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TO STUDY PREDICTION OF COVID-19 USING MACHINE LEARNING TECHNIQUES

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Abstract:- Coronavirus disease (COVID-19) is an inflammation disease from a new virus. The disease causes respiratory ailment (like influenza) with manifestations, for example, cold, cough and fever, and in progressively serious cases, the problem in breathing. COVID-2019 has been perceived as a worldwide pandemic and a few examinations are being led utilizing different numerical models to anticipate the likely advancement of this pestilence. These numerical models dependent on different factors and investigations are dependent upon potential inclination. Here, we presented a model that could be useful to predict the spread of COVID-2019. We have performed linear regression, Multilayer perceptron and Vector auto regression method for desire on the COVID-19 Kaggle data to anticipate the epidemiological example of the ailment and pace of COVID-2019 cases in India; anticipated the potential patterns of COVID-19 effects in India dependent on data gathered from Kaggle. With the common data about confirmed, death and recovered cases across India for over the time length helps in anticipating and estimating the not so distant future. For extra assessment or future perspective, case definition and data combination must be kept up persistently.

Keywords: *COVID-19, exponential smoothing method, future forecasting, Adjusted R2 score, supervised machine learning*

I INTRODUCTION

The coronavirus disease (COVID-19) is a global pandemic that was discovered by a Chinese physician in Wuhan, the capital city of Hubei province in mainland China, in December 2019. Currently, there is no approved human vaccine for combating it. COVID-19 propagation is faster when people are in close proximity. Thus, travel restrictions control the spread of the disease, and frequent hand washing is always recommended to prevent potential viral infections. Meanwhile, fever and cough are the most common infection symptoms. Other symptoms may occur, including chest discomfort, sputum development, and a sore throat. COVID19 may progress to viral pneumonia which has a 5.8% mortality risk. The death rate of COVID-19 is equivalent to 5% of the death rate of the 1918 Spanish flu pandemic.

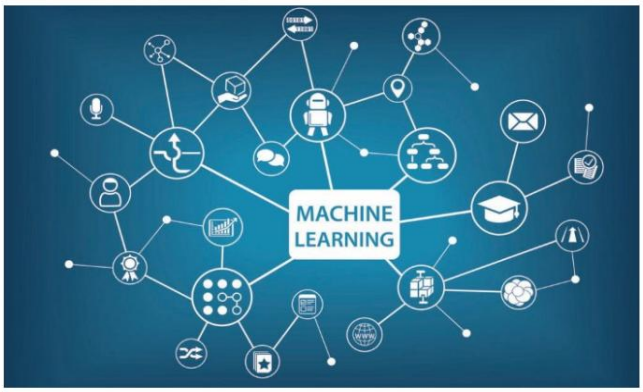
The analysis and detection of COVID-19 have been extensively investigated in the last few months. The first part of this section addresses issues related to COVID-19 detection based on deep-learning approaches using CT scans and chest X-ray images. The second part reviews the related literatures to assess future estimates of the number of COVID-19 confirmations, recoveries, and deaths.

Radiological imaging is considered an important screening method for COVID-19 diagnosis. Demonstrated the consistency of the radiological history of COVID-19-related pneumonia with the clinical nature of the disease; when examined by CT scans, almost all COVID-19 patients have exhibited similar features including groundglass opacities in the early stages and pulmonary consolidation in the latter stages. In fact, the morphology and peripheral lung distribution can be rounded. AI can be used to initially evaluate a COVID-19 patient as an alternative solution to traditional approaches that are time-consuming and labour-intensive. In this paper, we advocate the use of AI to forecast COVID-19 cases and diagnose COVID-19 patients via chest X-ray images.

We propose an automated intelligent system for distinguishing COVID-19 patients from non-patients on the basis of chest X-ray images. Our system instantly reads the structure of a chest X-ray image, leverages hidden patterns to identify COVID-19 patients, and reduces the need for manual pre-processing steps.

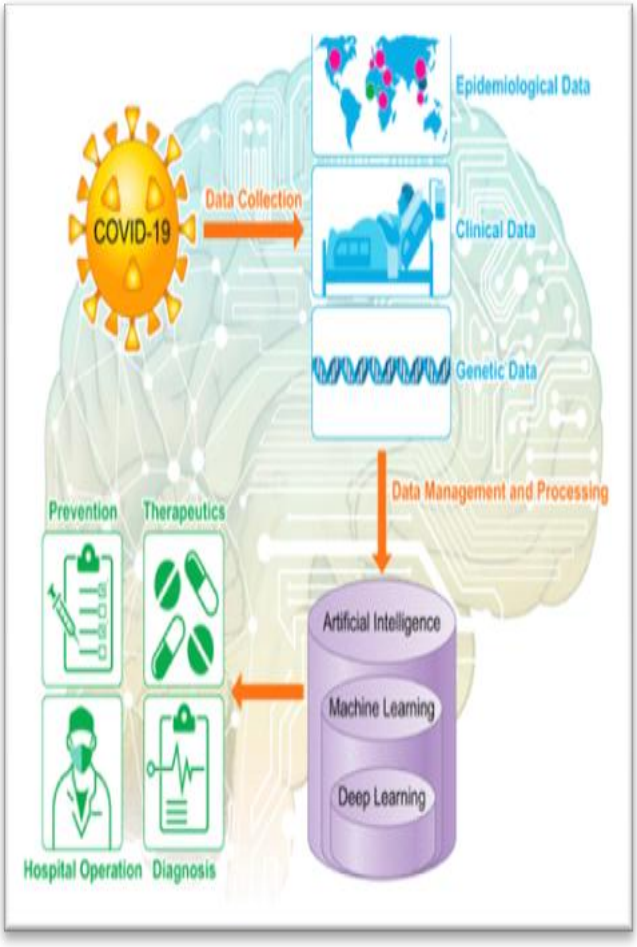
The use of machine learning (ML) has been rapidly increasing in various fields including malware detection, mobile malware detection, medicine and information retrieval. In 2012, a modern ML system called deep learning was introduced, which is based on a convolutional neural network (CNN). It won the ImageNet classification competition, the world's best-known computer-vision competition.

Deep-learning algorithms enable computational models composed of multiple processing layers to learn data representation through several abstraction layers. They train a computer model to perform classification tasks directly from pictures, texts, or sounds. According to deep-learning models feature high accuracies and can improve human output in certain instances.



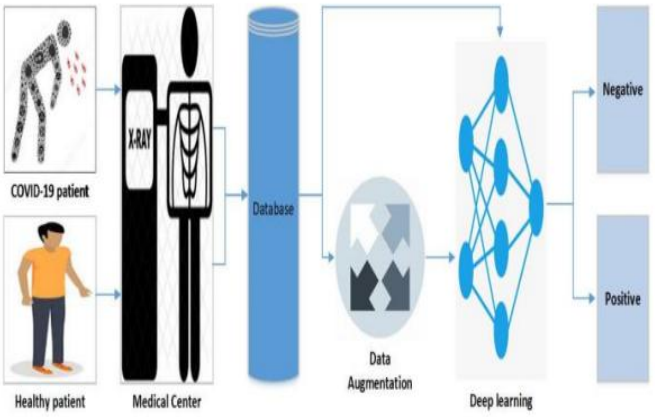
ML is the science of training machines using mathematical models to learn and analyze data. Once ML is implemented in a system, the data are analyzed, and interesting patterns are detected. The validation data are then categorized according to the patterns learned during the learning process. As COVID-19 infection has rapidly spread worldwide and international action is required, it is important to develop a strategy to estimate the number of potentially infected people on a regular basis to adopt the appropriate measures. Currently, decision-makers rely on certain decision-making statistics such as imposing lockdowns on infected cities or countries. Therefore, ML can be used to predict the behaviour of new cases to stop the disease from spreading.

COVID-19 is a severe global problem that has crippled many industries and killed many people around the world. One of the primary ways to decrease the casualties is the infected person's identification at the proper time. AI can play a significant role in these cases by monitoring and detecting infected persons in early-stage so that it can help many organizations. In this paper, we aim to propose a fully-automated method to detect COVID-19 from the patient's CT scan without needing a clinical technician. We introduce a new dataset that contains 48260 CT scan images from 282 normal persons and 15589 images from 95 patients with COVID-19 infection. Our proposed network takes all the CT scan image sequences of a patient as the input and determines if the patient is infected with COVID-19. At the first stage, this network runs an image processing algorithm to discard those CT images that inside the lung is not properly visible in them. This helps to reduce the number of images that shall be identified as normal or COVID-19, so it reduces the processing time.



Also, running this algorithm makes the deep network at the next stage to analyze only the proper images and thus reduces false detections. At the next stage, we propose a modified version of ResNet50V2 that is enhanced by a feature pyramid network for classifying the selected CT images into COVID-

19 or normal. If enough number of chosen CT scan images of a patient be identified as COVID-19, the network considers that patient, infected to this disease. The ResNet50V2 with feature pyramid network achieved 98.49% accuracy on more than 7996 validation images and correctly identified almost 237 patients from 245 patients.



The proposed method is implemented in four phases, viz., data augmentation, preprocessing, stage-I and stage-II deep network model designing.

This study is performed with online available resources images and further strength utilizing data augmentation techniques to provide better generalization of the model and to prevent the model overfitting by increasing the overall length of dataset to images. Deep network implementation in two stages is designed to differentiate COVID-19 induced pneumonia from healthy cases, bacterial and other virus induced pneumonia on X-ray images of chest.

At the end of 2019, a new form of Coronavirus, called *COVID-19*, has widely spread in the world. To quickly screen patients with the aim to detect this new form of pulmonary disease, in this paper we propose a method aimed to automatically detect the *COVID-19* disease by analyzing medical images. We exploit supervised machine learning techniques building a model considering a data-set freely available for research purposes of chest X-rays.

Therefore, this study selected chest X-ray images as the research object. However, radiologists and experts mainly interpret images based on personal clinical experience when analyzing X-ray images. Usually, different doctors or experts have a different understanding of the same image. Moreover, the situation of the same image in different periods is not entirely consistent, and the conclusions produced will be different. Also, the workload of interpretation of images is vast, and doctors are prone to misdiagnosis due to fatigue. Therefore, there is an urgent need for a computer-aided diagnosis system to help radiologists interpret images faster and more accurately.

According to the survey, in addition to some of the literature mentioned above reports, the use of deep learning or other methods to diagnose and screen COVID-19 in X-rays is few. Therefore, our goal is to establish an efficient combination of deep features and machine learning classification to help radiologists diagnose COVID-19 more accurately in X-ray images.

Transfer learning is adopted to overcome the over fitting problem caused by the limited number of training images in deep learning. Due to the lack of public COVID-19 dataset, we prepared a dataset containing 1102 chest X-ray images of healthy patients and COVID-19 positive patients, and randomly divided the training set and test set. Five popular convolutional neural network models including VGG16, InceptionV3, ResNet50, inception and DenseNet121 were pre-trained on the ImageNet dataset. And their performance was evaluated on a test set containing 298 X-ray images.

We use the method of automatically extracting features from deep convolutional neural networks. This method does not require traditional manual methods for feature extraction, avoiding complex feature extraction processes. This method can directly extract bottleneck features from five pre-trained depth models. After extracting bottleneck features, COVID-19 patients are screened by five traditional machine learning classifiers.

Through extensive experiments, we find that each deep model shows excellent performance on different classifiers. The accuracy of the best model is as high as 99.33%. It is worth mentioning that our best model also shows good accuracy on another dataset.

II RELATED WORK

Studies show that Chest X-Ray images, Computed tomography scans Magnetic Resonance Imaging scans are considered in improving the analysis of presence of viruses in the lungs. In multiple works, deep learning based techniques have been developed to identify pneumonia, different classes of thoracic disease. In a work, a convolutional neural network model has been used to identify Covid-19 patients with the help of CT scan images. There are several more research works to detect the presence of Covid-

19 virus in the human lungs with the help of CT scan. In a multi-task, self-supervised AI model have been developed for the diagnosing of the Covid-19 virus in human lungs with the help of CT scan images, with an accuracy of 89%. An automatic segmentation and quantification of the lungs is done in describes a fully automatic framework to detect coronavirus affected lungs from chest CT scan images and differentiated it from other lung diseases. However, have concluded that CXR images are better than any other means in the detection of Covid-19 because of their promising results along with the availability of CXR machines and their low maintenance cost

Apart from using individual state-of-the-art deep learning models, there has been one work which has developed a custom architecture termed as CovidNet architecture for the classification of Covid-19 patients, healthy subjects and pneumonia patients. This custom network, designed using a lightweight projection-expansion-projection-extension (PEPX) design pattern, has demonstrated a classification accuracy of 94% - a result that outperforms laboratory testing.

As can be observed, most of the works related to Covid19 detection from CXR images have utilized individual deep learning models e.g. DenseNet, ResNet, Inception, etc. None of the works have tried to combine the models to multiply their capability of classification. Various works done on Ensemble Learning with Deep Neural Networks show that ensembling learning methods are superior in prediction than an individual model and also helps in preventing overfittinga weighted average of the output probabilities have been introduced as a method for ensembling. It is found to be better than un-weighted average. In another work, relative performance of the different ensemble methods with Convolutional Neural Networks like un-weighted average, majority voting, Bayes Optimal Classifier and Super Learner have been compared. In this research we have proposed a new method to ensemble three state-of-the-art CNN models - DenseNet201, Resnet50V2 and Inceptionv3 to classify Covid-19 +ve patients from CXR images.

III PROBLEM STATEMENT

The application of ML techniques for COVID-19 diagnosis using our CNN-based COVID-19 detector is recommended. It is well known that VGG16 outperforms many convolutional networks, such as GoogLeNet and SqueezeNet, and its feature representation capability is beneficial for classification accuracy. Hence, VGG16 is a recommended version of a deep CNN-based algorithm as it makes training easier and quicker. It was implemented and to predict in our COVID-19 detector to improve its accuracy in diagnosing COVID-19 in chest X-ray images. A better training process was achieved as the gap between the training and validation became smaller.

IV LITERATURE REVIEW

Automatic COVID-19 Detection from X-Ray images using Ensemble Learning with Convolutional Neural Network AMIT Kumar Das, Sayantani Ghosh, Sammrudhin Thunder, Rohit Dutta, SachinAgarwal, Covid-19 continues to have catastrophic effects on the lives of human beings throughout the world. To combat this disease it is necessary to screen the affected patients in a fast and inexpensive way. One of the most viable steps towards achieving this goal is through radiological examination, Chest X-Ray being the most easily available and least expensive option. In this paper we have proposed a Deep Convolutional Neural Network based solution which can detect the Covid-19 +ve patients using chest X-Ray images. To test the efficacy of the solution we have used publicly available chest X-ray images of Covid +ve and -ve cases. 538 images of Covid +ve patients and 468 images of Covid -ve patients have been divided into 771 trainable images and 235 testing images. Our solution gave a classification accuracy of 95.7% and sensitivity of 98% in the test set-up. We have developed a GUI application for public use. This application can be used on any computer by any medical personnel to detect Covid +ve patients using Chest X-Ray images within a very few seconds.

COVID-19 Prediction and Detection Using Deep Learning Article · May 2020, MoutazAlazab , AlbaraAwajan, AbdelwadoodMesleh, Ajith Abraham, VanshJatana, Salah Alhyari,Currently, the detection of coronavirus disease 2019 (COVID-19) is one of the main challenges in the world, given the rapid spread of the disease. Recent statistics indicate that the number of people diagnosed with COVID-19 is increasing exponentially, with more than 1.6 million confirmed cases; the disease is spreading to many countries across the world. In this study, we analyse the incidence of COVID-19 distribution across the world. We present an artificial-intelligence technique based on a deep convolutional neural network (CNN) to detect COVID19 patients using real-world datasets. Our system examines chest X-ray images to identify such patients. Our findings

indicate that such an analysis is valuable in COVID-19 diagnosis as X-rays are conveniently available quickly and at low costs. Empirical findings obtained from 1000 X-ray images of real patients confirmed that our proposed system is useful in detecting COVID-19 and achieves an F-measure range of 95–99%. Additionally, three forecasting method

A machine learning forecasting model for COVID-19 pandemic in India R. SujathJyotir Moy ChatterjeeAboul Ella Hassanien, Coronavirus disease (COVID-19) is an inflammation disease from a new virus. The disease causes respiratory ailment (like influenza) with manifestations, for example, cold, cough and fever, and in progressively serious cases, the problem in breathing. COVID-2019 has been perceived as a worldwide pandemic and a few examinations are being led utilizing different numerical models to anticipate the likely advancement of this pestilence. These numerical models dependent on different factors and investigations are dependent upon potential inclination. Here, we presented a model that could be useful to predict the spread of COVID-2019.We have performed linear regression, Multilayer perceptron and Vector auto-regression method for desire on the COVID-19 Kaggle data to anticipate the epidemiological example of the ailment and pace of COVID-2019 cases in India. Anticipated the potential patterns of COVID-19 effects in India dependent on data gathered from Kaggle

Prediction of COVID-19 using Machine Learning Techniques Durga Mahesh Matta Meet Kumar Saraf, pneumonia of unknown cause detected in Wuhan, China was first reported to the World Health Organization Country Office in China on 31 December, 2019. Since, then the number of cases of corona virus is increasing along with high death toll. Corona virus spread from one city to whole country in just 30 days. It was named as COVID-19 by World Health organization. As this COVID-19 is spread from person to person, Artificial intelligence based electronic devices can play a pivotal role in preventing the spread of this virus. As the role of healthcare epidemiologists has expanded, the pervasiveness of electronic health data has expanded too. The increasing availability of electronic health data presents a major opportunity in healthcare for both discoveries and practical applications to improve healthcare. This data can be used for training machine learning algorithms to improve its decision-making in terms of predicting diseases

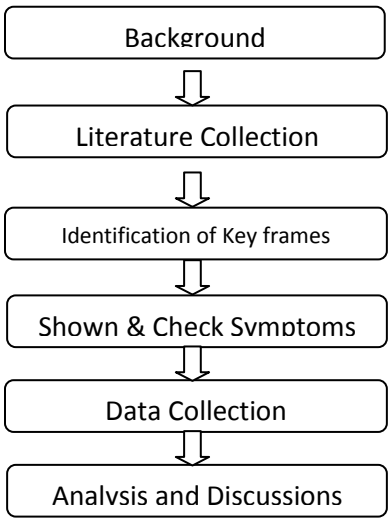
Covid-19 Future Forecasting Using Supervised Machine Learning Models Furqan Rustam1 , Aijaz Ahmad Reshi2 , Arif Mehmood3 , Saleem Ullah1 , Byungwon On4 , Waqar Aslam3 And Gyu Sang Choi, Machine learning (ML) based forecasting mechanisms have proved their significance to anticipate in perioperative outcomes to improve the decision making on the future course of actions. The ML models have long been used in many application domains which needed the identification and prioritization of adverse factors for a threat. Several prediction methods are being popularly used to handle forecasting problems. This study demonstrates the capability of ML models to forecast the number of upcoming patients affected by COVID-19 which is presently considered as a potential threat to mankind. In particular, four standard forecasting models, such as linear regression

V OBJECTIVES

The aim of this thesis is to predict whether a person has COVID-19 or not, using machine learning techniques.

- Identifying the most suitable machine learning technique for prediction, to perform on clinical reports of patients.
- Preparing a machine learning model that could make accurate predictions of COVID-19 in patients.
- Identifying the features that affect the prediction of COVID-19 in patients.
- The prediction is performed using the clinical information of the patients
- The goal is to identify whether a patient can potentially be diagnosed with COVID-19.

VI Methodology



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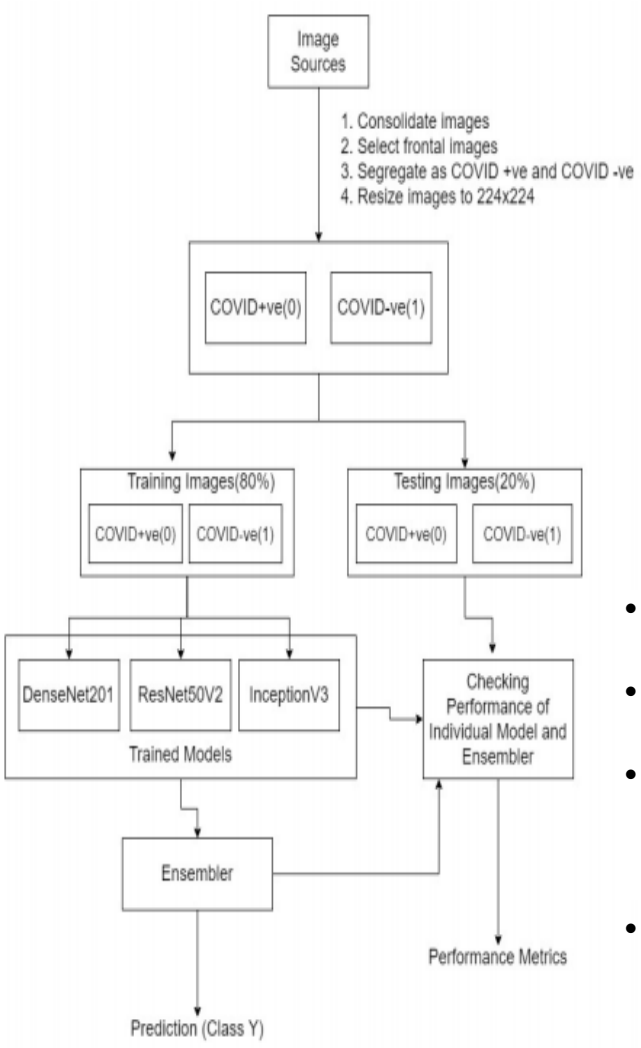
Flow Chart



Consolidation of CXR images for healthy subjects, patients having pneumonia or other bacterial infection and Covid patients from different sources

• Retaining only frontal CXR images

• Resizing images to a uniform size

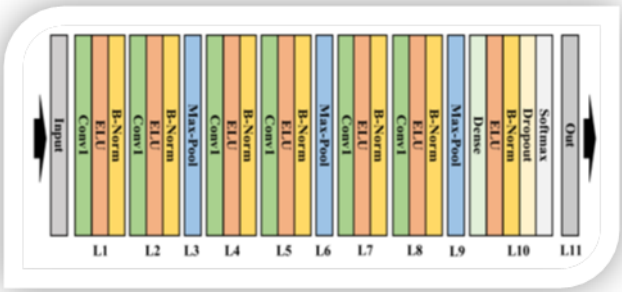
• Divide the images into two portions - one major portion to train the models and another portion for testing the efficacy of the trained model

• While dividing the images into training and testing, ensure that there is no patient overlap i.e. different images of the same patient is not present in both training and testing datasets

•Train the models- DenseNet201, ResNet50v2 and Inceptionv3

• Run the trained models on the test images and select class label value 0 or 1 based on weighted average ensembling of the 3 models.

Dataset Description



Architecture of CNN

A convolutional layer that extracts features from a source image.

A pooling layer that down samples each feature to reduce its dimensionality and focus on the most important elements.

A fully connected layer that flattens the features identified in the previous layers into a vector, and predicts probabilities that the image belongs to each one of several possible labels

Convolutional Neural Networks (CNN) is a deep model that performs well with a variety of tasks such as image classification, natural language processing, and signal processing. CNNs are explicitly designed to deal with multi-dimensional input and overcome the high number of parameters that are requested by standard FNN. For example, a single RGB image of size 64x64, in an FNN would require: $64 \cdot 64 \cdot 3 = 12288$ neurons as input. The issues that arise when the FNN is over parameterized are the following:

A huge number of input neurons will require more layers at a high computation cost and time required for training

Over parameterization is a symptom of over fitting: in the specific case of an image, the FNN would behave too meticulous since it will take into account each single pixel.

Convolutional layers convolve the input and pass its result to the next layer. This is similar to the response of a neuron in the visual cortex to a specific stimulus.Each convolutional neuron processes data only for its receptive

field. Although fully connected feed forward neural networks can be used to learn features as well as classify data, it is not practical to apply this architecture to images. A very high number of neurons would be necessary, even in shallow (opposite of deep) architecture, due to the very large input sizes associated with images, where each pixel is a relevant variable

When programming a CNN, the input is a tensor with shape (number of images) x (image height) x (image width) x (input channels). Then after passing through a convolutional layer, the image becomes abstracted to a feature map, with shape (number of images) x (feature map height) x (feature map width) x (feature map channels). A convolutional layer within a neural network should have the following attributes:

- Convolutional kernels defined by a width and height
- The number of input channels and output channels
- The depth of the Convolution filter the input channels must be equal to the number channels of the input feature map.

ARIMA:

https://www.statsmodels.org/stable/generated/statsmodels.tsa.arima_model.ARIMA.html

•Fbprophet: https://pypi.org/project/fbprophet/

•ImageDataGenerator: https://keras.io/preprocessing/image/

• Keras: https://keras.io/

LSTM:

https://www.tensorflow.org/api_docs/python/tf/keras/layers/LS TM

• Matplotlib: https://matplotlib.org/

• NumPy: https://numpy.org/

• Pandas: https://pandas.pydata.org/

• Python: https://www.python.org/

• Scikit: https://scikit-learn.org/

•SciPy: https://www.scipy.org/

• TensorFlow: https://www.tensorflow.org/

Feature Number	Feature Name
18	Chest CT findings - Advances, Absorption
13	Fever
21	Lymphocyte count
4	Respiratory system disease
14	Cough
24	PCT - Procalcitonin
22	Monocyte count
20	Neutrophil count
3	Age
23	CRP - C-reactive protein
19	White Blood Cell Count
5	Comorbidity
6	Fatigue
12	Chest tightness
2	Clinical Classification
7	Cardiovascular and cerebrovascular disease
17	Diarrhea
1	Gender
8	Malignant tumor
10	Digestive system disease
0	Days from onset of symptoms to hospital admission
15	Liver disease
16	Endocrine system disease
9	Patient Condition
11	Renal disease

Attribute S

Attribute	Description
Patient ID	Internal identifier
Offset	Number of days since the start of symptoms or hospitalization for each image. If a report indicates "after a few days", then 5 days is assumed.
Sex	Male (M), Female (F), or blank
Age	Age of the patient in years
Finding	Type of pneumonia
Survival	Yes (Y) or no (N)
View	Posteroanterior (PA), Anteroposterior (AP), AP Supine (APS), or Lateral (L) for X-rays; Axial or Coronal for CT scans
Modality	CT, X-ray, or something else
Date	Date on which the image was acquired
Location	Hospital name, city, state, country
Filename	Name with extension
doi	Digital object identifier (DOI) of the research article
url	URL of the paper or website where the image came from
License	License of the image such as CC BY-NC-SA. Blank if unknown
Clinical notes	Clinical notes about the image and/or the patient
Other notes	e.g. credit

VII CONCLUSION

A systematic literature review has been conducted to identify the suitable algorithm for prediction of COVID-19 in patients. There was no pure evidence found to summarize one algorithm as the suitable technique for prediction. Hence, a set of algorithms which include Support Vector Machine (SVM), Artificial Neural Networks (ANNs) and Random Forests (RF) were chosen. The selected algorithms were trained with the patient clinical information. To evaluate the accuracy of machine learning models, each algorithm is trained with record sets of varying number of patients. Using accuracy performance metric, the trained algorithms were assessed. After result analysis, Random Forest (RF) showed better prediction accuracy in comparison with both Support Vector Machine (SVM) and Artificial Neural Networks (ANNs). The trained algorithms were also assessed to find the features that affect the prediction of COVID-19 in patients. There is a lot of scope for Machine Learning in Healthcare. For Future work, it is recommended to work on calibrated and ensemble methods that could resolve quirky problems faster with better outcomes than the existing algorithms. Also an AI-based application can be developed using various sensors and features to identify and help diagnose diseases. As healthcare prediction is an essential field for future, A prediction system that could find the possibility of outbreak of novel diseases that could harm mankind through socio-economic and cultural factor consideration can be developed.

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