

# A Survey on COVID-19 Disease Detection using Advanced Techniques

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Keywords: Machine Learning, Deep Learning, COVID-19

Abstract: Coronavirus disease (COVID-19) has become the most dangerous pandemic in worldwide. The World Health Organization (WHO) has declared COVID-19 as an outbreak that has placed a heavy burden on all nations. Health sector has included the help of emerging technology including Machine Learning, Artificial intelligence, Deep Learning, Internet of Things, Block chain and etc. to battle and look ahead against the new diseases. In recognizing and recommending the production of a vaccine for COVID-19, various advanced technologies may play a vital role. In this paper, we provide a brief survey on COVID-19 detection of disease based on 75 collected papers. Furthermore, a study on recently used techniques, their limitations and applications is also included in this survey.

## 1 INTRODUCTION

The advent of the second decade of the 21st century is marked by the outbreak of extremely contagious and equally dangerous Severe Acute Respiratory Syndrome-Corona virus (SARS-CoV). The epicenter of the COVID-19 is found to be Wuhan, Hubei Province, China, in the sea food market and traces its origin in Bats. With time, for the last few months this epicenter has shifted its allocation to Italy and now is reaching America and other continents. This has led to declare COVID-19 as pandemic and a situation of Global Health emergency. To combat this new threat India has already taken various steps and has gone under complete lockdown. This move is seen as a step to flatten the curve of this pandemic to release pressure on the medical infrastructure and to allow for its containment. The demand for medicines and medical types of equipment such as Ventilators has been skyrocketing and India is trying its level best to match the need. Intensive care units are being built to ensure the safety of the people. According to WHO, this pandemic will have huge repercussions shortly and can come down heavily on the health infrastructure and economy of various nations. It is expected that it will grow in the recent future but in a controlled manner.

In this paper, our aim is to provide the answer of following questions:

- What are the recent techniques used in the COVID-19 disease detection in computer science domain?
- What are the limitations of techniques in the COVID-19 disease detection?
- What are the applications in COVID-19 disease detection?

For this, we have collected 75 published papers based on COVID-19 disease detection. After that, based on the keyword and abstract, we categorize all papers into various category. Figure 1 elaborates the total numbers of papers in different category. Here, ML, DL, and AI denote machine learning, deep learning, and artificial intelligence (AI) respectively. IoT and BC identify the internet of things and block chain respectively. Remaining part of the paper is elaborated as: section 2 highlights the related work on COVID 19. Furthermore, related work includes the comparative study of recent works on COVID-19. In section 3, we provide the brief information about techniques used in COVID-19 disease prediction. After that, limitations of various techniques are discussed in section 4. In section 5, we provide the various applications of AI. At the end, section 6 concludes the paper.

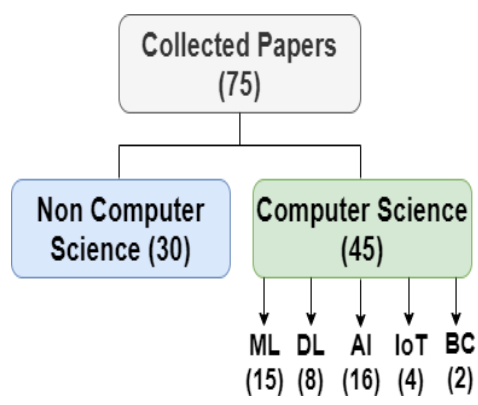


Figure 1: Distribution of selected papers.

## 2 RELATED WORK

(Wu et al., 2020), December 2019 saw an out break of severe acute respiratory syndrome(SARS) coro In this paper (Zhangetal.,2020), the rationale behind SARS-CoV using ACE2-receptor as a point of entry into cells is observed and studied. Benvenuto et al. have proposed to study the evolution and spread of COVID-19 (Benvenuto et al., 2020). The Johns Hopkins epidemiological data is used in ARIMA model to predict the pattern of growth of COVID-19. The work of Liao et al. (Liao et al., 2020) is to prepare Intensive Care Units (ICU) in such a way that they can be used to isolate and treat extreme cases of COVID-19. The extreme cases pose serious threat to other people and hence need to be handled properly. Shanmugaraj et al. (Shanmugaraj et al., 2020) have provided a constructive discussion on the outbreak of COVID- 19. (Al-Qaness et al., 2020) have introduced a modified form of the flower pollination algorithm (FPA) is used along with the salp swarm algorithm (SSA). It is called FPASSA and improves the performance of the adaptive neuro-fuzzy inference system (ANFIS) by determining optimal values of the parameters. Xu et al. (Xu et al., 2020) have published a systematic review on COVID-19 and then compare between SARS-CoV and SARS-CoV-2 in the matter of their originations, incubations, treatment methods and diagnosis, pathogenic mechanisms, and proteomic and genomic sequences is the goal of this paper. Gralinski and Menachery (Gralinski and Menachery, 2020) have given stress to use historical pandemics data with latest tools to handle group 2B coronavirus.

In paper corona virus in the Wuhan, Hubei province, China. The ability of the virus to spread from animals to humans highlights its threat to global health. Looking at the gravity of corona virus crisis, it

is the moral responsibility of all academic journals, websites to share the data related to COVID-19 for research and prevention measures (Wu and Poo, 2020). This is a technical guidance created for instructing centres to control disease at all possible level and describe the procedure for conducting laboratory testing of the unexplained pathogens causing viral pneumonia in Wuhan, China (National et al., 2020). Andersen et al. have reviewed and studied the discovery and development of broad-spectrum antiviral agents (BSAAs) and identify different drug combinations for the treatment of various viral infections (Andersen et al., 2020). With the death of Dr. Li Wenliang, the doctor who first found SARS-Cov-2 in Wuhan, China; the threat posed by SARS-Cov-2 to the clinicians treating people and to the frontline workers has become evident and needs to be handled very efficiently (Petersen et al., 2020). Wang et al. (Wang et al., 2020) have mentioned that The outbreak of COVID-19 in Wuhan should continuously be monitored and necessary and strict public health measures should be implemented in phased manner till the infection reaches to an ideal level. Liu et al. (Liu et al., 2020) have reviewed that the average basic reproduction number (R0) of COVID- 19 is 3.28 which overwhelmingly exceeds WHO estimates of 1.4 to 2.5. Abbad et al. (Abbad et al., 2019) have provided the trend of an emerging Middle East respiratory syndrome corona virus (MERS- CoV). The first case of Coronavirus was observed in Nov, 2019 in Wohan, China. In this research paper the author (Schwartz and Graham, 2020) have mentioned about the effect of on infection of SARS-CoV and MERS-CoV on women during their pregnancy. It is mentioned how pneumonia is dangerous for pregnant women. According to this research paper the major cause of indirect maternal death is pneumonia. Out of all the pregnant women who are suffering from pneumonia there are 25% pregnant women who need to be hospitalized and their care to be taken. The observation of this research is that pregnant women need extra care during the pregnancy so that the risk of infection in pregnant women can be reduced. For identifying the cases of COVID-19, the idea of using the algorithms of machine learning has been proposed (Rao and Vazquez, 2020); In order to decrease the chances of spread, the population with high risk can be quarantined earlier as compared to population with mid-risk or low-risk. The population with high-risk, mid-risk and low-risk can be identified using AI by collecting the details of previously affected cases. As of February 20, 212 cases has been tested, out of which only one case was positive and 211 cases

showed negative result in Nepal (Shrestha et al., 2020). The confirmed case in Nepal is a 32 year old male student studying in China, who returned to Nepal for winter holidays on January 9. The Nepal Government has taken several steps to take care and many centres have been constructed. Several satellite hospitals and network of five hubs has been constructed in Kathmandu, at hub hospitals 55 isolation beds has been provided. In paper (Al Kahlout et al., 2019), it is hard to identify from where the virus has arrived. It is hard to identify its original source. According to the analysis of phylogenetic, the corona virus is categorized as: alpha-, beta-, gamma-, and delta-corona viruses.

In 2012, in the kingdom of Saudi Arabia, the human beta-coronavirus (HCoV) which is a Middle East respiratory syndrome coronavirus (MERS-CoV) was identified. Until 2017, 21 cases have been identified, in the state of Qatar. Out of these 21 cases 33.33% (7 cases) results to death. Among all 21 cases 20 were male and only one female case was reported, in Qatar. Isolation was initially done in Qatar. In this research paper (Reusken et al., 2020), the idea for molecular test of 2019-nCoV has been discussed. It is mentioned that out of 30 EU/EEA countries 24 countries has already implemented the above test. In this research paper (Nishiura et al., 2020), there analysis of spreading of coronavirus is done. Epidemiological Analysis is done by analyzing epidemic curve in three steps. As a result it has been observed that epidemic curve is consistent. It is hard to say that there is any zoonotic transmission occurred because there is no proof that the virus in animal sold on the market. According to this research paper (Ji et al., 2020), there are 70641 cases of corona virus are confirmed by February 16, 2020, out of these 70641 cases 1772 are deaths. 2.5% is the average mortality, while the mortality rate of Wohan is greater than 3%. New local medical facilities are built by China Government. Kock et al. (Rahimi and Abadi, 2020) have mentioned that the humans affected by corona virus may suffer from cold. The genome of 2019-nCoV are related to the bat corona viruses and SARS-CoV. The main reason of spreading 2019-nCoV is considered the seafood and animal market in Wohan, China. In spite of this, Table 1 shows the comparative study of some recent papers that use various algorithms/techniques (Bhattacharya et al., 2021; Suri et al., 2021).

From literature review, we observe various techniques used in the COVID-19 disease prediction.

### 3 ADVANCED TECHNIQUES

- **Machine learning:** The aim of machine learning is to develop algorithms that can learn and create mathematical models for data processing and prediction. On the basis of the data presented, the ML algorithms should be able to learn by themselves and make specific predictions without having been specifically trained for a given task. In recent years, not only computer scientists and AI algorithm manufacturing specialists have seen rapid development beyond theoretical developments in the application of machine learning, but also other researchers in different fields who are applying these techniques for their own purposes. Chemical and material sciences have been affected by the usage of machine learning to speed certain analytical activities or to solve problems for which traditional simulation methods are ineffective, among many other fields of research. A subset of machine learning based on artificial neural networks (ANNs), deep learning is targeted at further escalating AI developments.
- **Deep learning:** Deep learning is an AI function that emulates the functions of the human mind in the analysis of image classification data, voice recognition, translation of expression, and strategic thinking. Deep learning AI is capable of learning without proper supervision, trying to on both unstructured and unlabeled data. A deep neural network is an ANN with several layers between the input and output layers (DNN). Each architecture has found success in specific domains. Unless they have been tested on the same data set, the performance of different architectures cannot always be correlated.
- **Artificial Intelligent:** AI refers to any human thought exhibited in computer science by a computer, robot, or another machine. AI refers to a computer or machine's ability to imitate the human mind's commonly used abilities, to learn from illustrations and knowledge, to recognize objects, to interpret and respond to language, to make decisions, to solve problems, and to integrate these and other abilities to perform tasks that a person might perform.
- **Blockchain:** Blockchain's implementation seems to be complex, which it can undoubtedly be, but the core principle is indeed very clear. A blockchain is a form of a ledger. In order to be able to grasp the blockchain, you first need to understand what a network actually is. Blockchain systems compensate for the difficulties of security and

Table 1: Table for covid cases

References	Used Techniques	Used dataset	Used Evaluation Metric	Challenges/Future improvement
Kermary et al. (2018)	DL framework + Transfer learning	Optical Coherence Tomography (OCT) image dataset	Accuracy, Cross-Entropy Loss, True Positive Rate and False Positive Rate	Images from varied sourced can be utilized for future improvement.
Rajaraman et al. (2018)	Customized CNN model-VGG16	Chest X-ray dataset	Accuracy, AUC, Precision, Recall, Specificity, F-Score and MCC	Nonlinear locality prediction
Peng et al. (2020)	AI + DL based Framework	CT Images from Xi	Accuracy, Specificity and Sensitivity	Relationship between Hierarchical features of CT images and genetic, epidemiological information needs
Ghoshal et al. (2020)	Bayesian Convolutional Network	X-ray Images of Posterior-Anterior	Prediction Uncertainty and Accuracy	Omics dataset should be considered for better observation
Apostolopoulos et al. (2020)	Transfer Learning + CNN	X-ray Image dataset from GitHub	Accuracy, Sensitivity and Specificity	Larger dataset requires for better analysis
Hemdan et al. (2020)	CNN	X-ray Image Dataset from Dr. Joseph Cohen and Dr. Adrian Rosebrock	Accuracy, Precision, Recall and F1-Score	Larger dataset requires for better analysis
Narin et al. (2020)	CNN	X-ray Images from Dr. Joseph Cohen GitHub Repository	Accuracy, ROC and Confusion Matrices	Larger dataset requires for better analysis
Ardakani et al. (2020)	CNN+TL	CT images	ACC:99.51%, SE:100% SP:99.02%, AUC:0.994	Larger dataset requires for better analysis
Gozes et al. (2020)	3-D + 2-D CNN	chest CT scans	SE: 98.2%, SP: 92.2% AUC: 0.996	Larger dataset requires for better analysis
Shi et al. (2020)	ML (RF)	Images from different location-specific features	ACC:87.9%, SE: 90.7% SP: 83.3%, AUC: 0.942	Larger dataset requires for better analysis
Liu et al. (2020)	LA-DNN+TL	chest CT scans	ACC:88.8%, F1S: 94.7% AUC: 0.88	Larger dataset requires for better analysis
Pereira et al. (2020)	ML+DL+TL	chest X-ray images	FS: 89%	Larger dataset requires for better analysis

and confidence in many respects. First, there is still linear and chronological storage of fresh blocks usable. That is, the 'end' of the blockchain is still attached to them. "You can find that each block has a "height" location on the chain when you look at the Bitcoin network.

- **The Internet of Things (IoT):** It comprises a system of interconnected, internet-connected devices that can capture and transmit data across a wifi connection without human interference. Endless individual or company possibilities exist. A 'device' can apply to a connected medical system, a biochip transponder (think livestock), a solar panel, a connected car with sensors that warn the driver to a number of potential problems (fuel, tyre pressure, maintenance needed, and more) or any object fitted with sensors that can collect and relay information through a network.



Figure 2: Mutation stages of COVID-19

## 4 CHALLENGES AND ISSUES

The problems and problems related to DL integration for computational biology for COVID19 disease outbreak management in green infrastructure are described below:

Table 2: Applications

S. No	Applications of AI in COVID-19 pandemic	
1	Early diagnosis and identification of the infection	AI can evaluate abnormal symptoms and other red flags rapidly and thus alert patients and health authorities (Shanmugaraj et al., 2020; Al-Qaness et al., 2020). It helps, and is cost-effective, to have quicker decision making. It helps to build, through useful algorithms, a new diagnosis and management framework for the COVID 19 cases. With the aid of medical imaging technologies such as computed tomography (CT), magnetic resonance imaging (MRI) scanning of human body parts, AI is useful in the diagnosis of infected cases.
2	Control of the therapy	For automated monitoring and prediction of the spread of this virus, AI can create an intelligent platform. In order to remove the visual features of this disorder, a neural network can also be built and this will aid in the proper monitoring and treatment of the affected individuals (Xu et al., 2020; Wu et al., 2020). It has the capacity to provide patients with day-to-day updates and also to provide solutions to the pandemic of COVID-19.
3	Tracing the contacts of individuals	AI can help analyze the extent of infection by identifying the clusters and 'hot spots' by this virus and can effectively track and control the individuals' contact tracing. It can forecast the future course and possible reappearance of this disease.
4	Scenario projection and mortality	From the available data, social media and media platforms, this technology can monitor and predict the existence of the virus, about the risks of the infection and its possible spread. In addition, the number of positive cases and mortality in any area can be estimated. AI will help recognize and take steps accordingly for the most vulnerable territories, individuals and countries.
5	Drug and vaccine development:	By evaluating the data available on COVID-19, AI is used for drug testing. It's useful for the design and production of drug delivery. This technology is used to speed up real-time drug testing, where normal testing takes plenty of time and thus helps to dramatically speed up this process, which might not be feasible for a human being (Xu et al., 2020; Gralinski and Menachery, 2020). It can help to identify useful drugs to treat patients with COVID-19. It has become a valuable method for the production of diagnostic test designs and vaccinations (Wu and Poo, 2020; Andersen et al., 2020). AI helps to produce vaccines and therapies at a much quicker pace than normal and is also useful during vaccine production for clinical trials.
6	Reduction of healthcare workers' workload	Healthcare workers have a very high workload because of a rapid and massive rise in the number of patients during the COVID-19 pandemic. AI is used here to decrease the workload of health workers (Petersen et al., 2020; Rao and Vazquez, 2020). It helps to provide early diagnosis and care using digital methods and decision science at an early stage, providing students and doctors with the best training in this new disease (Shrestha et al., 2020; Al Kahlout et al., 2019). AI will have an effect on future patient care and tackle more possible problems that minimize doctors' workload.
7	Disease Prevention	AI will provide updated information that is helpful in the prevention of this disease with the assistance of real-time data analysis. It can be used during this crisis to forecast the possible sites of transmission, the influx of the virus, the need for beds and healthcare professionals. AI is helpful for the future virus and diseases prevention, with the help of previous mentored data over data prevalent at different time. It identifies traits, causes and reasons for the spread of infection. In future, this will become an important technology to fight against the other epidemics and pandemics. It can provide a preventive measure and fight against many other diseases. In future, AI will play a vital role in providing more predictive and preventive healthcare.

- **Privacy** Availability of large data and greater collections from COVID-19 is a significant obstacle given medical customer privacy.
- **Pattern** The spread and outbreak of the disease does not have a simple pattern. This has got a very complex and different behavior from country to country and time to time as covid-19 virus mutates itself.

from computer science background. We have discussed the different works done using various techniques and algorithm from machine learning, deep learning, artificial intelligence, internet of things and blockchain. In spite of this, we have also discussed bottleneck for these techniques and algorithms. Applications of these techniques in detecting COVID-19 have been analyzed. The advantage of our survey is that it covers various parameters and research directions for beginners.

## 5 APPLICATIONS

Applications of the latest Techniques has been given in the table 2.

## 6 CONCLUSION

This paper provides a brief survey on COVID-19 disease detection. For this, we have collected various papers from different domains. Filtering has been done based on the keywords well as abstract of the collected papers and then selected the papers

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