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Review

Comparative Analysis on Available Technique for the Detection of Covid-19 through CT-Scan and X-Ray using Machine Learning: A Systematic Review

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Abstract: (1) Background: In the year of 2020 Covid-19 was declared epidemic by WHO. From that time millions of people were affected and died by this disease. The main detection process for this epidemic is RT-PCR test or reverse polymerase transcription chain reaction test. One of the reason of spreading of this disease so much is lack of efficiency in RT-PCR test. Sampling error and low viral load were two main reasons for what the testing process faced such problems. Lung infection is a very common symptom for covid-19 patients, so, CT scan and chest X-ray imaging technique can be applied to detect patient at a very early stage of infection. Which will be very effective and also can be a better option to RT-PCR test; (2) Methods: We searched data in Scopus for articles published between 2020 and 2023. The initial set of articles was 189, from which 21 articles will eventually be selected by exclusion criteria; (3) Results: A total of thirteen (61.90%) articles were found working on detecting Covid-19 by extracting the X-ray and CT scan data individually. Three (14.28%) of those articles focused on a hybrid model of CT scan and X-ray Image Data. Another four articles made a comparison between Covid-19, pneumonia and a normal person to identify a Covid-19 patient. Where others have worked on unsupervised learning methods or SVM to detect Covid-19.; (4) Conclusions: We have conducted a systematic review of the studies that have been published up to this time, with the purpose to present a summary of the evidence about the detection of COVID-19. In this article, we have summarized and critically reviewed literatures which worked on development or application or both of different AI or ML technique from chest CT and X-ray images to find a solution to detect covid-19.

Keywords: Covid-19; Deep Learning; Computerized Tomography; Artificial Intelligence; Machine Learning; X-ray

1. Introduction

Within the period of 2020-2022 Covid-19 was the main reason of death all over the World [1]. It affects a wide geographical area, especially in countries with large populations like India [2, 3]. WHO announced Covid-19 as pandemic because coronavirus has been found in every nation on earth, and it was also advised that slowdown the growth rate of the disease is only possible by early detection, isolation and immediate treatment of the affected person.[4, 5]. For this reason several institutions had started research work on Covid-19 [6].

Artificial intelligence (AI) has come at the fore front in the scientific field as surprisingly new discoveries are made [7]. AI as a part of computer science, can be applied to the creation of intelligence systems and is often implemented as software [8]. The recent use of AI in disease diagnosis has expanded its potential. In mid-20th century, medicine and healthcare system was most auspicious field for application among other fields [9]. Vari-



ous decision support systems had been developed by researchers to diagnose disease effectively and accurately [10]. AI system, which was applied for detection of disease, decoding EKG images and other tasks, choosing the best course of action and generation of hypothesis, were adequate in late 1970s [11, 12]. Machine learning algorithms are applied by Modern AI to find patterns and associations in data, as opposed to previously used knowledge-based AI systems that rely on medical expertise based on the evidence-based AI system [13]. The modern revolution in AI can largely be characterized as successful and trained artificial neural network, worked on a huge labelled data set by use of deep learning method.[14-16]. According to researchers, this systems can essentially help doctors make decisions faster and more effectively, and even occasionally eliminate the need for human decisions [17]. Success of AI, at present, in healthcare can be attributed to the growing amount of data in the industry because of more use of digital technologies and huge development of big data analytics [18]. Collection of data becomes so easy through mobile applications, because of frequent use of mobile at present scenario. While Artificial Intelligence in healthcare is still in its infancy. Cancer, neurology, and cardiovascular disease are three target field on which AI is mainly working [19]. Powerful AI can use evidence to uncover insights from medical data. Those are usually used mainly for forecasting with support in decision making system also. [16, 20].

Researchers believe AI could be effective tool to fight against Covid-19 as it has already shown promise in the healthcare industry [21]. Present researches on Covid-19 infections indicate, AI could be helpful to identify the infection, assume the next outbreak, and chalk out the pattern of attack and discovery a way to cure. Image processing, data mining, and ML have been shown to be useful to diagnose, classify, and develop vaccines for Covid-19 in recent studies. [22, 23]. Our study examines some specific work limited to the usage of AI to detect Covid-19 from X-ray and CT scan image data. We also suggest some ways for future researchers how AI and machine learning could be used to fight other pandemics besides Covid-19. Together, our study examines the research conducted using AI to combat the Covid-19 pandemic.

The following sections are arranged as follows. Section 2 of this review study discusses the methods and materials used to carry it out. Section 3 covers the analysis and results of the review data. Conclusions and the different scopes in future for researcher in Covid-19 are presented in Section 4, and the final comments, limitations, research proposals are presented in Section 5.

2. Materials and Methods

2.1. Search Strategy

We searched Scopus for related articles with X-ray [24, 25] and CT scan [26, 27] imaging process for Covid-19 detection published between 2019 to march 2023 with preferred reporting items for systematic review to identify Covid-19 through X-ray and CT scan image. The search term included (covid* AND detect* AND (xray OR scan) AND ((artificial AND intelligence) OR AI OR (machine AND learning))) and further it was limited to its language, subject field, publication stage, source type. The following figure 1 will show the documents by subject area after applying the search query and figure 2 will show the number of document published in the year 2020 to 2023.

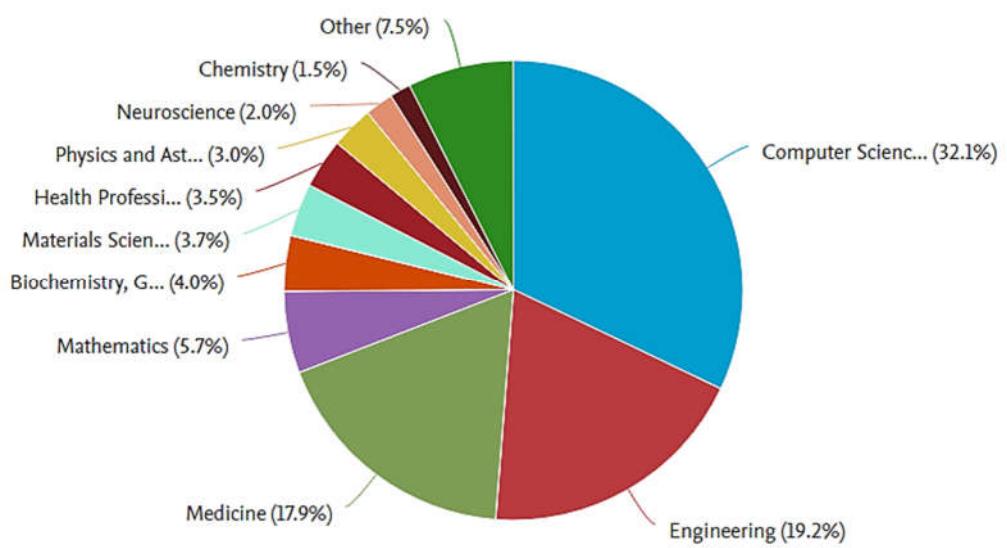


Figure 1. Available documents in various subjects domain.

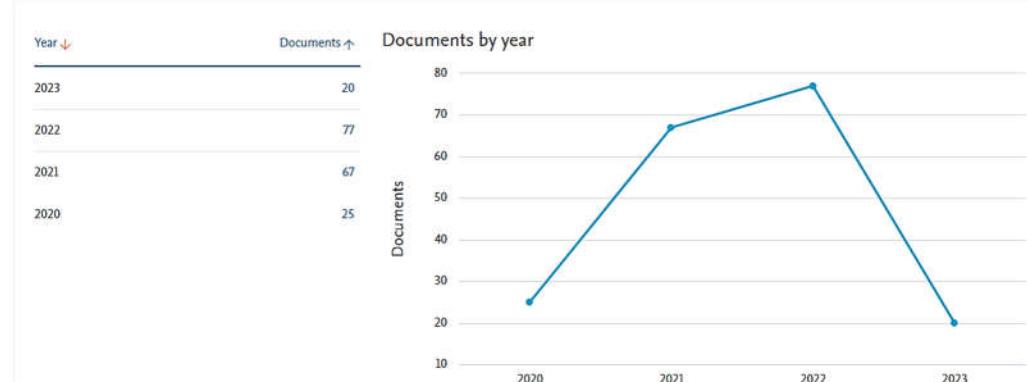


Figure 2. Research paper published in various years from 2020.

2.2. Inclusion and Exclusion Criteria

We included the articles for analysis according to the criteria of: (a) The article which belongs to computer science, engineering, medical, genetics and biotechnology field (b) the articles use or develop Artificial Intelligence or Machine Learning technique, Algorithms for detection of Covid-19 (c) The articles which associated with X-ray and CT Scan Data. (d) Only published journal Article.

With these inclusion criteria we have also used the following exclusion criteria: (a) studies which does not meet the aim of research (b) Studies, which are not written in English language (c) Articles which do not contain Computational data. (d) Articles which consider only CT scan or X-ray image data not the both.

2.3. Study Selection

After Searching Scopus database 498 articles were found in the specific research topic. Figure 3 which is a PRISMA Flowchart, exhibit the article selection procedure through various steps, what we get by the inclusion- exclusion criteria. From 498 articles, at first round the study selection process was done by limiting the selected article by written language, publication stage and field. After the first round of selection process total 309 articles were excluded. In Second round 189 Articles written in English language and from relevant field were screened based on their title and abstract, to understand the data from those are suitable with inclusion criteria or not. From these articles, after applying

all of the exclusion inclusion principle, for the final review 21 articles were selected. The final selected set of articles include original research the applied or implemented different AI or ML model to get the result from CT and X-ray image data.

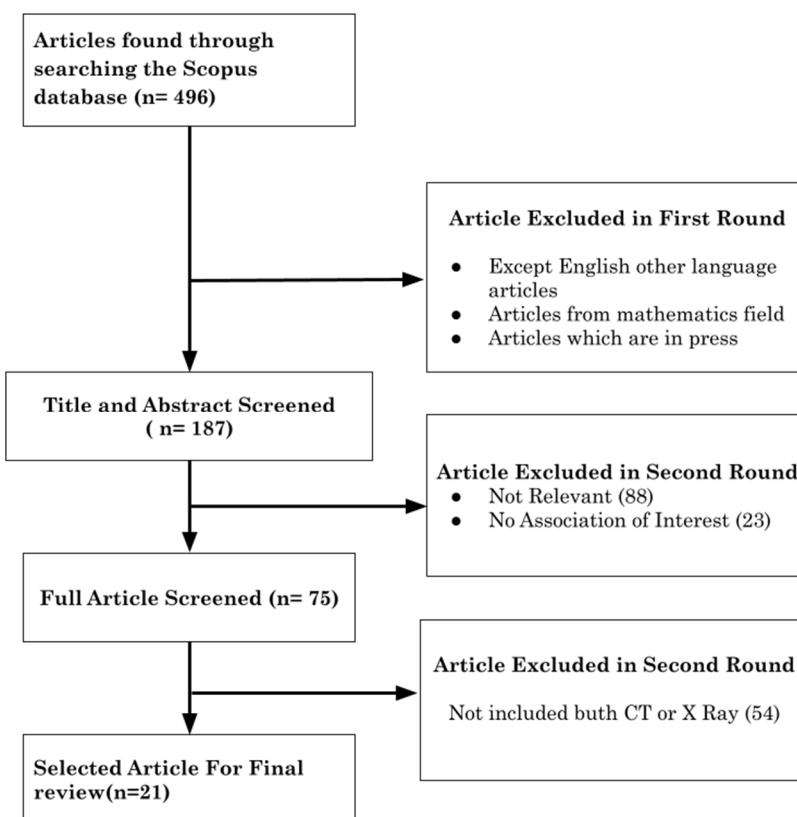


Figure 3. Inclusion and Exclusion Criteria for selection of article for analysis.

2.4. Data Extraction

Data extraction was carried out to scrutiny various Artificial Intelligence or Machine Learning techniques, algorithms and systems. Their applications for detection Covid-19 from patient's X-ray and CT scan data are also explored. Selected articles were read minutely and carefully to gathered research data to write the review article. Researchers from AI, ML, and health informatics backgrounds oversaw and kept an eye on the complete research process, to secure the accuracy and excellence of this review article. The data extraction process for each chosen article focused mainly on the type and context of the study, research goals, results, methods followed by them, used technique and algorithm and dataset. After extraction the collected data were combined, analysed to provide a summary of the previous study and to pinpoint potential areas for further investigation.

3. Data Analysis

3.1. Publication Type

All articles are collected from the Scopus database. These articles are published between 2020 and March 2023. All of the articles are published in reputed Journal. We only reviewed journal articles because they have already been reviewed, so we assume the articles will be more reliable and the data quality will be higher. In the 21 articles, 16 (76.19%) of them proposed a new method to detect Covid-19 using X-ray and CT scans.

3.2. Research Purposes and Objectives

We have collected all the research done so far to analyse how it can help detect Covid-19 early, easily and effectively. All of this summarized data is presented in Table 1 to highlight our findings and the precise purpose of the research linking these articles to detection of Covid-19 by AI. They used various algorithms, like convolutional neural network (CNN) model [28], support vector machine (SVM) [29], Gaussian Naive Bayes (GNB) [30], Decision Tree (DT), Logistic Regression (LR) [31], K-Nearest Neighbour (KNN) [32].

Though we have searched in database with the key word "Detect" so according to the search string, objectives of maximum of the selected papers are detection of Covid-19.

Total thirteen (61.90%) articles were focused only on the early, accurate and easy detection of Covid-19 through the individual extraction of the X-ray and CT scan data. In these articles CT scan and X-ray data were collected and examined without mixing them. Within these some articles develops/propose new methods. For example Elpeltagy M. *et al.* [33] develops a model, Modified ResNet50, where ResNet model was applied with modification of three layers, named, 'Conv', 'Batch_Normaliz' and 'Activation_Relu' for layers which is an accurate, fast, and low-cost auxiliary diagnostic tools to detect Covid-19, where Gupta R.K. *et al.* proposed InceptionResNetV2 model [34]. Some researchers worked through other convenient CNN models like Baz M. *et.al.* [35] experimented on CNN-based model to detect Covid-19 and achieved 99% accuracy by existing VGG-16, VGG-19, ResNet50 and other methods.

Three (14.28%) of those articles were worked on a hybrid model of Computer Tomography scan and X-ray Image Data. These models are more efficient like, Irfan M. *et.al.* proposed Hybrid Deep Neural Networks (HDNN) which gave an accuracy of 99% on the test data set [36].

In the article by Hayat A *et.al.* compared Covid-19 pneumonia and normal healthy sample by the proposed SCovNet architecture [37]. Article by Ahsan, M.M. *et.al.* [38] and Ko H. *et.al.* [39] also provided few opportunities to differentiate among Covid-19 patients, pneumonia patients and healthy person. Ullah F. *et.al.* [40] contributed in detection and classification Covid-19 in CT and X-ray images. Ravi V. *et.al.* [41] discovered the way for identification and analysis of Covid-19 through unsupervised learning. Some studies have perspective to develop efficient AI model to detect Covid-19 where some other articles focused on, within X-ray or CT scan data, which one will give better result through a particular CNN model and some worked on various models to differentiate Covid-19 from normal pneumonia.

Table 1. Main Objectives of Reviewed Studies.

	Brief Description	Reference	Frequency
Detection	Early detection of this disease Detect Covid-19 patient Detection of Covid-19 Covid-19 detection via features extraction	[42] [43] [44] [45]	4
Detection by CT and X-ray image together (with developed architecture/model)	Detect pneumonia and Covid-19. Detection via Convolutional Neural Network (CNN) -tailored Deep Neural Network (DNN) Detect through hybrid deep neural networks (HDNNs),	[46] [47] [36]	3
Detection by CT and X-ray image separately (with developed architecture/model)	Predicts Covid-19 detection by multi-modal covid network (MMCovid-NET) Accurate diagnose of Covid-19 by light CNN model with watershed-based region-growing segmentation Automatic detection by Multilayer Spatial Covid Convolutional Neural Network (MSCovCNN) Early detection of Covid patient by proposed InceptionResNetV2 model Differentiate Covid pneumonia normal sample by proposed SCoVNet architecture Modified MobileNetV2 model to understand the what features of CT/X-ray images used to know the reason behind Covid-19 Develop Modified ResNet50, accurate, fast, and cheap auxiliary diagnostic tool for detection DenseNet-121 model to image segregation Intelligent decision support system for Covid-19 empowered with deep learning (ID2S-Covid19-DL) To detect covid-19	[48] [49] [50] [34] [37] [51] [33] [52] [53]	9
detection and analysis of Covid-19 through unsupervised learning (with developed architecture)	Unsupervised deep learning-based Covid-19 detection by Autoencoder3-ResNet50 (GMM) model	[41]	1
Detection through differentiation between covid, pneumonia and normal patient (with developed architecture/model)	Accurate and efficient method to detect Covid-19 by CovidCon Distinguish between Covid-19 patients with others by NasNetMobile model Differentiate Covid-19 pneumonia, non-Covid-19 pneumonia and nonpneumonia diseases Differentiation between Covid-19, non-Covid-19 and pneumonia by CNN-based Covid-19 detection model	[54] [38] [39] [35]	4

3.3. Exploration of used data

All of the studies use only image data as our searching key word was "X-ray" and "CT Scan". But there is only article by Nasir N. et al. [43] which include clinical notes along with the X-ray and CT scan images. They found only 485 clinical notes available for 535 images. Seven of them used only Kaggle dataset to collect their data for training or testing purpose of developed model [35, 38, 42, 44, 46, 49, 51]. Three of them used only GitHub repository which was developed by Dr. Joseph Cohen [33, 43, 48], other four of them used both of the Kaggle and GitHub database [34, 47, 50, 54]. One used all of the GitHub, Covid-19 radiography database, Kaggle Covid-19 image data collection, and Actual Med Covid-19 Chest X-ray Dataset [36]. One article collected data From D. S. Kermany, et al., "Identifying medical diagnoses and treatable diseases by image-based deep learning", J. P. Cohen, P. Morrison, and L. Dao, "Covid-19 image data collection" [45]. Another one from GitHub, Italian Society of Medical and Interventional Radiology, Radiological Society of North America (RSNA), Radiopaedia, and SIRM and Kaggle repository [52].

Article [36, 46] worked on only Hybrid model, Where [47] worked on both of the individual and hybrid model of chest X-ray and Computer Tomography scan. In Hybrid model, CT scan and X-ray image is merged in a single Image and processed. All of them have worked with the global data which are free available for researcher. Seventeen of them developed new algorithm and tested those model on the collected dataset. They divided the collected data for testing and training purpose while most of them used 80% data for training and 20% for testing procedure. The following table 2 will describes details of the data used is the selected review articles.

Table 2. Details of Data used in Review.

Literature	Data Source	Data Volume
[42]	Kaggle	2482 CT scans image and 31 Covid positive along with 10,192 normal X-ray image
[48]	GitHub	108,948 images
[49]	Kaggle	3829 X-rays and 3829 X-rays
[43]	GitHub	535 CT and X-ray images and 485 clinical notes related with them
[37]	Mendeley Data	17,599 images
[44]	Kaggle	2481 images
[46]	Kaggle	2357 CT scan data, 2515 chest X-ray data and 2400 CT and chest X-ray hybrid data
[34]	Kaggle, GitHub	5856 chest X-ray & CT dataset
[54]	Kaggle, GitHub	2905 unique images for X-ray 617,775 images from 4154 patients
[41]	Mendeley Data	8,055 CT scan and 9,544 X-ray images
[51]	Kaggle	2591 mixed data
[33]	GitHub	17100 X-ray and CT images
[47]	Kaggle, GitHub	168 Covid and 168 normal cases for the both X-ray and CT scan images
[36]	GitHub, Covid-19 radiography database, Kaggle, Covid-19 image data collection, and Actual Med Covid-19 Chest X-ray Dataset	3500 infected and 1500 healthy controls

[45]	D. S. Kermany, et al., "Identifying medical diagnoses and treatable diseases by image-based deep learning," J. P. Cohen, P. Morrison, and L. Dao, "Covid-19 image data collection,"	images of normal 805 and Covid-19 195
[35]	Kaggle	Covid-19 400 Pneumonia 402 non-Covid 406
[50]	Kaggle and Git Hub	723 X-ray and 3228 CT scans images
[38]	Kaggle	400 chest
[39]	Wonkwang University Hospital(WKUH) and Chonnam National University Hospital (CNUH), Italian Society of Medical and Interventional Radiology(SIRM) public database.	X-ray images, and 400 CT scan images 3993 images.
[53]	-	527 images
[52]	From Git hub, Italian Society of Medical and Interventional Radiology, Radiological Society of North America (RSNA), Radiopaedia, and SIRM) and Kaggle repository.	1229 SARS-CoV-2,1161 negative

3.4. Context of Study

Usually contextual studies mainly focus epidemic forecasting and continuous development [13]. Articles on disease detection used public datasets and worldwide views which were not specified by the context. These results shows disease detection via various machine learning method methods were generally not reliant on context.

3.5. Exploring the AI Techniques

One Study focusing on real time surveillance on Covid-19 detection by Ullah F. *et al.* proposed the basics of Internet of Things platform is the connection of a web service to a cloud infrastructure service [52]. To identify Covid19, a combined model is formed that consists of Gaussian Naive Bayes [30], Support Vector Machine [29], Decision Tree [55, 56], Logistic Regression [31], K-Nearest Neighbour [32], and Random Forest [57]. For extraction of 350 prominent feature CNN model was used. Hyper-parameter tuning is used to select the suitable filter length and frequency. As a consequence, ReLU [58], a non-linear activation function, is applied to each component. In the suggested CNN model, two convolution layers employ 64 and 128 filters, four-size kernels, and the padding numbers which is determined by the number of the input which was taken based on the precise shape. In this model the performance measure have been done through the Gradient-weighted Class Activation Mapping (Grad-CAM) [59, 60]. Besides this they have use another performance measuring method called t-distributed Stochastic Neighbour Embedding (t-SNE) [61] which actually used for visualizing the multidimensional data by initializing any data point. Here authors have done this analysis on SARS-CoV-2 CT scan data from the Kaggle database.

A total of 6 papers worked on different CNN procedures like VGG19 [62], VGG16 [63], InceptionResNetV2 [64], MobileNetV2 [65], Densenet121 [66], InceptionV3 [67], Xception [68], and Resnet50 [68]. For example deep learning based Convolutional Neural

Network, Inception v3, VGG-19, ResNet-50 and Xception models are used by Mukhi S.E *et al.* [42].

After pre-processing the accuracy of models are analysed and estimated by obtained accuracy. They found that fine-tuned VGG-19 model has a highest accuracy at detection of covid-19. VGG-19 model shows an accuracy of 93% from CT scan and 94.17% from the chest X-ray data. Kathamuthu N.D. *et al.* [46], applied Densenet121, VGG16 and 19, InceptionV3, Xception, and Resnet50 models to detect Covid and they found VGG16 model performed much better than other models with the accuracy of 98.00%. In another article Baz M. *et al* [17] achieved 99% accuracy by applying a Covid-19 detection tool which works by CNN model.

Some articles proposed new method to detect Covid-19. In article [48] Padmapriya T. *et al.* proposed a new bespoke convolutional neural network (CNN) architecture named multimodal Covid network (MMCovid-NET). This model functions by varying the layer number from two to seven. 24 models were build up to for the testing purpose of the algorithm. MMCovid-NET-I, MMCovid-NET-II, MMCovid-NET-III, and MMCovid-NET-IV were the four models among them. MMCovid-NET-III gave best result with an accuracy of 99.75%. A novel light CNN model architecture was developed by Khan H.A. *et al.*, which is a lighter model gives mean of 98.8% accuracy for X-ray and 98.6% for CT scans. SCoVNet architecture [37] and InceptionResNetV2 [54] are two different architecture, are also developed to detect Covid, these were pre-trained by VGGNet-19, ResNet50, InceptionResNetV2 and MobileNet etc. SCoVNet architecture shows 99% accuracy on CT scan and 98% on X-ray data set. InceptionResNetV2 results 99.2%, 98%, 97% training, validation and test accuracy respectively. Convolutional Neural Network (CNN)-tailored Deep Neural Network (DNN) [47] was developed for training and testing both of the X-ray and CT scan data together. Which gives 96.28% accuracy and the Area Under Curve (AUC) is 0.9808 and 0.0208 is the false negative rate. Another automatic detection process is provided by the Multilayer Spatial Covid Convolutional Neural Network (MSCovCNN) [50], with detection accuracy of 93.63%, for X-ray images 97.88% AUC and detection accuracy of 91.44% and AUC of chest CT scan 95.92%. 5-tiered 2D-CNN frameworks, softmax classifier [69] and ANN [70] are used in this model. Detection of Covid-19 pneumonia can be done by Fast-track Covid-19 classification network (FCONet) [39], based on a single CT image with sensitivity 99.58%, specificity 100.00%, and accuracy 99.87%. VGG16 has fewer parameters and needs less training time, which leads to better results. It therefore works better than other CNN models [44].

Ravi V. *et al.* shows an 84% accuracy for CT scan and chest X-ray data by their model Autoencoder3-ResNet50 (GMM). Separate four sets of experiments are performed on both CT and CXR scan data. The convolutional autoencoders, pre-trained CNNs, hybrid, and PCA-based models are applied methods for feature extraction. for clustering both of the Autoencoder1-VGG16 (KMeans and GMM) models, K-means and GMM techniques are applied in the experiment and these models reached at accuracy of 70% [41]. Reis H.C develop COVID-DSNet model to classify Covid and typical pneumonia (bacterial, viral). COVID-DSNet model gives an accuracy of 97.60 % and sensitivity of 97.60 %. Sensitivity values of 100 % for typical pneumonia, 96.30 % for common pneumonia, and 96.58 % for COVID-19 are collected. [46]. The table 3 will show the list of various algorithm and there respected obtained accuracy, used or developed in the selected research articles. And following figure 4 will describe the accuracy performance chart of various selected articles for individual imaging methods like X-ray, CT, and X-ray or CT both.

Table 3. A Summary of algorithms used in the articles.

Article	Algorithm and Model	Result
[42]	CNN with Deep Neural Network <ul style="list-style-type: none"> • Network VGG-19 • ResNet-50 • Inception v3 • Xception 	<ul style="list-style-type: none"> • VGG-19 for chest X-ray with 94.17% Accuracy • VGG-19 for CT Scan with 93% Accuracy
[48]	Bespoke CNN <ul style="list-style-type: none"> • MMCovid-NET developed. 	99.75% accuracy
[49]	Light CNN (Watershed based region growing segmentation)	<ul style="list-style-type: none"> • Chest X-ray with mean accuracy 98.8% mean accuracy • CT Scan with mean accuracy 98.6%.
[43]	Multi-modal system <ul style="list-style-type: none"> • VGG16 • ResNet50 • InceptionResNetV2 • MobileNetV2 	Accuracy with 97.8%
[37]	CNN <ul style="list-style-type: none"> • SCovNet • Resnet18 • SVM • LR 	<ul style="list-style-type: none"> • X-ray through SCoVNet with accuracy of 99% • CT scan through SSoVNet with accuracy 98%.
[44]	CNN <ul style="list-style-type: none"> • VGG16 • VGG19 • Densenet121 • InceptionV3 • Xception • Resnet50 	• VGG16 with accuracy of 98%.
[46]	Deep CNN (Covid-DSNet developed)	• 97.60 % accuracy
[34]	CNN <ul style="list-style-type: none"> • VGGNet-19 • ResNet50 • InceptionResNetV2 • MobileNet 	• InceptionResNetV2 with accuracy 97%
[54]	CovidCon	• 99.13% Accuracy
[41]	Convolutional auto encoders with pre-trained CNN <ul style="list-style-type: none"> • Autoencoder3-ResNet50 • Autoencoder1-VGG16 	• CT scan using Autoencoder3-ResNet50 (GMM) with accuracy 84%.
[51]	Deep CNN <ul style="list-style-type: none"> • VGG16 • MobileNetV2 • InceptionResNetV2 • ResNet50 • ResNet101 • VGG19 	• MobileNetV2 accuracy of 95%
[33]	CNN ResNet50	<ul style="list-style-type: none"> • CT Scan with accuracy 97.7% • X-Ray with accuracy 97.1% 96.28% Accuracy
[47]	Tailored Deep CNN	
[36]	Hybrid Deep Neural Networks (HDNNs)	• 99% classification accuracy
[45]	VGG-19	• Accuracy 99%

[35]	CNN	<ul style="list-style-type: none"> Accuracy 99%
[50]	MSCovCNN	<ul style="list-style-type: none"> Chest X-ray with accuracy of 93.63%
[38]	CNN	<ul style="list-style-type: none"> CT Scan accuracy 91.44%
	<ul style="list-style-type: none"> VGG16 InceptionResNetV2 ResNet50 DenseNet201 VGG19 MobileNetV2 NasNetMobile ResNet15V2 	<ul style="list-style-type: none"> CT scan using NasNetMobile shows accuracy of 82.94%
[39]	FCONet	<ul style="list-style-type: none"> Chest X-ray using NasNetMobile with accuracy 93.94%
[53]	ID2S-Covid19-DL	<ul style="list-style-type: none"> Accuracy 99.87% For validation sensitivity 94.38% and specificity 97.06%
[52]	CLAHE	<ul style="list-style-type: none"> Accuracy 98.5%
	<ul style="list-style-type: none"> GNB SVM DT LR KNN RF 	

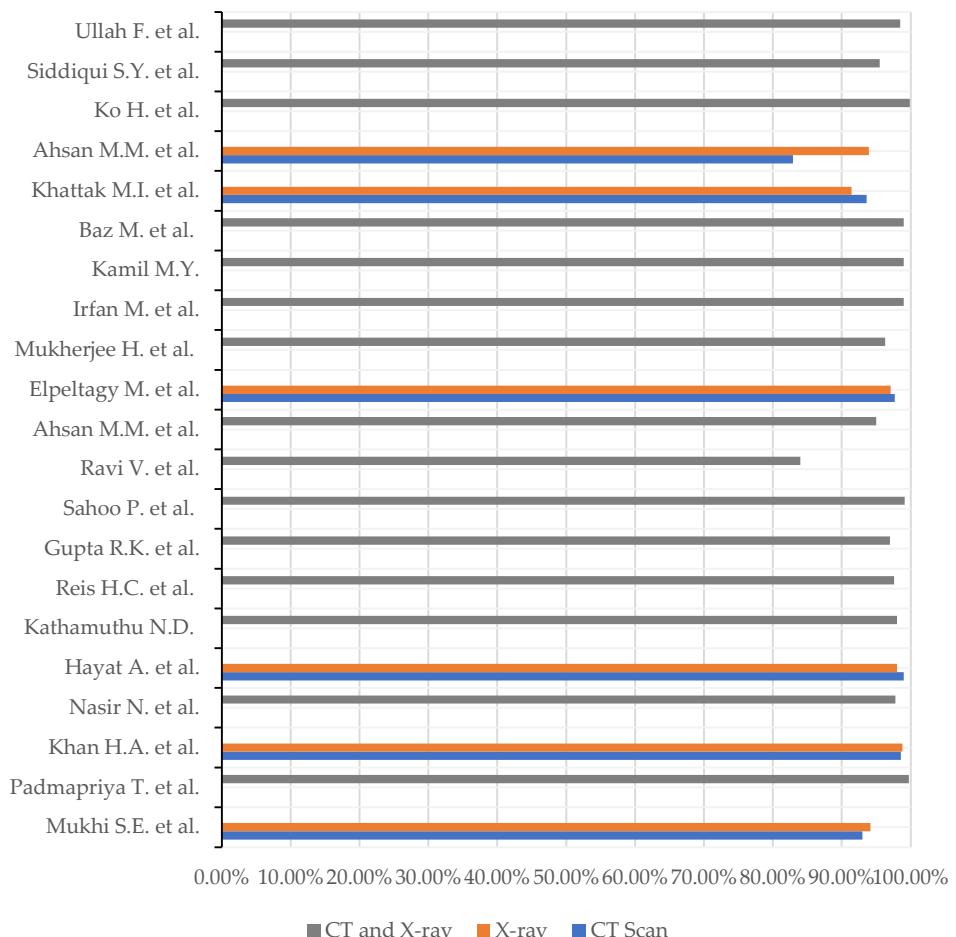


Figure 4. The Accuracy obtained by various selected research articles with different imaging techniques.

4. Future Research Opportunities

We've briefly discussed the difficulties and potential directions for future study in this section with regards to using AI and machine learning to combat the Covid-19 pandemic as well as potential future pandemics.

1. Use of a Large Set of Data in Research – There are opportunities to gather substantial amounts of data and make them accessible to researchers so they can run various tests. Such initiatives will be incredibly helpful in the battle against the pandemic. Global data were used in all disease detection study projects. However, we suggest that more work in this area could benefit from using a variety of worldwide data sources. Future studies could look into whether larger databases could produce more well-structured, verified, and generalised results. Additional research could be done to create an algorithm that is more efficient and effective. With enough information in the future, the claims made in the research can be investigated further.
2. Development of New Algorithm – New algorithms can be developed in future for more efficient and accurate detection of Covid-19. CNN with multiple layer can be developed for more refined result. The structural architecture of machine learning algorithm can be modified in near future by observing the potential performance level through this literature review.
3. Hybrid Data – Among 21 articles only three of them used Hybrid data to detect Covid-19. Use of hybrid data should be more. Because hybrid data gives more accurate and effective result in diagnosis of Covid-19. Because hybrid data consider CT scan image and X-ray image together as a single image, the retrieved data from that image is more accurate as input to any algorithm.
4. Other Data Should Include – In these articles we noticed that when researcher use CT scan and X-ray data usually they do not consider any other kind of data like health history, pathological, clinical etc. with exception of one Article [43]. If researcher include other related data for the research, the study will be strong and detection process will be more accurate.
5. Managing the ICU Surge during the Covid-19 Crisis - According to reports, some hospitals chose to only treat young patients, abandoning elderly patients who had a lower chance of surviving because the hospitals were running low on supplies. Further study can be done to determine which individuals, based on their X-ray and CT scan report, are more likely to be critical cases. This would assist hospitals in identifying patients who can be treated at home versus those who require intensive care unit assistance. Studies that concentrate on ICU admission could help some patients be discharged early, freeing up room for those who really need it. Studies can also help to delay the early discharge of ICU patients.

5. Conclusion

Within this research study, significance of artificial intelligence, machine learning, deep learning is intended to search for an early, easy, and accurate detection of global pandemic, Covid-19. Based on the method used to detect diseases, we divided the study into five different categories. In our research, we also found that, with acceptable accuracy, application of AI and ML could be useful for the differentiation among seasonal flu, normal pneumonia and Covid-19 pneumonia [38, 39]. Besides that, our study found that Artificial Intelligence has performed very efficiently with existing or new models for detection of Covid. Those studies which are critically reviewed, they used deep learning algorithms for analysing image data, particularly only on X-rays and CT scans with exception [43], which used clinical notes along with image data. We have suggested five possible way to research in future based on these findings.

Conducted systematic review has given an extensive overview to combat with Covid-19 when taken as a whole. These articles were examined and compared in a num-

ber of ways, taking into account the input features, the techniques they used for data processing, as well as their different goals to achieve. We have offered a variety of insightful details throughout the study, such as the application type, the use of machine learning, related assessment carried out in every article.

Our review study may have a number of flaws, but at the same 6+time it also opens up some possibilities for further research work in the indicated areas. First, we conducted a thorough keyword searching to find relevant. Despite the fact that our search terms produced useful results for achieving our study's objective, there is a chance that we might have missed some crucial materials. Second, we believe that the main components we have outlined, examined, and summarised in this paper are current materials pertaining to covid-19 virus and machine learning techniques. Third, we are only concerned with using AI and ML on the retrieved data from CT scan and X-ray images to combat Covid-19.

Despite the fact that there are many studies that either use CT scan or X-ray data, we did not include those kind of articles in the review the main cause for this, they do not accurately align with the aim of our research study. We view above factor as a limitation of our work. Although, when we broaden our search criteria and our study goal in the future, this can be addressed and assessed.

Future work is therefore required to gather and examine more pertinent data. Supportive data, like datasets which includes high data points features or more variable or observations and collaborate to healthcare field, could do some betterment in how AI and ML handle this health danger and help governments and communities control the virus's or any similar types of pandemic effects early on.

Future study could be done on examination of data security in the pertinent fields in addition to information extraction. Furthermore, some pioneering technologies like internet of things (IoT) should be the main tool for the enhanced and enriched AI and ML techniques with more effectiveness in order to remotely assist Covi-19 patients.

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