and physical contact were recognized as most attacking weapons to spread the disease [14]. The primary transmission occurs among the family members and close contact of an infected individual which eventually turns into community spread if concrete measures were not taken timely. Since then, government has uploaded the advisory to maintain social distancing aiming to cut this transmission chain [15]. As per the investigation, it was proclaimed that the incubation time may vary from 2 to 14 days (95% CI, 9.2 to 18) [16]. The doubling rate of case was found to be seven days on an average scale and each patient can transmits the infection to an additional 2.2 individuals [17]. However, with increased investigations and studies over the time there is a fair chance that these results might get change.

4 Prevention

It is well stated that “Prevention is always better than cure”. This pandemic will never end until concrete prevention policies are being adopted globally. Careful prevention strategies need to be focused upon the isolation of patients and tracing back their contacts. WHO and other organizations have issued the following guidelines as a preventive measures [18]:

- To restrict close contact with someone manifesting the symptoms of acute respiratory infections.
- To maintain personal hygiene.
- To restrict unprotected contact with farm animals.
- To promote social distancing
- Immuno-compromised individuals, elderly population and children below 10 years of age should avoid public gatherings as much as possible.

Apart from these crucial measures, frequent hand washing is strongly recommended to wash away the lipid envelope of the virus with the soapy lipid layer [19]. Respiratory etiquettes during sneezing and coughing needs to be adopted, following that hand sensitization would vanish the possible chance of infection [20]. One should avoid touching eyes, noses and mouth after interacting with a possible infectious source. Use of mask is the best remedy to protect the transmission through droplets or aerosols however the proper discarding protocol of mask after use is equally essential [21]. Health workers and armed forces are the front line warriors during this pandemic, their protection is the utmost responsibility for the nation. Use
of PPEs such as N95 masks, eye googles, gowns, gloves and protective shoe covers are strongly recommended while working in the hospital and other contagious environment [22].

5 Diagnosis

Epidemiological record and medical expression fabricates the ground of clinical diagnostic approach for COVID-19 infection. These approaches has been classified as: (1) Nucleic acid detection; (2) Immunosorbent assay; (3) Imaging technique; and (4) Blood culture. Until now, sign and symptoms of patients infected with covid-19 includes were reported as high fever, dry cough, dyspnea and viral pneumonia. Surprisingly, it was reported that significant transmission has been contributed by people who were asymptomatic [22, 23]. To battle such scenario, auxiliary inspection such as epidemiological record plays a crucial role.

5.1 Nucleic Acid Detection Technology

Initially, blood culturing and high throughput sequencing approach was adopted to identity SARS-CoV-2. Later, it was realized that these methods were time consuming, expensive and requires sophisticated instruments for the analysis [24]. Thereafter, the interest of scientific community was inclined to RT-qPCR due to its high efficiency and feasibility to detect the infected cases [25]. RT-qPCR detection also showed high sensitivity and specificity for SARS-CoV and MERS-CoV infection [26]. Supplementary to this, RT-PCR was also reported to suffer from long detection hours and inconvenient nucleic acid detection operations.

5.2 Computed Tomography (CT) Scanning

Though RT-PCT is an extremely sensitive technique yet it may result in false negative, hence a combination of CT scan along with RT-PCT would assist to detect those missed cases. It has been recommended to employ high-resolution CT (HRCT) to diagnosis the severity of patients with SARS-CoV-2 at very early stage [27]. Bilateral pulmonary parenchymal ground-glass and consolidative pulmonary opacities is clearly seen in a conventional CT scan [28]. It is evident that Ct has a huge clinical potential to spot the infection cases however at times it is unable to clearly distinguish the SARS-CoVs-2 image from that of other cases of viral pneumonia.

To overcome the limitations of RT-qPCR and CT scanning, point of care testing (POCT) which is based upon the principal of specific antigen-antibody binding showed even better detection rates [29].
6 Treatment

Till date, no specific antiviral treatment or vaccine have foot forward to be competent against covid-19. Majority of health workers are recommending the symptomatic treatment and empathetic supervision. The supportive treatment includes ventilation and use of antiviral against the prevailing infection. Recent studies have reported the effect of choroquine (antimalarial drug) and remdesivir (antiviral drug) as an inhibitor on the growth of SARS-CoV-2 in vitro [30]. Today, numerous countries are anticipating the use of plasma therapy as a promising treatment against COVID-19. The objective of plasma therapy is to provide the defence against corona virus in a struggling patient through the antibodies of recovered patient. Not only this, its potential can be effective to immunise those who are at a high risk of contracting the virus [31].

7 Literature Review of AI Based Analysis

7.1 State-of-the-art in Covid-19 Scenario

In this subsection, we give a brief overview of the state of the art methods and their performance in image based Covid-19 analysis. In [32], authors proposed a joint model for classification and segmentation pipeline with explainable results. They also provided Covid-CS dataset with classification and pixelwise lesion segmentation data. In the classification task, the model has achieved an average sensitivity of 95% and specificity of 93% on the test set. On the segmentation test set, the model achieved a Dice index of 78.3%. In [33], authors have proposed an extension to EfficientNet for detecting Covid-19. The main idea is to reduce the computational cost and the form factor of the models by reducing the number of hyperparameters thus making it suitable to perform mobile processing. It achieved a state of the art results on Covidx dataset with an average accuracy of 93.9%, sensitivity of 96.8% and prediction rate of 100%. The performance gain is while having 28 times fewer parameters than baseline VGG16 and 5 times lesser than Resnet50 architectures.

7.2 Image Processing Based Analysis

In [34], authors proposed an automated Covid19 detection using chest CT scans and its performance analysis. They proposed COVNet to detect and predict the occurrence of Covid-19 and compared it with community acquired pneumonia and non-pneumonia CT scans. The data was acquired over 6 hospitals from Apr, 2016 to Feb, 2020. The thorough performance analysis was given using receiver operator characteristics curves, Area under the curves and precision, recall rates. In [35], authors
provided review of all the works which address the detection of Covid-19 using CT scan images and also elaborated the challenges faced during this. However, the deep learning models such as GoogleNet, ResNet are doing the detection accurately it is quite challenging to predict whether the pneumonia caused in the lungs is due to Covid-19 or any other bacterial or fungal infection. In [36], authors provided a review on image processing based techniques for segmentation. It has detailed the entire pipeline of acquisition, analysis, diagnosis and follow-up. In [37], authors investigated Covid-19 CT scans with bedside CXRs in Italy. In [38], authors provided first of its kind open source data repository of Covid-19 frontal view X Rays collected via several websites and publications. Apart from Covid-19 it also contains images of Severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS) and acute respiratory distress syndrome (ARDS). In [39], authors have provided the survey of all the medical imaging data available for Covid-19. In [40], authors have provided a generative adversarial network GAN based technique for leveraging the data for augmentation in order to provide more data for generalization. In [41], authors utilized MobileNet for training on 3905 X-Ray images and achieved an accuracy of 99.18%. In [42], authors have proposed an AI inspired model for Covid-19 analysis for patients to respond to treatment. Here, they have used two modules detection using CNN based techniques and prediction module that utilizes whale optimization algorithm to select the best features of the patient to decide the survival rate. In [43], authors utilized a technique to detect the severity level of infection due to Covid-19. They first extract the lung region and then utilize image enhancement using Harmony search and Otsu based analysis followed by segmentation of the affected area. Once the region of interest is extract based on image based ratio analysis the severity level is determined.

7.3 Data Science Based Forecasting

In [44], authors proposed the forecasting analysis of the Covid-19 spread in the Chinese provinces and cities. They utilized an unsupervised technique using stacked autoencoders to forecast the transmission dynamics of Covid-19. The data was collected across 4 months from Jan, 2020 to Apr, 2020 and a total of 9 groups were formed by clustering techniques. It was predicted that the spread curves would reach a plateau around April. In [45], authors have suggested that Covid-19 cases can be quickly identified by using mobile phone based web survey. In [46], the authors provided a review of AI advances in molecular, medical and epidemiological applications during Covid-19 crisis. They illustrated how AI can be used for non invasive tracking of disease evolution based on multiple data inputs inclusive of e-health records. It is highly effective for promising drug development. In [47], authors utilized autoencoders to predict the epidemic transmission rate, its trajectory, predict severity. In [48], authors provided a conceptual framework that combined block chain and AI to combat Covid-19. They highlighted different use case scenarios in Covid-19 where such a joint framework is usable and the potential impact on them. In [49],

authors have proposed a cough sound analysis dataset to do the tracking of the evolution of the patient's condition by just analyzing the cough patterns. This dataset is mainly for the analysis of patients who are under quarantine. In [50], authors provided an approach for early forecasting of Covid-19 based on less data. In [51], authors proposed an approach where composite Monte Carlo based method is used for forecasting in high uncertainty based Covid-19 analysis. They utilized a hybrid architecture of deep learning and fuzzy rule induction.

7.4 Genomics Based Analysis

In [52], authors utilized deep learning based techniques to identify progeny drugs similarity with parent drugs used for Covid-19. Apart from the molecular formation similarity, the arrangement (context) of the functional groups is taken into consideration. In [53], authors utilized deep learning approaches for novel drug discovery by pocket based generator, ligand estimators etc. In [54], authors utilized artificial intelligence for examining the blood samples to test positive cases. In this, they used an ensemble of support vector machine, SMOTEBoost, KNN based approaches. They designed it in 2 stage process first used the AI model to check for influenza cases and then check whether they are also positive for Covid-19. In [55], authors utilized metaheuristic based techniques to identify the ordinary spreaders and super spreaders and developed a fitness function to see the current population based on two additional parameters i.e. travel and isolation. They further leveraged this with Long Short term Memory (LSTM) Networks to optimize the hyperparameters used. In [56], authors proposed network for drug repurposing based on 3 methods: network proximity, diffusion and AI based methods. It is ascertained that the virus can dwell in other tissues like reproductive organs and brain regions.

7.5 Role of Mathematical Modelling in Infectious Diseases

It has been well evident from the fact that how infectious diseases outbreak affected the harmony worldwide [57]. However, advancement in technological ground to battle these epidemics always showed the light of hope in that darkness. Antiviral drugs and vaccines against these deadly viruses have protected generations from devastation [58]. Yet, certain queries of any epidemic situations for instance: how the infection is going to disperse, for how long it will last, how much destructive it will going to be, how about its re-emergence and what type of medications are required to control it at earliest etc. can only be untangled with the development of a mathematics model [59]. A mathematical model is a tool which illuminates from the mechanism of a disease dissemination to its future chain prediction in order to develop substantial approach to struggle across the path [60]. Long back in the year 1854, London has witnessed the first successful mathematical model which was used
to eradicate cholera epidemic [61]. Till date, considerable statistical model has been reported for the apprehension of infectious disease eruption [62]. A conventional regression model has always been the prime-most choice for the researchers due to its simplicity and feasibility however it sometimes suffers from a high prediction error due to numerous factors [63]. Hidden Markov model is a well recognized model to ascertain about the kinetics of an infectious disease and could estimate its convulsion from the possible indicators [64]. Susceptible-Infected-Recovered (SIR) model [65] is yet another simple model and profoundly acceptable model used to explain the dynamics of COVID-19 outbreak which is explained in next subsection.

8 Mathematical Preliminaries of Infectious Disease Modeling

Mathematical modeling of infectious diseases help in understanding how the disease will spread and the likely outcomes of an epidemic. A rather specialized domain in AI is machine learning and statistics which governs the mathematical modeling of infectious diseases. The first work was done by statistician Bernoulli in 1766. He gave a model around inoculating against the infectious disease smallpox. There were emergence of other epidemic modeling around 1900s. These models were termed as Suspected-Infected-Recovered (SIR) models. There are two basic types of epidemic models: (i) Stochastic and (ii) Deterministic. Stochastic models can be used when the infectious disease is further dependent on one or more random variables (such as exposure or contact based risk, environmental factors etc). Whereas deterministic models work on the inherent assumption that the epidemic process is deterministic. In this, the population is divided into compartments or subgroups and transition between states take place. The entire model can be defined by set of differential equations.

The generic SIR model [66] can be defined as,

\[ N = S(t) + I(t) + R(t) \]  

where N denotes the total population divided into three compartments S: suspected cases, I:infected cases, R: recovered cases (due to immunization or death) and t denotes time. The reproduction number or \( R_0 \) denotes how transferable the disease is. For e.g. there is an infected person due to which 2 more persons can be contracted with disease then the \( R_0 \) becomes 2. It can be computed as the ratio of known spread rates over time. Lets say, the infectious individuals comes in contact with \( \beta \) individual per unit time and all of them get contracted with disease and the mean infecting period of the disease is given by \( \frac{1}{\gamma} \) then the reproduction number \( R_0 = \frac{\beta}{\gamma} \).
The transition in the SIR model is $S(t) \rightarrow I(t) \rightarrow R(t)$. The three differential equations are given as,

$$\frac{dS}{dt} = -\frac{\beta SI}{N} \quad (2)$$

$$\frac{dI}{dt} = \frac{\beta SI}{N} - \gamma I \quad (3)$$

$$\frac{dR}{dt} = \gamma I \quad (4)$$

The assumption in this model is that every individual is having equal probability of contracting the disease. These differential equations are governed by the law of mass action which states that rate of contact between any two groups will be proportional to size of each individual group that is concerned.

9 Datasets Available

In this section, we highlight the main imagery datasets available for covid-19 detection. Figure 1 gives few examples of Covid-19 and other similar ailments Xray images.

**COVID-CS dataset**: This is the first dataset to provide the pixel level annotations of the covid-19 infected regions in the lungs (CT scans collected using different scanners). It is named as Covid-19 Classification and Segmentation dataset. There re in total 144167 CT scan images of 750 patients out of which 400 (175 males and 225 females) are positive cases and rest are negative. Here, community acquired pneumonia cases are not considered. For pixel level annotations, professional labelling is done by senior radiologists. After this step, a total 3,855 pixel level annotations for 200 positive case patients is performed. Rest 200 patients data is used for test purpose. The number of lesion counts varies between 1 to 10 in each CT scan image. The infected patches are uniformly distributed.

**Covid-chestxray-dataset**: It consists of 123 frontal view Xray images. It has the images of the following viral infections: Severe acute respiratory syndrome (SARS), Acute respiratory distress syndrome (ARDS), COVID-19, Pneumonia. each image file has a file identifier or metadata associated to it which consists of the patient ID, number of days for onset of symptoms, sex, age, type of pneumonia, survival rate, view angle, modality, date on which it is taken, location and other file identifiers.

**COVIDx dataset**: It consists of 13800 CXR images of 13,725 patient cases which is collected over 3 publicly available datasets. It consists of both non-covid pneumonia (8066 cases) and non pneumonia patients (5538 cases). Also, it contains 183 CXR images from 121 Covid-19 patient cases.

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1[https://github.com/ieee8023/covid-chestxray-dataset](https://github.com/ieee8023/covid-chestxray-dataset).
2[https://github.com/lindawangg/COVID-Net/](https://github.com/lindawangg/COVID-Net/).
COVID-19 Radiography Database dataset\textsuperscript{3}: It contains 219 COVID-19 positive images, which comprises 1341 normal images and 1345 pneumonia patient images. It is a Kaggle challenge dataset.

COVID-19 CT segmentation dataset\textsuperscript{4}: It contains 100 axial CT images collected from more than 40 COVID-19 patients basically converted from JPG images (openly accessible). The images are rescaled, normalized and compiled into a single NIFTI file. The segmentation masks consisted of 3 labels namely, ground class opacification (label 1), consolidations (label 2) and pleural effusions (label 3). They were normalized back into Hounsfield Unit scale.

COVID-CT-Dataset\textsuperscript{5}: It consists of 275 CT scans positive for 143 COVID-19 cases. This is a unique dataset collected from all medRxiv and bioRxiv preprints available online. The authors used PyMuPDF\textsuperscript{6} to preserve the structural information of the images embedded in these preprints. Then they analyzed the captions of the figures in order to identify whether they belong to positive or negative cases. In case the figure had conjoint images they would do a split of CT scan images and then select it. In case it is not evident from the caption about the label of image data they would scan in the relevant text excerpt which would certify the positive/negative label about the image.

10 Case Scenarios: Problem and Solution

These are the following thrust areas where main action needs to be targeted to mitigate the problem of Covid-19.

Forecasting and alert generation: Based on the past data and trends, the system can predict the outbreaks of pandemics \cite{67}, potential hotspots, suspected cases, death toll etc. However, such forecasting tasks may require a huge amount of data. With certain amount of uncertainty, it can be extrapolated to get the future course of trends to be followed. Most of the Covid data has been simulated by the Center.

\textsuperscript{3}https://www.kaggle.com/tawsifurrahman/covid19-radiography-database.
\textsuperscript{4}http://medicalsegmentation.com/covid19/.
\textsuperscript{5}https://github.com/UCSD-AI4H/COVID-CT.
\textsuperscript{6}https://github.com/pymupdf/PyMuPDF.
for Systems Science and Engineering (CSSE), Johns Hopkins University\(^7\) where the entire pandemic data including casualties, recoveries and infected cases have been reported worldwide. Several statistical models such as exponential smoothing functions, logistic/S-curves or maximum likelihood approaches can be used to build such forecasting models. It helps in finding the convergence rate of the curves such as mortality rate etc.

*Covid-19 patient tracing and prediction:* AI based approaches can be used for contact tracing of the susceptible patients who might have come in contact with positive patients. Now, using the IMEI number in the phones and GPS live tracking of the people it can be ascertained whether they are following quarantine norms or not. Also, if they are near more people it can be live-traced. Based on the symptoms and travel history of the person, the AI based models can do an early prediction of the disease and the person can take the necessary actions by performing social distancing.

*Dashboard Preparation for data:* Another important application is to develop dashboard which reflects the data for pandemics or epidemiological spread. One can interactively visualize graphs and bar charts to compare the ongoing trends. Different features can be utilized to visualize the data and see the effect on the spread. Some of the most popular ones which have been trending in data visualization in Covid-19 cases include UpCode,\(^8\) Thebaselab,\(^9\) the BBC,\(^10\) the New York Times,\(^11\) and HealthMap.\(^12\)

*Diagnosis of Covid-19:* The diagnosis and prognosis of this pandemic can be done either by discovering new drugs at the earliest or by studying the CT scan reports and identify the patients who are suffering with this. AI based techniques particularly resorting to Deep learning based techniques have been very successful. It enables the doctors to do an automated scanning of the reports and generate authenticated and accurate reports of the patients thus reducing manual inspection.

### 11 Conclusion

In this chapter, we have provided a thorough report on the inception of Covid-19, details on the spread worldwide and the approaches followed by the researchers and scientists to cope with it. Particularly, we focus on the efforts that researchers are taking on AI based solutions can offer. Primarily, we observed that if proper diagnosis is done using AI based imagery techniques and AI based patient tracing is done, then we can perform stringent measures on ensuring quarantine is being

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\(^7\)https://github.com/CSSEGISandData/COVID-19.

\(^8\)https://www.againstcovid19.com/singapore/dashboard.

\(^9\)https://coronavirus.thebaselab.com/.

\(^10\)https://www.bbc.com/news/world-51235105.

\(^11\)https://www.nytimes.com/interactive/2020/world/coronavirus-maps.html.

\(^12\)https://www.healthmap.org/covid-19/?mod=article_inline.
followed and social distancing is managed. Forecasting and prediction models again can be extremely helpful as it enables to know the epidemiological trends and take the successive measures. We envisage that our holistic study can be helpful and provide a bird’s eye view on the problem.

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