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Retraction

Retracted: IoT-Based Technological Framework for Inhibiting the Spread of COVID-19: A Pandemic Using Machine Learning and Fuzzy-Based Processes

Security and Communication Networks

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope

(2) Discrepancies in the description of the research reported

(3) Discrepancies between the availability of data and the research described

(4) Inappropriate citations

(5) Incoherent, meaningless and/or irrelevant content included in the article

(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] A. Kaur, M. M. Elarabawy, M. Abd-Elnaby, V. Varadarajan, and S. Sharma, "IoT-Based Technological Framework for Inhibiting the Spread of COVID-19: A Pandemic Using Machine Learning and Fuzzy-Based Processes," *Security and Communication Networks*, vol. 2022, Article ID 6272480, 10 pages, 2022.

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Research Article

IoT-Based Technological Framework for Inhibiting the Spread of COVID-19: A Pandemic Using Machine Learning and Fuzzy-Based Processes

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The COVID-19 infestation has resulted in the loss of the lives of millions of people and the destruction of commercial, communal, and healthcare systems around the world. To control these kinds of pandemics, complete knowledge of the traits and responses to the disease is required, and this knowledge can be gathered using various computational methods. These computational techniques can be very helpful in information building required for taking appropriate action timely and applying preventive mechanisms. Although there are numerous computational approaches that the researchers are applying over the past few months, there is a need to re-evaluate and compare these available techniques for finding out the best technique that can help reduce the extent of COVID-19. Hence, in this paper, we carried out a literature review to emphasize the assistance of various computational approaches around COVID-19. The paper presents a categorization of approaches such as multicriteria decision-making, fuzzy AHP, machine learning, neural network, and data science that have been used to deal with the epidemic. Furthermore, this study discusses various challenges experienced when accessing the COVID-19 data. The conclusions of the paper propose the best computational approach among all to be appraised for future investigations and implementations.

1. Introduction

If we consider the whole world as a single ecosystem, its parameters should represent the ecosystem's reaction and conduct. There can be various classifications of these parameters ranging from population density, wealth, civilization, edification, transport system, healthcare, atmospheric conditions, and so on that make up a system. Some of these parameters have high weightage than others for evaluating the organization's reaction and conduct. COVID-19 also named coronavirus or SARS-CoV-2 has been recognized as extremely contagious. The research community is trying to comprehend the underlying forces of the outspread of this virus using the prognostic approaches for pandemics and the reaction of the organization to assist in the procedure of handling and managing the epidemic [1]. According to WHO, the prime medium for the spread of COVID-19 is droplet transmission through the human respiratory system. Scientists are trying to figure out the various agents that may lead to the spread of this virus. Some

important factors incorporated are climatic, financial, and cultural attributes [2]. Several relationships have been established among these parameters that can lead to widening the growth of COVID-19 in a variety of techniques [1]. The results of these relationships represented more COVID-19 receptiveness in elder people and people living in areas with less temperature than in the younger population and the people living in the high-temperature zone [3]. In contradiction to these studies, the velocity of infection keeps on increasing in the summer season and also attacking younger people and invalidating the assumption of the spread of the virus in the elderly and low-temperature areas given by many researchers [4]. Even though many factors are somehow linked with COVID-19 being acknowledged, research is therefore needed where all the factors that are affecting the spread of this virus either directly or indirectly can be quantified [5]. A complete understanding of these factors and their immensity of impact on the spread of COVID-19 would be very fruitful for the decision-makers to administer the spread of COVID-19 [6]. Various approaches such as machine earning, neural network, data science [7], fuzzy AHP, AHPU, and multicriteria decision-making [8] can be used in order to learn the intensity of impact on the spread of COVID-19. This paper presents an approach to recognizing the important factors responsible for the spread of COVID-19 using these above-mentioned techniques. Upon recognizing these factors, the spread of the COVID-19 can be controlled to some extent if the user will be able to get the required data for maintaining distance and other factors required for the control of COVID-19 using IoT device.

2. Background and Literature Review

This section describes the basics of COVID-19, and what the various researchers have defined about COVID-19 using artificial intelligence, neural network, big data, multicriteria decision-making, and fuzzy AHP.

COVID-19 is a disastrous pandemic; the virus of COVID-19 is SARS-COV-2, a type of betacoronavirus that causes rigorous acute respiratory syndrome in human beings [9]. The first case of COVID-19 was found in the Wuhan city in China in December 2019, and after that, within a couple of days, it had been spread to almost all the countries of the world. Until now, there is no indication that the number of cases of infection and deaths will get decrease and that the condition will be under control. The number of cases is increasing at a very high rate, and the recovery rate is also not too good. The worldwide trends of COVID-19 (as of 18 May 2021) can be represented in Figure 1.

Because of this critical situation in the world due to COVID-19, the health agencies in the world have escalated the risk analysis of COVID-19 to its maximum level. Due to the substantial effect of COVID-19 on the world, a lot of endeavors are being done by the government to control the COVID-19 outbreak [10]. The government is taking efforts to cease the spread of the pandemic by using various preventive measures such as lockdown and supporting healthcare systems in the situation of crisis to provide supportive packages to the citizens [11].

In addition, global efforts are continued for the development of the most effective vaccine and medicine for fighting against COVID-19. There can be multiple computational areas that can be used to present state of art solutions for dealing with this pandemic [12]. Methodologies based upon AI [13], neural network, fuzzy AHP, MCDM [14], and data science can be taken into consideration for this purpose. The research community has done a lot of research work in the identification of various factors responsible for the spread of COVID-19 using these methodologies. Table 1 provides a summary of studies done by some of the researchers to find the best possible solution to deal with a pandemic.

3. Computational Methodologies for Detection and Prevention of COVID-19 Spread

Computational methodologies are the most factual approaches to understanding the progression of natural events such as the spreading of the pandemic. Hence, these methodologies have been extensively used in examining the risk factor involved with the pandemic and in the process of decision-making [15]. This section presents the motive behind the usage of various computational approaches for responding to the COVID-19 pandemic.

3.1. Machine Learning and Data Science. Artificial intelligence incorporates a wide range of technologies that intend to impersonate the intellectual functions and thinking capability of human beings [16]. Machine learning is a branch of artificial intelligence that aids out the machines to build a model from sample data without being programmed explicitly by the user [17]. Furthermore, deep learning is a branch of machine learning that provides more flexibility as compared to machine learning modeling using artificial neural networks to sort out complex problems, which majorly include categorization of medical images, natural language processing, and so on [18]. Artificial intelligence is helping out in tracking of the outspread of the virus, is picking out the patients at high risk, and is instrumental in regulating the further spreading of the virus in real-time environment [19]. It is also capable of forecasting the rate of mortality by analyzing the previously available data. Furthermore, it also helps out in the community screening, apprising the people, and afterward supports therapeutics [8]. Figure 2 below represents an application of AI that assist the medical practitioner to diagnose the symptoms of COVID-19. Here, how the AI-based methodology can be used to handle the disease is discussed, and how it is different from the handling mechanism of the traditional methodology has also been defined [20]. Data science is responsible for collecting and analyzing a lot of data that thus helps ML algorithms predict the output efficiently.

We may employ multiple variants of machine learning technologies to enable the efficient detection and prevention of the novel coronavirus and other related diseases in the future (Abhinav Juneja, Juneja, Soneja, et al., 2021). A few of

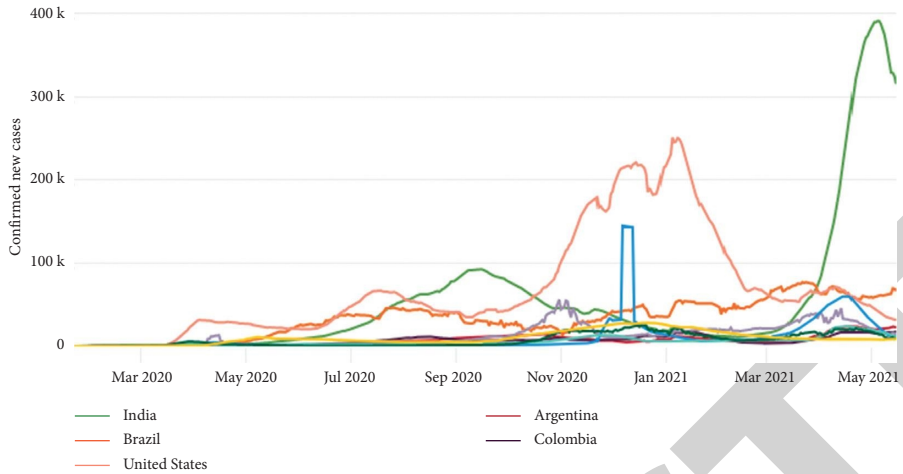

Figure 1: The worldwide COVID-19 trend (source: Coronavirus Resource Center) as of 18 May 2021.

Table 1: Recent contributions from the research community to tackle the pandemic crisis.

S. No.	Author and year	Methodology adopted for battling against COVID-19	Findings
1	Pham et al. (2020)	Artificial intelligence and big data	The authors highlighted the techniques to detect, diagnose, track, and predict the spread, vaccine, and drug discovery using both artificial intelligence and big data approaches and recommended some points to be taken by the authorities.
2	Shahid et al. (2020)	Machine learning	The authors presented various machine learning techniques to track and forecast the disease, medical abetment, and virus detection in the human body and also defined the approach to be considered for the proper understanding of virology to combat the pandemic.
3	Nayak and Naik (2021)	Deep learning and machine learning	The authors used machine learning and deep learning approaches for the screening and diagnosing of COVID-19. The authors also presented various ML algorithms such as SVM, KNN, LF, and RF that can be used for dealing with COVID-19. The author proposed the research community to use optimization method and fuzzy techniques of ML for future projection of COVID-19.
4	(Alsunaidi et al., 2021)	Big data analytics	The authors presented various applications of data analysis for COVID-19 and provided a hierarchical structure to classify these applications into four classes: diagnosis, predicting the risk factor, decision-making for treatment to be provided, and medication.
5	Behnam and Jahanmahin (2021)	Descriptive and prescriptive data analytics	The authors presented a study to predict the frequency of the trend of COVID-19 in order to get the best fitting pattern for prediction of the peak and end of the pandemic in various time slots and also analyzed the rate of mortality, rate of recovery, rate of spread of infection, and weekly data about the disease. The authors concluded that the Gaussian function is best among all techniques to predict the spread of COVID-19 and other important parameters as it can presume the curve with more accuracy.
6	(Swapnarekha et al., 2020)	Deep learning and artificial neural network	The researchers concluded that SVM, linear regression, K means, and RF approaches can be used to solve the remedial issues of COVID-19, while CNN and deep learning can be used for the early prediction of COVID-19. The authors further stated that although these techniques are much useful in prediction and diagnosis, still, lack of data sets and medical images leads to inaccurate results of the research that further can be sorted out using bagging, stacking, and so on.
7	(Car et al., 2020)	Multilayer perceptron model	The authors collected the data sets, applied those data sets to the multilayer perceptron model, and reached the conclusion that it is feasible to get a high-quality model that can predict the various parameters involved in the spread of COVID-19 by taking the geographical data and time as the input data. For future work, the authors suggested using some testing techniques of various parameters (such as percentage of infected population) to check the quality of the model.

Table 1: Continued.

S. No.	Author and year	Methodology adopted for battling against COVID-19	Findings
8	(Tuli et al., 2020)	Cloud computing and machine learning	The authors discussed how enhanced mathematical modeling in collaboration with cloud computing and machine learning help in predicting the broadening of COVID-19 at the initial stages. A model named robust Weibull model was proposed to make the statistical forecast and compared this with the Gaussian model and finally concluded that the robust Weibull model is more accurate for making predictions
9	Syeda et al. (2021)	CNN model in machine learning	The authors reviewed that there can be various application areas for handling the pandemic where machine learning can be effectively utilized ranging from tracing and curing the viral infection. The researchers further presented some light on machine-learning-based tools for the discovery of appropriate drug.
10	Latif et al. (2020)	Data science	The authors used the available data sets on COVID-19 and presented a bibliometric analysis to keep on the track spread and weakening strategies of the virus.
11	(Ghorui et al., 2021a)	Multicriteria decision-making	The researchers analyzed the most dominant risk factor in spreading COVID-19 using the HFS TOPSIS and fuzzy AHP approach.
12	(Samanlioglu & Kaya, 2020)	Fuzzy AHP technique	The authors proposed the MCDM-based hesitant F-AHP technique that can be implemented by governments, healthcare service providers, and decision-makers in order to improve the condition or prevent it from getting worse because of pandemic.
13	Mondal et al. (2020)	Data analytics	The authors used polynomial regression for the modeling of increment in a number of confirmed cases. The authors also proved that LR, MLP, and XGBoost approaches can be very effective for classifying the patients suffering from COVID-19.
14	(Łuczak & Kalinowski, 2022)	Fuzzy approach	The authors have used fuzzy C means clustering to identify the most affected states of COVID-19.
15	(Alotaibi & Elaraby, 2022)	Exponential fuzzy approach	The author of the paper has used a multithreshold approach using a generalized exponential entropy-based algorithm for the segmentation of CT scans for identifying COVID

the implementation techniques in the current scenario have been listed in the following sections.

3.1.1. Supervised Learning. This is one of the most widely employed prediction techniques that work effectively when we have past relevant data of input and corresponding output from a system [20]. The supervised learning technique requires providing input and corresponding output explicitly for the training process to the machine [20]. Various algorithms of supervised machine learning [21] such as naive Bayes algorithm, decision tree, logistic regression, and so on can be used for making the predictions of COVID-19 spread using the labeled pandemic data set for the positive and negative cases in the world. Figure 3 below represents the supervised machine learning algorithm for finding out the possible number of cases of COVID-19 [22].

3.1.2. Unsupervised Learning. An unsupervised machine learning algorithm intends to employ the data that is not classified [23]. In this approach, the machine tries to learn from a function in order to present the hidden data pattern [24]. This algorithm finds and learns the pattern of data in the untagged data set. Various algorithms such as PCA and K means clustering can be used for this purpose [25]. In the case of COVID-19, unsupervised machine learning can be applied to the data set to find the various parameters such as mortality rate, death rate, recovery rate, and so on by finding out various clusters across the globe and then applying K means clustering algorithm to that clusters. The algorithm can form groups of various countries showing similar behaviors towards COVID-19. So these clusters can help out in predicting the less affected country and the most affected country [26]. Figure 4 here represents the illustrations of unsupervised machine learning for COVID-19

3.1.3. Reinforcement Learning. This methodology adopts a unique process of an agent interacting with its immediate environment and taking actions based on the current state of the environment [22]. The agent's actions have a reaction to the environment, and the same is sent as feedback to the agent [11]. The agent learns from its environment over time to make the most appropriate decisions [27]. The method uses a scheme of rewards and punishment for the agent based on the type of action chosen by the agent pertaining to a particular input environmental state [28].

3.2. Multicriteria Decision-Making (MCDM). Multicriteria decision-making techniques permit the aggregation of an alternative's consensus to the individual criteria to attain the

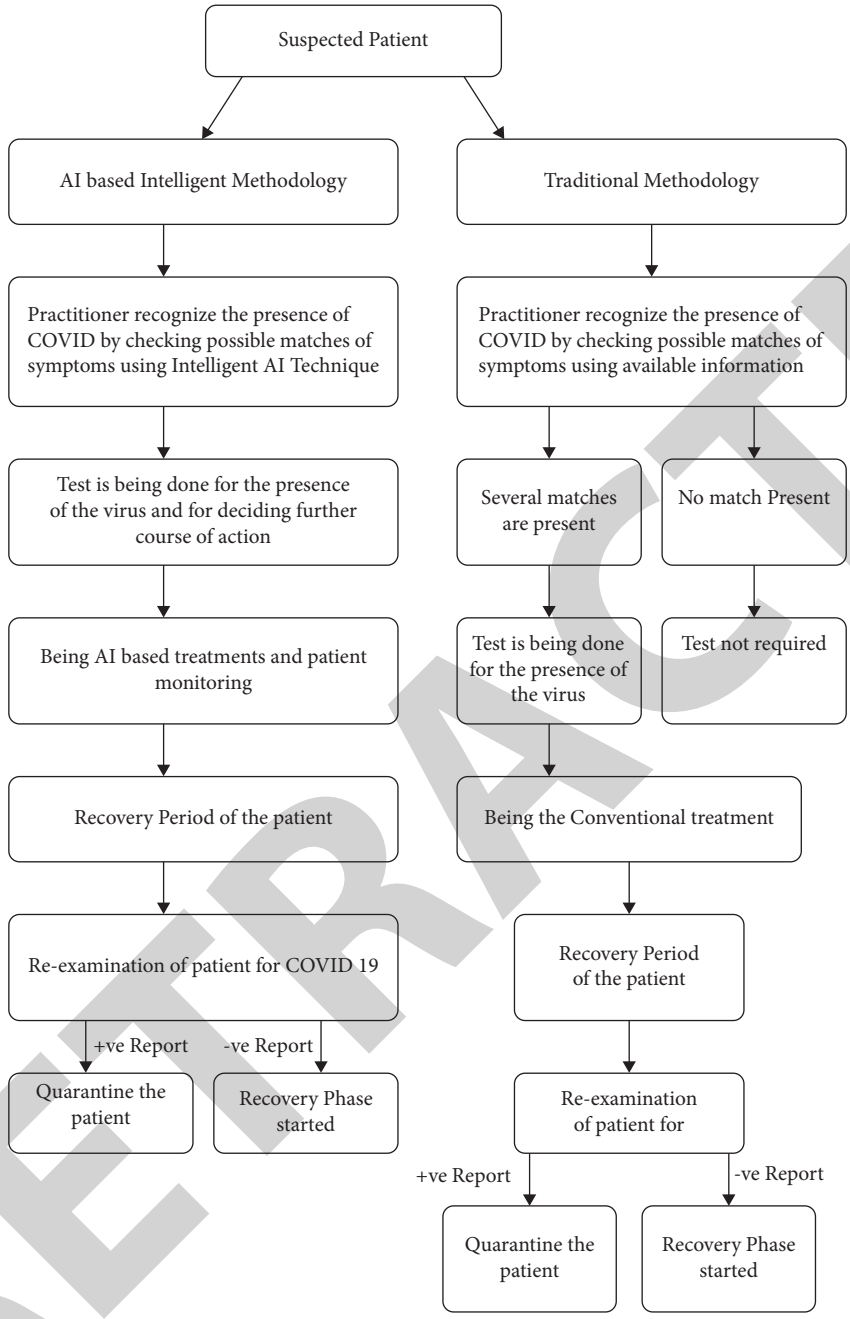

Figure 2: COVID-19 patient detection with conventional versus artificial intelligence approach.

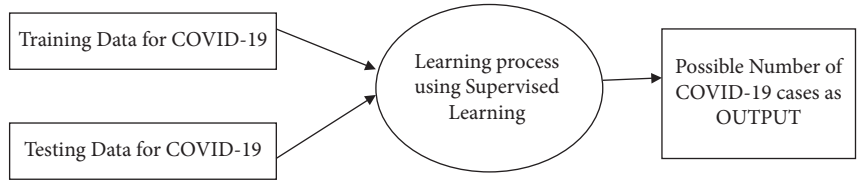

Figure 3: Supervised learning approach for finding a possible number of COVID-19 cases.

alternative's overall consensus corresponding to a decision-making problem [29]. MCDM generally employs a rule-based approach in order to realize the decision functions [25]. There are several multicriteria decision-making techniques [30]. A few of such techniques have been elaborated on in this section.

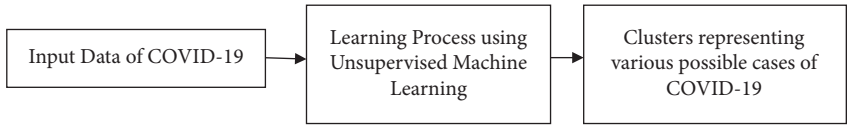

Figure 4: Unsupervised machine learning for COVID-19.

3.2.1. Analytical Hierarchical Process (AHP). It is a type of multicriteria decision-making technique, and its purpose is to model the decision for complicated problems having various criteria, which are usually contradicting each other [32]. So it is simply a tool that has been used for decision-making in various engineering fields [31]. The process of decision-making has been divided into three parts: the complex problem and its best possible solution, all the feasible solutions which are being named as alternatives, and the set of criteria on the basis of which these alternatives are evaluated and judged [33]. AHP prepares a structure that presents the quantification of all the available criteria for the best possible solution and all other alternatives as well [34]. The last step of the process is to calculate numerical priority for each of the available alternatives [35]. A ranking of the possible solutions could be generated using this approach that helps out in the decision-making process [36]. Figure 5 represents an AHP based approach for evaluating the AHP-based risk analysis of COVID-19.

3.2.2. Fuzzy AHP. Fuzzy AHP (F-AHP) is also being used for decision-making [37]. The fuzzy AHP approach helps out in better, realistic, and flexible decision-making [38] using available alternatives and criteria [27]. Fuzzy AHP is a type of AHP to which fuzzy logic theory is applied [39]. This technique is somehow similar to AHP; the only difference is that the fuzzy AHP technique puts the AHP scale in a fuzzy triangle scale for priority measurement [40]. The fuzzy AHP process can be explained in the following steps [41]:

(1) problem the suitable solution
(2) Create a comparison matrix using the available criteria and data
(3) Examine consistency
(4) Put up the triangular fuzzy number
(5) Compute the weight of the fuzzy vector
(6) Order and select the final decision

3.2.3. Hasse-Diagram-Based Ranking. This is a unique discrete mathematics ranking methodology in multi-criteria decision-making and has been effective in making ranking decisions more confirmed [8]. Using the Hasse diagram, we first generate a partial order of all the elements in the set considering the multiple attributes of each of the parameters, and it may even give weightage to the attributes [40]. This partial order is known as a partial order set (POSET). Hasse diagrams are representational structures created to visualize the order of ranking relations in the POSET [42].

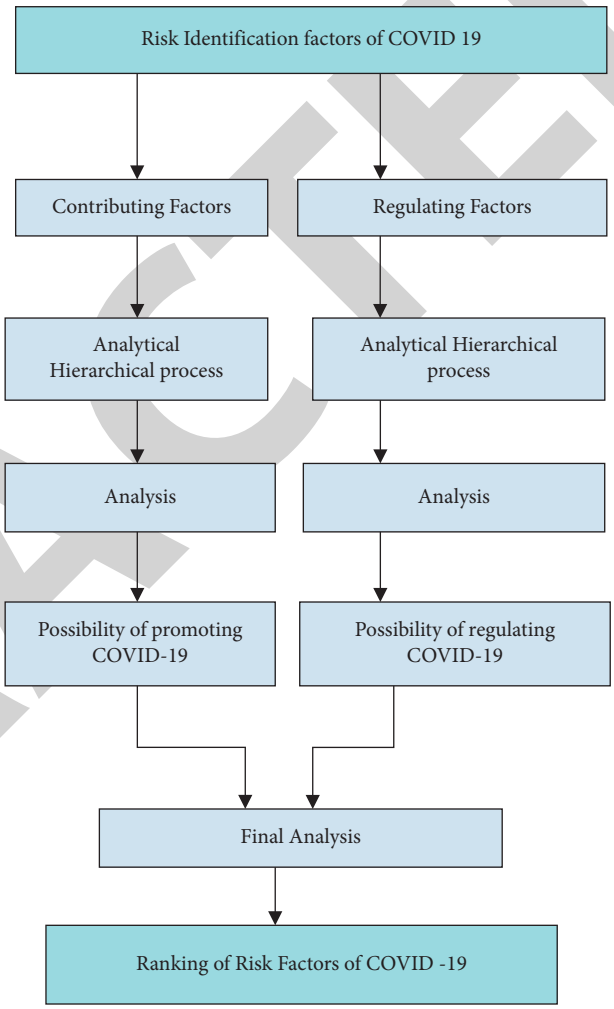

Figure 5: Ranking contributing and regulating factors.

4. Critical Barriers in Maintaining Self-Isolation during COVID-19

Based on inputs from various research works done on knowing the factors responsible for the spread of the COVID-19, some key factors have been identified among the population at large. We identified these critical barriers to the implementation of self-isolation in the Indian context that has already proven to be very deadly for the entire world at large [8]. The reasons for the spread of this viral infection though may be similar throughout the globe, but there are some demographical variations that are sometimes very critical to be identified to manage the situation in an effective manner and prevent loss of lives [43]. The various identified factors have been classified into two levels, including six prime factors and related two subfactors of each one of them as shown in Figure 6.

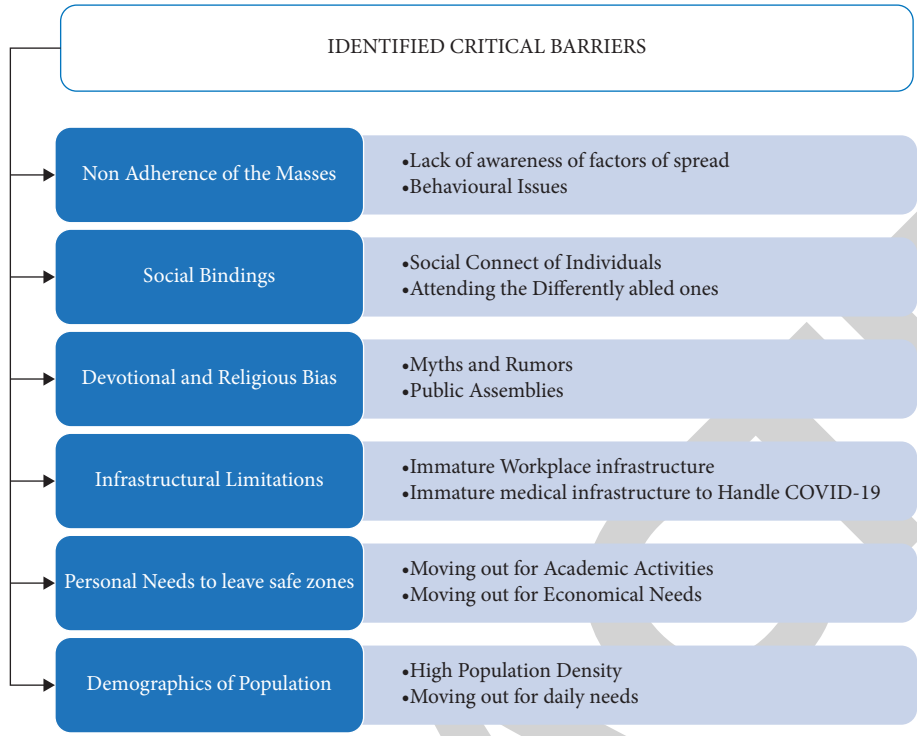

Figure 6: Identified critical barriers to maintaining the social distance protocol during COVID-19.

4.1. Nonadherence of the Masses. These factors are related to the behavior and mindset of the masses and their ignorance about the tentative catalysts of the spread of COVID.

(a) *Lack of Awareness of Factors of Spread* [15]. There is a lack of information in the masses about the tentative factors of spread. Generally, people are not able to speculate about reactions to their innocent actions.

(b) *Behavioral Issues*. It has been evidentially observed in several cases that people restrict themselves in telling their COVID-19 status, travel histories, and travel while being a carrier [44].

4.2. Social Bindings. India is a nation where family values and joint family culture are still dominant and also certain other social obligations that lead to defying the restrictions.

(a) *Social Connect of Individuals*. People are socially so deeply connected that they cannot restrict meeting their near and dears, be it in a residential society, a township, or a village [45].

(b) *Attending the Differently Abled Ones*. The obligatory contact required to aid the physically disabled and handicapped persons is also one point of mandatory contact between individuals.

4.3. Devotional and Religious Bias. India is a country famous for the religious bias of its people. The citizens are very devoted and sentimental with their religious beliefs.

(a) *Myths and Rumors*. There are several so-called old mythological beliefs about the treatment. It has been observed that in the initial days of the spread, several rumors and misconceptions were spread to control COVID-19, and even for vaccination also, the same suit was followed.

(b) *Public Assemblies*. There have been administrative efforts to make people isolated, but on ground, things have not been executed as planned. It has been observed that huge gatherings have taken place irrespective of any number of daily positivity rates in one or the other part of the world [46].

4.4. Infrastructural Limitations. The pandemic of COVID-19 was never an anticipated one. The whole world witnessed the advent of COVID-19 and seemed helpless to fight it at all levels.

(a) *Immature Workplace Infrastructure*. The forced or voluntary lockdowns made the individuals and organizations think of alternative operations to continue their work. But it has been felt that job roles needed interaction and it made people take risks.

(b) *Immature Medical Infrastructure*. The medical facilities of every nation, even the most developed ones, were tested to neck during wave peaks, and it was felt that there was a lack of resources to treat the patients.

4.5. Personal Needs to Leave Safe Zones. The entire population of nations has been affected due to the sudden shutdown of all avenues. This cannot continue for long.

There are binding needs to move out of the safety of the home to several segments of the population.

(a) *Moving Out for Academic Activities*. The students, whether from schools or colleges, cannot be kept away from learning. Though online learning is being used, it is being used to a small extent because of the scarcity of resources.

(b) *Moving Out for Economical Needs*. Individuals need to leave their homes for the bread and butter of their respective families. The long halt has forced people to face an acute economic crisis. There is an urge to move outside and earn their livings among those who earn on daily basis for survival.

4.6. Demographics of Population. There is a wide diversity in the economical standards of the Indian population. Some sections of society are highly rich while others barely make a day's meal somehow. Due to this, there is a huge variation in the kind of infrastructure of living and daily routine of the individuals.

(a) *High Population Density*. There is a significantly high density of population in several regions of the nation. In such high-density populated regions, it is not possible to maintain the social distancing. These are very small accommodations to live that restrict anyone to practice the protocol for distancing.

(b) *Moving Out for Daily Needs*. People need to buy essential goods for their survival. This makes it necessary for them to move out of their safe zones and enter the potential areas where infection can enter them. Sometimes, people go to crowded markets to procure cheaper products even without caring about life. The major population has not adapted to online purchasing so far.

5. Conclusion

Through this work, we have created a roadmap for the researchers to obtain these identified critical parameter data from the masses in some form or other. The data that will be generated for these parameters shall act as fuel for the state-of-the-art technological framework supported by advanced technologies such as artificial intelligence and machine learning to generate valuable information, which may be able to identify a few of the most critical barriers among the identified ones. We may assign some deliberate weightage to these barriers for ranking them.

The work may be helpful for the government agencies, social and public societies, the resident welfare associations, and the industry at large to give due weightage and priority to these identified barriers. The industry may come up with innovative solutions in order to limit these barriers, the scope of innovation in this field is wide open as every day some new information and theory on the factors related to the spread of COVID-19 and isolation norms are coined. The disease is very young and new, so there is a need to put more efforts to devise methods in order to counter its spread and thus save the community from this disease somehow in some way.

Data Availability

The data will be available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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