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A Study on the Data Science in the Age of Covid

Jaspreet Singh Deo and Shruti Jaiswal***

ABSTRACT

COVID-19, a SARS-CoV-2 illness, was confirmed a pandemic in March 2020. By August, 21 million will be positive globally. As illnesses spread quickly, people work to stop them. I organise COVID-19 research using data science, which includes AI, ML, statistics, modelling, simulation, and data visualisation. I analyse COVID-19 databases and repositories and offer mitigation methods. I also evaluate these articles bibliometrically. Finally, I discuss common concerns in the surveyed works. This publication supports data science and AI activities. This study covers data science methodologies for COVID-19, including epidemiological parameter estimation, diagnostics, policymaking, mental wellbeing, case management, social media analytics, and vaccination design and dissemination. I emphasise difficulties, research fields, and local resources. It helps strategists and policymakers understand the challenges, prospects, and risks of leveraging this new diverese field to fight COVID-19.

Keywords: *Covid-19, Data Science, Epidemiological Parameter, Diagnostics, Mental Wellbeing.*

1.0 Introduction

Due of the big affect on global economy and people health, the pademic need the critical evaluation to get for fast and reliable data sources which covers a broad population to create data-focused understandings into disease surveillance and control. The pandemic attracted a big deal of interest from scientists in data and computational science disciplines that were more peripheral during previous epidemics. (Wu et al., 2020) (Zhu et al., 2020)

From December 2019, more than 24,000 scholarly articles from various publications have been made accessible.("Over 24,000 coronavirus research papers are now available in one place | MIT Technology Review".) . Since the majority of this work has not yet been subjected to peer review, it is especially difficult to comprehend this quickly evolving research landscape. This essay aims to solve this issue by giving a comprehensive review and the precise summary on COVID-19 research using Data Science. "Data science" includes terms algorithms, AI, ML, NLP, statistics, simulation, modelling, and other approaches that can understand from data wheter structured or unstructured.

The epidemic has galvanised the scientific community to fight COVID-19, resulting to useful and innovative applications. These apps required subject-matter experts and multidisciplinary teamwork. A challenging year passed, yet multidisciplinary, data-related studies on rising communicable viruses thrived. Therefore, it's necessary to review past achievements and set out a plan for using data science and creative computer models to treat COVID-19 patients and battle future contagious viruses. The goal of this essay is to systematise current resources, aid the research community in developing COVID-19 pandemic solutions, and build on recent reviews and perspective publications (Bullock et al., 2020). In this, section 2 explains the methodology, Section 3 shed light on challenges facing in research and finally section 4 gives the conslusion.

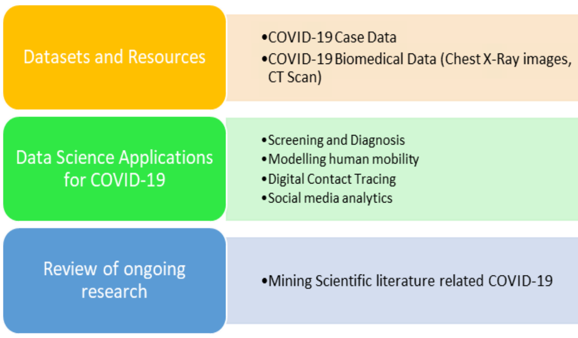
2.0 Methodology

This paper examines the burgeoning field of COVID-19 data science research and offers three additions. First, we describe pressing research concerns associated with COVID-19, for which the

**Corresponding author; Faculty, Msc Data Science, University of East London (E-mail: jasy9018@gmail.com)*
***Faculty, Msc Data Science, University of East London*

dataset plays an important role. We present a summary of the COVID-19 datasets that are accessible to the public and used for research. Second, a list of potential applications to combat the COVID-19 emergency is explored. Thirdly, we highlight the important topics addressed by contemporary research in the field. We concentrate on the various types of data analysis. Finally, by merging our observations, we identify many of the most significant obstacles. Figure 1 displays the organisational structure of the methodology.

Figure 1: Structure of Methodology Adopted in This Paper



2.1 Dataset and Resources

COVID-19 dataset plays a significant role in research and experiments; without it, scientists cannot generate findings. At the start of the epidemic, COVID Datasets are a challenge. But eventually, data will be in new formats, posing new issues. Positive cases, deaths, and recovered data are abundant on government portals nationwide. We also cover the COVID-19 datasets in this section. Further data categories:

2.1.1 Data related to Covid-19 cases

COVID-19 cases and geolocations can be utilised to monitor illness spread and patient dispersion. Several nations share infection data. John Hopkins University has produced a popular dataset that contains daily positive cases, cured patients, and national and state/provincial mortality rates ("GitHub - CSSEGISandData/COVID-19: Novel Coronavirus (COVID-19) Cases, provided by JHU CSSE"). The nCOV2019 contains national and various municipal COVID-19 health records of patirnts. ("GitHub - beoutbreakprepared/nCoV2019: Location for summaries and analysis of data related to n-CoV 2019, first reported in Wuhan, China"). Main data criteria relates with geo-location, confirmation date, signs of covid, and travel record. The NYT produces a state-by-state dataset including death tolls and confirmed cases.("GitHub - nytimes/covid-19-data: An ongoing repository of data on coronavirus cases and deaths in the U.S"). Kaggle data repository is another source to find daily COVID-19 case data ("COVID-19 Dataset | Kaggle," n.d.). Also, numerous datasets are acquired via community surveys, requesting individuals to report rates of infection within the social networks, as contrasted to state-compiled figures. ("Coronasurveys Home," n.d.).

2.1.2 Biomedical data related to Covid-19

Biomedical data aids diagnosis, forecast, and treatment. X-rays and pathology reports are important data sources (genomic sequencing). As the COVID-19 diagnosis and outlook frequently indicate the promise for computer vision research applications, such as automated diagnosis from chest X-rays, which now requires human interpretations. There are currently some COVID-19 X-ray scans available for free, including the COVIDx dataset (Wang et al., 2020). Various models in Deep learning for COVID-19 infection evaluation and diagnosis can be trained using these datasets ("GitHub - ieee8023/covid-chestxray-dataset: We are building an open database of COVID-19 cases with chest X-ray or CT images"), ("COVID-19 X rays | Kaggle," n.d.). Lung CT scans also help indicates COVID-19 symtoms. The CT scan datasets are accessible on many public websites.

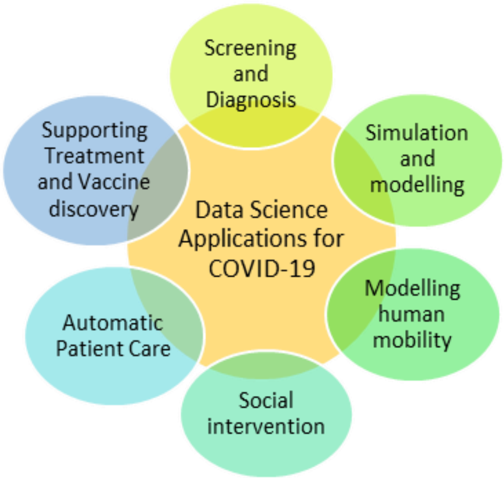
2.2 Applications utilizing data science for COVID-19 virus

The term Data science includes time-series modelling, statistical learning, machine learning (ML), and Artificial Intelligence (AI). We summarise some of the widely used applications in this section. Figure 2 shows the data science application on COVID-19.

2.2.1 COVID-19 diagnosis and screening

Due to absence of adequate facilities, the screening and diagnosis is a significant problem for nations with rising COVID-19 infection rates. Since persons with minor symptoms frequently not aware they have the disorder, this makes capacity management and social isolation strategies more difficult. Automated technologies can be developed further to facilitate screening in crowded place such as airports, supermarkets, multiplexes by employing thermal imaging powered by computer vision to identify fever.

Figure 2: Data Science based Applications Focused on COVID-19

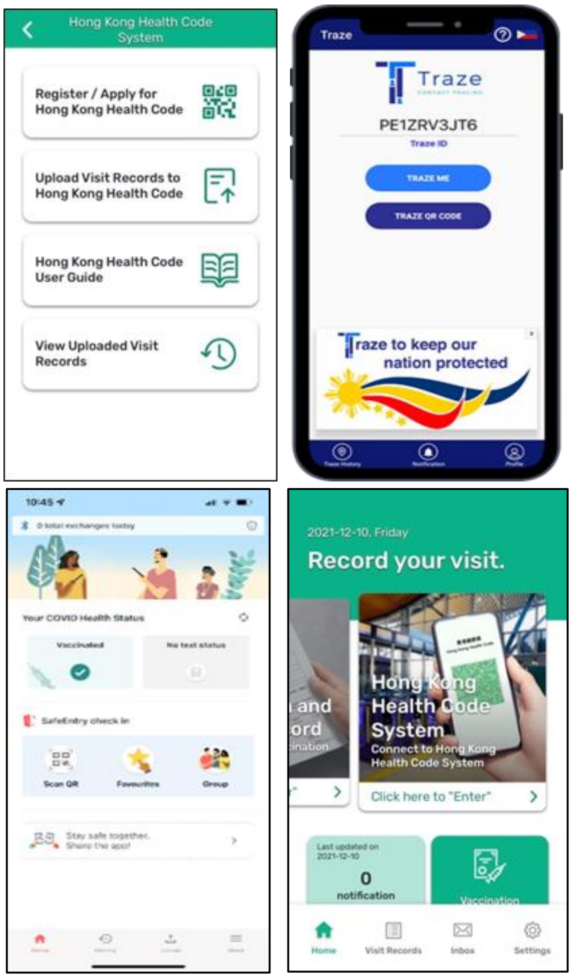


2.2.2 Modelling human mobility

Most nations implemented containment actions in response to COVID-19's initial phases. This usually entails quickly diagnosing sick people, then quarantining them and tracing their contacts. Most public health practises have continued to exploit manually contact tracing in COVID-19 outbreak. Major difficulties with traditional manual contact tracing include recollection bias and time delay. Due to the extensive usage of smartphones, modern digital contact monitoring techniques could replace human contact tracing. (Bengio et al., 2020). To quickly identify contamination, online polls, computerised diagnosis, and mobile contact sensing have all been suggested.

Since most modern phones come with GPS and Bluetooth, so no technical barriers to efficient digital contact tracing in industrialised nations or regions (Cebrian, 2021). Google and Apple both added frameworks to smart phones in exposure to alerts and contact tracing. Some of the digital contact tracing app named as *Trace Together*, *Traze*, *Health Code systems*, and *LeaveHomeSafe* are available shown in figure 3. Given the potential of COVID-19 being a big pendemic, digital monitoring may spread. Except for a few nations in East Asia, the widespread applications related to digital contact tracing was not that much successful. Privacy, accuracy, health authority allegiance, or other societal and political issues are debated. ("How digital contact tracing slowed Covid-19 in East Asia | MIT Center for International Studies"). In several low- and average-income nations, where people are less technology awared, manual monitoring of contact is still the practice.

Figure 3: Four Digital Contact Tracing Apps 1.LeaveHomeSafe System 2.Traze 3.TraceTogether System 4. Health Code System



2.2.3 Simulation and modelling

Simulator models are useful in many situations. (Currie et al., 2020), including Choices that impact disease transmission, like quarantine and social distancing, resource management, such as critical care unit capacity, personnel, resource allocation within and between regions, in-patient hospital beds, and care decisions, like as determining limits for patient discharge and admission and minimising the impact on other patients.

2.2.4 Automatic patient care

A lack of healthcare staff has been brought on by the pandemic. Automated general practice tools, including remote chatbots and expert systems, could be created to help ease this. Such systems can assist individuals by disseminating details about an outbreak, its symptoms, and safety precautions, among other things.

Some of the used remote care devices listed as AliveCor(“AliveCor,” n.d.), CLEW’s TeleICU solution (“CLEW harnesses technology to save lives in the ICU,” n.d.)(“Managing Diabetes and Covid-19,” n.d.). FreeStyle Libre , Home pulse oximetry (“COVID-19: Home Pulse Oximetry Could Be Game Changer, Says ER Doc”).

2.2.5 Social interventions

To slow the development of COVID-19, numerous governments have put social exclusion measures into place. This non-pharmaceutical method of treatment lowers human contact within the community limits the transmission of COVID-19 virus (Wilder-Smith and Freedman, 2020).

Data science can help monitor social distance by tracing contacts using social media and language processing (Schmitt, n.d.; St Louis and Zorlu, 2012), These analyses may also aid in recording encounters for usage as people experience symptoms. Additionally, devices might be used to follow the general populace and determine compliance with social distance.

2.2.6 Supporting treatment and vaccine discovery

The considerable data science work that was done prior to COVID-19 (Mitchell, 2018) can also be used to aid the international effort to find or repurpose pharmacological therapies and vaccines. Computational techniques, for instance, can cut down on the time needed for data analysis, protein structure prediction, and genome prediction (Mak and Pichika, 2019). It can also help with the time-consuming and expensive process of locating patients who qualify for clinical trials (Tyson et al., n.d.), which is a common aspect of medication development.

2.3 Survey of ongoing Covid-19 research based on data science

In this section, a detailed discussion of research done based on image data of COVID-19 presented.

Table 1: Research on Diagnosis of COVID-19 using Data Science Techniques

Reference	Description
Wang et al.(Wang et al., n.d.)	COVID-19 patients’ radiographic alterations are detected by DL. Employing patients’ CT scans with pathogen confirmation, they indicate that DL can extract radiological information useful for diagnosis.
Xiaowei et al(Xu et al., 2020)	Describe a lung CT screening tool that employs a 3D DL modeling with location-attention.
Chen et al. (Chen et al., 2020)	UNet++ can locate hazardous lesions in CT scans. More than 200 scans were employed to train and test the model. When analysing COVID-19 CT scans, they find any suspicious locations.
Ophir et al.(Gozes et al., n.d.)	Get the Corona score with 2D and 3D CNNs (it shows the progression of the disease in the lungs). 2D CNNs assess virus presence in each CT scan slice, while 3D CNNs identify lung diseases (such as lung nodules).
(Li et al., n.d.)	COVNet: a neural network which detects virus of COVID-19 from chest Ct scan images. DL-based algorithms can reliably identify the COVID-19 and distinguish it from various diseases in lung and CA-P, according to the study.
Ezz et al. [(El-Din Hemdan et al., n.d.)	COVIDX-Net, a DL-based framework, detects COVID-19 in X-rays. COVIDX-Net consist of VGG19 and Google MobileNet as CNN alternatives. The models can classify COVID-19 as negative or positive. In this about 50 X-ray images—25 from corona patients—were used to verify the technique.
Linda et al. (Wang et al., 2020)	Describe a DL-based method for finding COVID-19 in data related to chest X-rays. They also create COVIDx to train a deep CNN.
(Narin et al., n.d.)	Inception, ResNet-50 ResNet uses CNN-based algorithms to identify COVID-19 in pneumonia X-rays.
Farooq et al. (Farooq and Hafeez, n.d.)	How to train ResNet-50 to recognise COVID-19 anomalies (called COVID-ResNet).
Prabira et al. (Kumar Sethy et al., 2020)	DL to extract significant chest X-ray properties, then training an SVM to identify infected individuals.

Computer vision algorithms have been utilised in numerous research (Robertson et al., 2018; Usman et al., 2020a, 2020b) for increasing the rate of process of illness identification over a variety of imaging models, with other studies suggesting the image analysis approaches can outperform professional radiologists (Qin et al., 2019; Singh et al., 2018), Techniques namely CT and X-ray being tested intended for the diagnosis of COVID-19 viruses, which is summarised in Table I.

3.0 Challenges in the Researh of COVID-19 using Data Science

Following shows some of main bottleneck in the research.

3.1 Data limitations

Data science systems grow when more data and knowledge are obtained. The data should ideally be highly accurate and substantial. Extensive labelled datasets are still unavailable for several applications. But, one can access few accessible datasets for textual and medical image analysis, in comparison to what deep learning models need. Beyond these difficulties with data accessibility, there are also issues with the data itself. Obstacles are being created in the development of some sorts of high-quality datasets because of this research's time-sensitive nature. Finding analytical strategies that can function with these data constraints is a major task.

3.2. Reliable results

Rapid results are obviously needed, yet the approaches examined in this work are mostly focused on statistical learning with recently created datasets. Few researchs found that prediction models can be biased.

3.3. Lack of standards, protocols, and morals

Most of examined work suggest the usage of potentially sensitive data. A significant problem is producing solutions that produce positive outcomes while still respecting privacy and upholding high ethical standards. We contend that this may be essential for promoting uptake across communities, especially given that organizational setup may endure after the pandemic ("Yuval Noah Harari: the world after coronavirus | Free to read | Financial Times" .). The development of medical analytics that protect privacy has already received significant attention. To enable sites to federate datasets with privacy guarantees, MedCo (Raisaro et al., 2019) utilises homomorphic encryption.

3.4 Need of interdisciplinary platform

COVID-19's long-term consequences are unknown. To make a significant contribution, incorporate domain knowledge from different fields. Global coordination and COVID-19 tracking are already under threat. As healthcare practitioners are unwilling to use technologies built without medical professionals, licensability and adoption will suffer. It's important to quickly assemble complementing skill sets. This adds challenges, such as establishing a team's consistent knowledge of ethics, benefits, and risks.

3.5 Economically feasible

Populations with limited access to healthcare (such as those in underdeveloped nations) face additional hurdles from COVID-19. Priority: inclusive tech. This contains use-case-specific real-world challenges. A contact-tracing mobile app should be affordable, resource-constrained, developed with limited network connectivity in mind, and handle several languages. Providing technology solutions is crucial to fighting this pandemic.

4.0 Conclusion

Data scientists are currently addressing the most recent COVID-19 challenges. This essay was written to provide a summary of ongoing initiatives to the greater community. For the convenience of researchers, we first summarised publically available datasets. Since the study is primarily intended for computer science and engineering professionals, the article is concentrated the analysis on the available datasets. Then, it broadened the inquiry to include a bibliometric examination of of recent articles. Finally, it described some of the common challenges we discovered during our systematic review, including data accessibility and privacy concerns.

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