The Role of Artificial Intelligence and Data Science Against COVID-19

Saumya Tripathi and Dilip Kumar Sharma

Abstract Today, a massive outbreak of a deadly virus has challenged humanity in each aspect; we deemed ourselves powerful. Millions of people are at risk, and in some cases, even if the person has reported negative, it is relapsing. Globally, data scientists are also working to tackle this issue by diagnosing, predicting it with the help of machines. Artificial intelligence (AI) serves as a potential tool in fighting against the COVID-19 pandemic. Science the onset of a pandemic, the use of AI has exponentially increased to detect patients suffering or those who are critical. In this paper, the authors discussed the role of AI and the selective review of constraints associated with the functioning of AI. We will also discuss the shortcomings due to the excessive data available between the private and public organizations related to the health sector and their rigorous use without taking note of the data validity.

Keywords COVID-19 · Coronavirus · Data science · Artificial intelligence

1 Introduction

The virus named SARS-CoV-2 has been spreading terror in the hearts of people due to its deadly nature. It was first identified in Wuhan, China, as pneumonia of unknown cause on December 8, 2019 [1]. The spread of this disease has been so fast and so wide that the world is struggling to stabilize itself. As of April 25, 2020, there has been 2,802,118 cases of coronavirus and 195,443 deaths globally. The nations are fighting the coronavirus as best they can by expanding their healthcare facilities, stopping people from collecting at a particular place and in that they have also started utilizing the power of data science, artificial intelligence (AI) and machine learning. Since December 2019, a new type of coronavirus called novel coronavirus (2019-nCoV, or COVID-19) was identified in Wuhan, China. The COVID-19 has then

S. Tripathi (✉) · D. K. Sharma
GLA University, Mathura, India

D. K. Sharma
e-mail: dilip.sharma@gla.ac.in

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rapidly spread all over China and the world. It can cause symptoms including fever, difficulty in breathing, cough and invasive lesions on both lungs of the patients [1]. It can spread to the lower respiratory tract and cause viral pneumonia. In severe cases, patients suffer from dyspnea and respiratory distress syndrome [2, 53]. There are total 175,622,44,582,692 cases, recovered case 159,171,963 and 3,788,723 death according to World O meter [16]. The World Health Organization (WHO) has declared that COVID-19 is responsible for the death of many individuals and termed a pandemic. Nations are responsible for the spread and one's own country wellness. The countries use AI and machine learning (ML) tools to avoid and secure their nations from this pandemic.

Many people who are suffering from COVID-19 infection are developing mild to moderate respiratory tract infection and uneasiness and inhaling oxygen. Older people suffering from another disease like blood pressure and diabetes other chronic illness are experiencing more threat to their lives. To avoid this disease, the best way that can be used is to prevent the spread of this disease as it is spreading from touch and smell. When an infected person comes in contact with a healthy person and if he sneezes or coughs that there are 99% chances that the healthy person might get infected from the virus. The droplets from the saliva of the infected person will get into the respiratory tract of a healthy person and may make him ill and suffered from COVID-19. Therefore, it is necessary to maintain hygiene and keep sanitizing hands as the guidelines provided by WHO indicates that either masking off and proper sanitization can keep you off from the virus.

The governments from various countries have a hard time-fighting coronavirus as they are putting all efforts into preventing the virus from spreading. The critical conditions are managed by applying emergencies and using technology from equipment to fight from it. The kits and their use contain artificial intelligence, data science, data analytics, machine learning, thermal sensors and other techniques. Furthermore, in Sect. 2, we have written about applications of data science, Sect. 3 is about the role of artificial intelligence in predicting COVID-19 patients, Sect. 4 discusses guidelines issued by WHO, Sect. 5 discusses the role of data science in managing critical patients, in Sect. 6, we listed some available datasets, Sect. 7 consists of the things that could be done to control COVID-19, Sect. 8 consists of a summary of techniques and challenges in applying them, and Sect. 9 deals with conclusion and future work.

2 Application of Data Science

In these times, many people feel helpless in the face of the pandemic. However, people could focus on how they can give back to society by helping people in need. Given below are some of the things that the data science community is doing in the face of the novel coronavirus.

2.1 Real-Time Visualization

Some of the people are making interactive visualizations by utilizing the data given by different governments and World Health Organization (WHO) with the help of various tools available. This is helping many people track accurate and up-to-date statistics.

2.2 Forecasting and Prediction

For making the database more accurate and suitable for finding results efficiently and provide proper suggestion and treatment regarding the avoidance of the spread of this virus.

2.3 Discovering Treatments

At Columbia University, two graduates are using machine learning to find treatment for this virus. They screen therapeutic antibodies, and the probability of success is quite high [3].

2.4 Calculating Risk Factors

The teams are trying to find various factors that can be responsible for the spread of COVID-19. They are also trying to predict how can we stop the spread and which measures are being helpful and which are not very helpful by using the data of different regions and precautions taken in those regions.

2.5 Identifying Who is Dying and Why

People are trying to find the pattern among the people who are dying because of COVID-19. This includes respiratory diseases, heart diseases, genetic component, environmental factors, etc. But this data is challenging to access because of HIPAA restrictions [4].

2.6 Drug Discovery

The overall research is going on in order to find the most vital drug that can fight the coronavirus. Though the scientist is still not successful but with the help of data science, the scientist can track what all discovery using some similar salts in creating a more appropriate drug is taking place.

2.7 Monitor Patients Health

Using artificial intelligence and data science, the health of patients can be monitored using a similar pattern of cell structure and changes in the patient's body and anatomy.

2.8 Track and Prevent Disease

By tracking the patients who are showing some signals regarding the flu and keep monitoring them till they are negative can help prevent the virus and stop its wide-spreading nature.

2.9 Robotics

In China, robots were used to help deliver medicines to patients so as to stop the spread of the coronavirus among doctors. They were also used to disinfect hospitals by using ultraviolet light.

2.10 Predictive Analytics

Making the patients aware of the symptoms and helping them to take certain kind of salt and another remedy to help cope up with the virus and prevent it from spreading.

2.11 Contact Tracing

Data science-based tools are used to track patients or people who are quarantined across the country. It is also used to trace contacts of the patients.

3 Role of Artificial Intelligence in Predicting COVID-19 Patients

The health industry needs a superpower to diagnose and make the decision to handle the virus efficiently and provide proper suggestion and treatment regarding the avoidance of the spread of this virus. AI serves as a boon to the health industry as it is capable of handling numerous amount of data and use its intelligence and diagnose the patient having certain issues common to categorize whether he/she is infectious of COVID-19 or not. It also helps in understanding the development of vaccine and their availability. This technology is used for prediction, analysis and tracking of patients currently suffering from the virus and helps the sector to be aware of the vast illness due to pandemic [56].

3.1 Early Detection

AI helps in monitoring and detecting disease using prior knowledge and through its experience. As the data is supervised to the machine, therefore it is speedy and more accurate rather than any medical doctor detection and diagnosis.

3.2 Decision Making

AI helps the patients to make the better decision during any critical situation as the patients are moped derived toward the access and dealing it using dataset monitoring.

3.3 Treating Disease

Healthcare workers seek help from the machine and the Internet to find accurate medicine by providing the symptoms of the patient. If the patient is well educated about the COVID-19 virus, the patient illness is slowed down from spread.

3.4 Associated Care

A small study in Wuhan [18] has shown that the risk of dying increases with age. Elderly people have more diseases such as heart disease, respiratory problems, diabetes and clotting of blood. The place visited by him should be sanitized and locked up, and people around him should be tested immediately.

3.5 Checking Health Through Wearable

This includes respiratory diseases, heart diseases, genetic component and environmental factors. It is made publicly available by AWS and is a repository that constitutes of datasets related to machines.

3.6 End of Life Care

If the patient is not treated well using in intelligence and machine learning tools gently and with care and all the medication is used well, then the infected person may lose his life. But if the tools are used efficiently, and the medication and care is taken properly, then the well-being of the patient can be maintained.

AI serves as a platform to train machines with huge dataset and analyze health sector data and categorize accordingly. It also helps doctors and health vectors to train machines and set algorithm to optimize the data related to the virus with speed and accuracy. These machines help in retrieving the more precise data and support the health workers by diagnosing the issue more efficiently.

4 Precautions to be Taken to Avoid Getting Infected

In order to avoid getting infected, whether from indoor or outdoor, certain measure and guidelines are published by World Health Organization (WHO). If a member is infected from one family, then avoid getting in touch with him, and keep necessary action when getting in touch with him. If one is moving out, then avoid getting in touch with the infected person and maintain proper distance. These are some of the limitations and guidelines to be followed to avoid virus outbreak in the country.

The guidelines issued by WHO indicates that a person should keep washing his hand whenever he is going outdoor or if there is an infected person indoor that wash hand while being indoor. Always have a mask on, and in the second wave, the double mask was changed in the guidelines. Always disinfect the area where the ill person is, and do not share your personal item with them. Social distancing is the key to preventing the virus from getting into one's respiratory tract. For children, special guidelines are indicated in which children above three years of age have to keep the mask on and keep sanitizing their hands. They are not allowed to go outdoors. All the schools and educational institutions are temporarily shut for children. For traveling in a four-vehicle like a car, try to keep proper ventilation, and if there are two-person traveling that tries to sit socially distant to avoid getting infected.

5 Role of Data Science in Managing Critical Patients

People affected by COVID-19 are requiring or critical respiratory care. Data science has come up to care for these patients. In [7], they have studied various researches and come up with a three-stage process that will categorize the search result in three states to help the patients in ICU. They have read studies from [7–11].

We can also determine who the people most vulnerable are so that they could be separated beforehand from the rest [38]. It will also help us in identifying the people who are more susceptible to death. A small study in Wuhan [37] has shown that the risk of dying increases with age. Elderly people have more diseases such as heart disease, respiratory problems, diabetes and clotting of blood.

6 Available Datasets

There are various datasets freely available on the Web to help combat COVID-19 (Table 1).

These are only some of the datasets that are available from the sea of them available online. Countries have shared their own datasets online for everyone to analyze and forecast. There are related to age groups, counts of confirmed, recovered and dead, hospital beds and testings, etc., depending on the country.

7 Controlling COVID-19

Worldwide, countries are quarantining people, imposing lockdown, sanitizing to stop community spread. Public health has been the top priority for countries currently, and they are willing to sacrifice their economy to save lives. Although there is no single measure that could be taken to stop the pandemic worldwide, there are still some steps that could be taken like.

7.1 Social Distancing

People should follow proper protocols to ensure a safe distance from each other. A minimum of 1 m distance is required.

Table 1 Available datasets for the COVID-19 data

S. No	Dataset name	Description
1	"Google Covid-19 Public Datasets" [39]	This dataset comprises various datasets that are provided by Google for free so that it is more accessible to researchers, data scientist and analysts. This contains JHU CSSE (Johns Hopkins Center for Systems Science and Engineering) dataset, OpenStreetMap data and global health data from the World Bank.
2	"Covid-19 Open Research Dataset" [40]	At the Allen Institute, the semantic scholar team is providing CORD-19 by partnering with groups that are leading in COVID-19 research. It is also available for free on the Web site
3	"The COVID tracking project collects and publishes the complete testing data available for US states and territories" [41]	As the name suggests, this has all the data published from US states and territories of testing constitutes of positive, negative and pending, deaths and total test results
4	"LitCovid" [42]	It is an organized hub of literature to track researches on COVID-19. It takes into account how many papers are getting published every week and from which country. It is the resource of NCBI
5	"ECDC data on Covid-19 cases Worldwide" [43]	ECDC is a European Centre for Disease Prevention and Control, and it delivers data on all geographical distributions of novel coronavirus
6	"COVID-19 Open Research Dataset Challenge (CORD-19)" [44]	It is a Kaggle dataset, constituting 57,000 scholarly articles, with over 45,000 including full text, about COVID-19, SARS-CoV-2, and related coronaviruses. To cope up with this, the medical research community needs different AI experts to find answers
7	"A public data lake for analysis of COVID-19" [45]	It is made publicly available by AWS and is a repository that constitutes of datasets related to characteristics and spread of COVID-19
8	"COVID19 Global Forecasting (Week 4)" [46]	It is a dataset launched by Kaggle and is one of the challenges to answering WHO and NASEM questions on the pandemic
9	"Research Resource Repository COVID-19" [50]	Related datasets for research and analytics. The data may be directly or indirectly related to coronavirus. It deals with some subsidiary issues also

(continued)

Table 1 (continued)

S. No	Dataset name	Description
10	"Complete our world in Data for COVID-19 dataset" [51]	It is a crucial metric to understand the pandemic from a positive perspective
11	"Activity, population and location-COVID-19" [52]	Deals with the location and population table in compliments and COVID-19 dataset
12	"Research initiatives in HRS for COVID-19" [48]	Data resource including the data for COVID-19 patients and questionnaire with the US State policyholder
13	"Covid-19 OPEN DATA–FIGSHARE" [47]	It deals with sharing the initiative of collaboration of universities and medical colleges
14	"ICPSR: Data Repository for COVID-19" [53]	It deals with the health industry and maintains a centralized repository for the medical record of the COVID-19 patients and store a secure enclave to study those records
15	"VIVLI-COVID Data" [54]	It deals with the clinical trials on COVID-19

7.2 Testing

Countries should start testing people in large volumes as the virus is spreading exponentially in the world. People should also ensure that if any symptoms occur, they should go and have themselves checked out.

7.3 Travel Measures

People should avoid traveling and getting in touch with people. Countries have sealed their borders, but also in-country travel should be avoided.

7.4 Containment

If a person has tested positive, he/she should be contained and quarantined so as to not spread the virus in other places. The place visited by him should be sanitized and locked up, and people around him should be tested immediately.

7.5 Personal Hygiene

Every person should wear a mask whenever going out and should wash hands regularly. Personal hygiene is necessary in this case as the virus enters our body from the eyes, nose, mouth, etc., and people should avoid touching their face. They should wash or sanitize their hands multiple times in a day.

8 Summary of Works Done by Researchers

See Table 2.

9 Conclusion and Future Work

AI serves as a potential tool in fighting against COVID-19 and many similar pandemic. Obviously data serves as the main center for such pandemic to give optimum results. The increase of documents from hospitals and patients pathological data has made us rely more on artificial techniques and machine learning to extract a more accurate data so that the diagnosis can be done rapidly. Extraordinary surveillance by the government to keep the track of records to get over the pandemic takes into lots of dataset and perfect coordination with the health workers. Due to the evolving pandemic, we are dependent on deep learning approaches and are developing a model that is more prognostic and empirical. These models help to retrieve datasets using AI models. These models help the health workers to guide and help patients to recover and establish a more reliable bond with their health workers as due to the crises patients and their relatives are more apprehensive. It is of great importance for the health workers to take care of their personal data and be justified with that. AI serves as a boon in the present crises to accelerate the digitization of economy and production activities.

In this paper, we have discussed about how data science, artificial intelligence and machine learning are used against the spread of COVID-19. It also helps doctors and health vectors to train machines and set algorithm to optimize the data related to the virus with speed and accuracy. These machines help in retrieving more of the various datasets that could be used to do the predictions and forecasting, real-time visualizations, finding contacts of people that are exposed to this virus and various other applications as discussed above in the paper. For future work, there can be various other applications that could be added to this paper. Every country has issued its own datasets. So, details about them can also be added to a paper. Furthermore, there are many things that could be done to stop the spread of them we have listed some of the main ones. All could be listed in detail.

Table 2 Authors and there related work regarding COVID-19

Authors	Data type	Technique/method	Challenges
Wouters et al. [32], Mathur et al. [9]	Population density, strategic data	Deep learning, clustering algorithm, DBSCAN	Low quality of data and issues with privacy factors
Pham et al. [55]	Public announcements and distribution data	Naïve Bayes model, machine learning and	Insufficient data and ambiguity, and there is no truthfulness of data being correct
Vaishya et al. [20], Wehbe et al. [26]	Radiology data (X-ray and CT scan)	Camera system and image recognition technique	Not able to explain the results and results taking a long time to train and Vulnerabilities need to involve medical experts to give correct results
Cresswell et al. [29], Abu-Raddad et al. [35]	Camera images (infrared images)	AI-based computer vision and FR (facial recognition system)	Need a high-quality system to capture images and noise present may make it difficult to train
Zhou et al. [11]	Satellite data (various location using GPS)	Non-parametric process using Gaussian technique	Noises in satellite images, phone data not synchronized
Soltan et al. [27]	Text data from social media	Deep learning, machine learning, speech recognition and synthesis of certain linguistic data Information extraction using machine learning	Insufficient data from time series, Privacy issues and invasion, deep learning models take a long time and are very heuristic Social media reports might not be of good quality and be multidimensional
Vijayashanthi et al. [12]	Healthcare reports, travel data	Dynamic programming heuristic data	To establish trust with autonomous system
Rahmatizadeh et al. [7]	Text data on various COVID-19 details	CNN-based model data, supervised learning, text extraction	Results to be verified, but it will become extremely tedious Efforts to train workers to work with autonomous systems

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