An Integration of AI, Blockchain and IoT Technologies for Combating Covid-19

K. Ashok Kumar, Vanga Karunakar Reddy, and A. Narmada

Abstract An entire world is facing epidemic from past one year due to Covid-19. With effect this, lot of countries and lot of states are collapsed their economic and also mainly common man suffers during lockdown. One of main reasons to get vaccination and drug delayed is variable characteristics of Covid-19 from individual to individual hence, it difficult to finalize characteristics and symptoms. Recently, there are huge research going on Covid-19 and presenting various directions to prepare vaccine and drug. This paper presents novel platform such as integrated IoT based AI with Blockchain technology to combat Covid-19. AI discusses with required ML and DL algorithms for prediction and analyzes data of Covid-19. This paper also directs new direction to prepare vaccine and drug based on AI hence updating and storing data of infected individuals automatically.

Keywords Covid-19 · AI · IoT · Blockchain · Vaccine · Integrated technology

1 Introduction

Corona virus disease-2019 (Covid-19) is spreading rapidly to entire globe from infected human beings. According to World Health Organization (WHO), total number of confirmed cases is 6,194,533 effected to 216 countries throughout the world by June 02, 2020 hence total number of deaths is 376,320 which is approximately 6.07%. The Covid-19 is mainly caused by Severe Acute Respiratory Syndrome (SARS) virus and rapid spreading results the global pandemic approximately four months. Main characteristics Covid-19 are identified from huge cases that are fever, pneumonia, respiratory problems, reduced count of lymphocyte and also decreased white blood cells (WBC) count in human body. In the absence of a vaccination, social distance is only solution which is widely adopted throughout world to suppress the spreading of virus as it is confirmed that the virus transmitted through human–human. An early detection is another acceptable solution to avoid spreading

K. Ashok Kumar (✉) · V. Karunakar Reddy · A. Narmada
Matrusri Engineering College, Saidabad, Hyderabad, Telangana, India

N. Marriwala et al. (eds.), *Emergent Converging Technologies and Biomedical Systems*,
Lecture Notes in Electrical Engineering 841,
https://doi.org/10.1007/978-981-16-8774-7_15

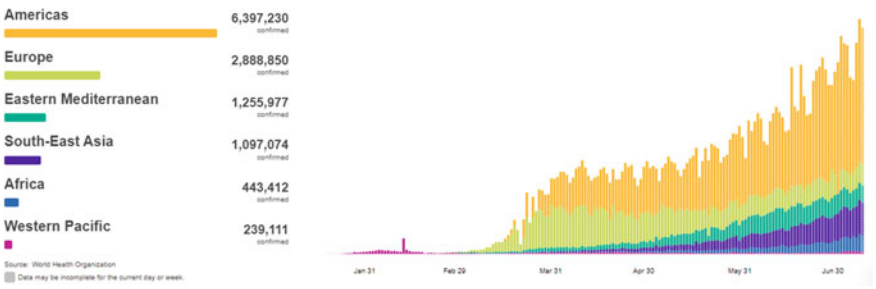

Fig. 1 The statistics of Corona virus region-wise (*source* WHO)

because of the virus is contagious nature. A reverse transcription polymerase chain reaction (RT-PCR) used golden standard for the diagnosis of Covid-19. However, RT-PCR has adequate, very limited supply and great delay in requirements of laboratory thereby posing unprecedented overheads for preventing the spread of virus especially at center of epidemic places. This is because of many factors like sample collection and its quality control whereas image accessing is easy in clinical practices such X-ray, Computed Tomography (CT) scan to clinicians in terms of assistance.

An exact source of virus is unknown and scientists are mapped genome of sequence of corona virus thereby identifying bats are the main source for Covid-19. The first human affected and reported from Wuhan city of china in December 2019, and then it is spreading massively throughout the world. As per WHO, approximately 213 countries and union territories are affected by Corona virus. Figure 1 shows statistics of Corona virus effected regions as per the WHO. Americans are the most effected region among all the regions and the maximum confirmed positive cases are reached to 6,397,230 till June 30.

The rapid increase in number of Corona cases throughout the world indicates that an immediate requirement of the vaccine or safety which leads to Covid-19 outbreak. The outbreak was linked to seafood and other animals in wholesale market of Wuhan. A β-Corona virus, SARS-CoV-2 is deemed responsible for outbreak of Covid-19. The characteristics of Corona virus is extremely contagious nature and proportionally long in period (1–14). A person may be infected in this period but it will not show any symptoms hence infected people spread carriers of virus unknowingly. The Covid-19 exhibits symptoms majorly fever, dry cough, sputum production and fatigue. In addition to this, headache, sore throat, breathlessness and myalgia are also shoed rarely in some infected humans. Table 1 shows symptoms of Covid-19 from much infected patients.

The remaining part of paper is as follows: Section-II presents related work and section-III propounded novel methodology to predict of Corona virus. Section-IV presents approximated results, and section-V concludes paper.

Table 1 List of basic symptoms (*source* WHO)

Most common symptoms	
Fever	88%
Dry Cough	67%
Fatigue	38%
Sputum Production	34%
Less Symptoms	
Shortness breath	19%
myalgia	15%
sore throat	14%
Headache	13.5%
Chills	11%

2 Related Work

An outbreak of Covid-19 prompted different researchers, scientists, scientists and organizations throughout the world to do research for developing vaccination and also treatment for Corona virus. As per WHO, the cause of most of the viral diseases is different viruses such as Corona virus and then severe effect on public health. In most recent, the Corona virus indicates danger bells to mankind because of change in symptoms periodically. As spherical range of corona virus is approximately 600 Å to 1400 Å, the best way of avoid Covid-19 is to wear mask and wash hands frequently. The various form SARS-COV and Middle East Respiratory Syndrome Corona virus (MERS-COV) witnessed for past two decades [1]. The first case of MARS-COV is found in Saudi Arabia and then spread large scale thereby resulting outbreak in Middle Eastern countries [2]. To identify characteristics of Corona virus, Wang et al. [3] analyzed and presented approximately 140 patients from Wuhan city, China. They considered medical history such as symptoms, signs, and demographics to determine clinical characteristics and effect on different organs of the patient body. Chen et al. [4] reviewed data of 100 patients and among 50 infected people are had direct effect from seafood market, Wuhan. They have investigated radiological, epidemiological and clinical characteristics and then reported 17% of patients developed acute respiratory distress syndrome (ARDS). They found approximately 11% of infected patients are died with multiple organ dysfunction syndrome (MODS). Jiang et al. [5] studied 6 published manuscripts on primary characteristics of Corona virus and also summarized findings overview of corona virus features and probable treatment for Covid-19. They have reviewed on CT scan features on Covid-19. Patel [6] focused on antimicrobial paper for combating bacteria and viruses which is very effective to arrest spread and dead novel corona virus. The difference of SARS-COV1 and SARS-COV2 is identified initially there after discussed survival period of SARS-COV2. There are two types of categories of paper production that are first category is antimicrobial paper with long lasting function and antimicrobial paper with short period. Another category of paper is ag- ion based microbial paper. Patel

Table 2 Simulated results [7] of deep learning model

S.No	Parameters	Specification
1	Accuracy	0.982
2	Sensitivity	0.976
3	Specificity	0.988

also proposed antibacterial nano particles which are integrated with minerals such as montmorillonite or pigments used as coating. Antimicrobial papers are effective to stop spreading corona virus on different surfaces (Table 2).

With reference of above literature, identification and restricting of spreading novel corona are prime concern of outbreak. Most of the literature is concentrating on techniques for identification of corona. Still, no one presents standard method to identify and treatment. Hence, this paper tries to direct unique technology for experimenting and producing standard medicine of novel corona virus.

3 Novel Methodology

Human being is the most intelligent creatures in the universe. The intelligence is integrated to any machine artificially known as artificial intelligence (AI). The intelligence is embedded into machine through computer programming hence it activates the senses like learn, think and applying intelligence similar to human beings. If the machine programmed properly, AI system produces incredible results in terms of accuracy and precision after experimenting at different conditions. AI primarily needed computational power to obtain intelligence from basic information. Initially, AI is broad area which is combined with machine learning later on it is combined with deep learning.

i. **Integration of AI with IoT**

In the modern age, there are lots of sources to generate massive data such as social media, search engines and e-commerce, etc. This generated data from sources is in the form of unstructured or raw data in the primary stage, and it requires huge time to sort this massive data. To solve this complex work, deep learning algorithms are used in AI. The word deep learning is known driving number of hidden layers in the processing of a problem. The deep learning utilizes supervised data through parallel processing mechanism. Machine learning algorithms are used to collect data thereafter trained from gathered data, and hence correctly predicted. Most of the algorithms are based on different approaches such as cluster learning, tree learning and Bayesian networks and so on. Computer vision is the best area for machine learning algorithm to obtain the objectives of AI. This technique targets to involve computer to interface real world and also able to understand time dependent conditions. The computer vision is mainly working based on digital image processing, signal processing and deep learning algorithms thereby identifying and classifying

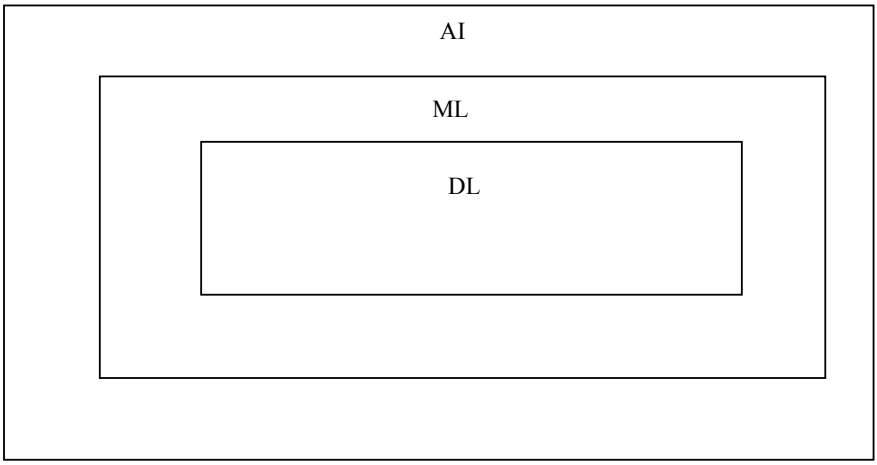

Fig. 2 Concept of AI, ML and DL technologies

of the objects to react accurately as similar as human. It is primarily requires certain algorithms of edge detection and filter circuit to detect shape and movement of object. Figure 2 depicts an idea for concepts of AI, ML and DL technologies.

The broad term of AI includes combination of machine learning (ML) and deep learning (DL) technologies and also fundamental requirement to adopt real-time conditions. There is a huge research going on this domain to analyze data and predict accurately. There are many complex attributes to predict accurately such as black-box strategy. IoT is another new strategy using in AI to process attributes and provide accurate results. AI-IoT based devices are interacted and communicated each other full duplex manner. The integrated technology of AI-IoT is structured transmitter, receiver and wireless sensor networks to explore high performance for future applications. Hence, integrated IoT based AI technology is the leading when compared to traditional techniques. Still, this technology needs huge amount of data to predict accurately.

ii. **AI used in Covid-19**

As IoT based AI technology is major technology in the present situation such as Alexa, Cortana, Siri and Google-Assistant from the companies of Amazon, Microsoft, Apple and Google, respectively. This pandemic situation occurred Covid-19 leads to outbreak in entire world. The IoT based AI technology plays major role in contagious disease such as treatment and prediction. Hence, contribution of this technology is begun in terms of combating Covid-19 disease. To reduce spreading of Corona virus, lockdown is used as one of best options entire worldwide. IoT based AI is the alternative method for Lockdown as face recognition through thermal cameras, cameras and also thermal screening at crowded places. Various steps are involved for combating covid-19 with AI technology that are data collection and early detection,

observing behavior for treatment, tracing out primary contacts, data analysis and development of vaccine and drugs.

(a) *Data Collection and Early detection*

In the country of Hongkong, whenever new person arrives from different country, person should wear Global Position System (GPS) based bracelet hence monitoring movement at quarantine period. India is also tracing Corona positive patients through ArogyaSethu mobile app hence detecting location of patients and performs action as per Law in case disobey of quarantine guidelines. The surveillance company Athena Securities in USA developed AI based module for detecting fever through video feed. This helps to make decision fast thereby developing new diagnosis systems for Covid-19 by utilizing required algorithms. Computed tomography (CT) scan and magnetic resonance imaging (MRI) scan are major medical imaging techniques for data collection in IoT based AI technology. One of main symptoms of Covid-19 is high temperature fever hence encouraging symptomatic persons to be quarantined to reduce the spread of Corona Virus. It also proved in china at early detection period, and temperature detection is primary key for combating Covid-19. These methods are used to data collection of protection and privacy individuals. Passive mode of data collection is not suitable for privacy and also need to be updated automatically. Many of European Countries are utilizing AI based data automation to combat epidemic.

(b) *Observing behavior for treatment*

Most of the corona patients are curing by themselves without consulting any doctor. This type of virus called as mild Covid-19 and recommended patients to be home quarantine to avoid additional health issues. Another type of virus is called severe and critical Covid-19, and these types of patients are recommended to visit hospital. These types of category patients are mostly experiencing hypoxemia which needs external set up for oxygen either through ventilator or face mask. AI based technique is an intelligent platform for prediction and monitor automatically of Corona virus. A neural network develops for AI based technique to extract features of virus thereby monitoring and providing exact treatment for affected ones. This technique is also update itself to record patient's data which helps to develop vaccine for Covid-19.

(c) *Tracing out primary contacts*

Contact tracing is the method of identifying people based on history of Covid-19 affected ones. This also helps not to test large set community. However, tracing out primary contacts are quite challenge through conventional methods as data of affected patients is not updated automatically. AI based methods identify primary contacts through bracelets which are composed with GPS navigation and ArogyaSethu application from affected ones. It is recommended to affected persons to be home quarantined to avoid spray to community. According to the WHO, the identification of primary contacts composed with three steps.

i. The individuals who are direct contact with infected individuals
ii. Maintaining record the details of infected ones

iii. Get details of individuals to be tested soon

The process of tracing primary contacts is highly useful to avoid community spread at first and second stages. AI based technique helps to analyze the levels of spreading thereby identifying "hot spots" and clusters successfully.

Blockchain

Blockchain technology is used mainly to track primary contacts and preserving details of patient. It is also enabling methods of encryption, distribution and security of digital medical field. It simplifies the tracking of drug trails and also record activities of trails. Blockchain technology has capability of summarize continuous varying data such as Covid-19. Hence, Blockchain technology plays an important role at combating of Covid-19 such as tracking primary contacts, protecting of privacy information and managing supply chain at medical domain. There are two types of Blockchain methods to analyze data of Covid-19 that are CIVITAS and MiPasa.

CIVITAS

An application (app) developed based on Blockchain technology in Canada to provide security to Covid-19 patients and also assists various aspects to different nations. This app indicates whether the candidate come out from home through official ID given while registration in app. This app also provides ideal time and busy for patient to reduce risk individual and also others by carrying required items. In addition to this, CIVITAS app offers telemedicine such as consultation of doctor and record of patient details.

MiPasa

MiPasa is a platform of data streaming composed on Hyperledger Fabric which is built from IBM Company by integrating Blockchain and cloud. This platform mainly used to share patient details and record health information among doctors, authorities and also cluster of hospitals. The WHO also approved and acknowledged this application to share information among doctors efficiently to develop vaccination for Covid-19.

d. *Data Analysis*

AI based technology forecasts and tracks the characteristics of Corona virus for recorded data from different platforms such as social media and media platforms thereby measuring risk of infection. The data analysis of AI based technology predicts the number of infected individuals and number death cases at particular region. This helps to measure the most affected regions, countries and community of people thereby providing safety measures, respectively. Before data analysis, data of corona patients initially processed three steps that are pre-processing for normalization, segmentation and classification. Different methods are used for above mentioned steps for data collection and analysis efficiently. AI based technique provides the latest information of vaccination for Covid-19 with help of data analysis. It predicts

and refers probable infection level by virus, requirement of beds and required equipment for treatment during epidemic. AI based technology is highly helpful in future such as second wave of Covid-19 as well as other epidemics. Pelaez and Loayza [7] analyzed different simulation parameters such as accuracy, sensitivity and specify by applying deep learning models for Covid-19.

e. *Development of Vaccine and Drugs*

AI based technology plays a vital role at development of vaccine and drugs for Covid-19 as it is adopt different conditions and update it. It is mainly using in drug research because vaccine needs huge amount of data from the different regions of patients. This technology accelerates the development of vaccine and also provides status of vaccine and drug. Because of adopt real-time conditions, AI based technology becomes a set of powerful tool for combating Covid-19 epidemic. This also recommends the positive case need to hospitalized or not based on severity of infection level by virus.

iii. **Different algorithms involved in ML/DL**

Algorithms of machine learning are broadly divided into two categories that are supervised and unsupervised algorithms. Figure 3 depicts broad classification of algorithms used in both ML and DL. The supervised learning is composed with classification and regression methods, and classification is implemented with Image classification and machine translation. The regression is implemented with stock prediction and image masking methods. The unsupervised learning is used in both machine learning and deep learning. The ML algorithm is composed with dimension reduction and clustering methods, whereas DL is composed with representation learning model and generative model. Principle Component Analysis (PCA) and t-SNE methods are utilized for dimension reduction and K-means, GMMs, HMMs are used for clustering technique. Mutual information, disentanglement and information bottleneck are techniques used in representation learning whereas GAN and VAE are used for generative model.

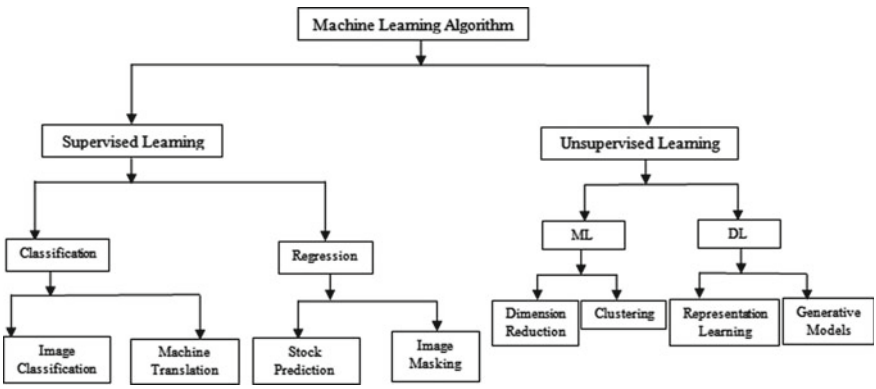

Fig. 3 Classification of algorithms of ML/DL

4 Conclusion

This paper presented novel platform by integrated different technologies such as AI, IoT and Blockchain for combating corona virus. Initially, this paper discussed corona effected countries by the region-wise which taken from WHO thereafter presented characteristics and required equipment to confirm Corona effected individuals. This paper is propounded IoT based AI technique with Blockchain for analysis of Corona characteristics and developing vaccine and drug. The novel platform IoT based AI with Blockchain discussed how it is suitable to combating Covid-19 with ML/DL algorithms. Finally, this paper tries to give the new direction for avoiding Covid-19.

References

1. Chan-Yeung M, Xu R (2003) SARS: Epidemiology. Respirology 8:S9–S14
2. World Health Organization (2020) Middle east respiratory syndrome coronavirus (MERS-CoV). Accessed 20 Apr 2020. https://www.who.int/emergencies/mers-cov/en/
3. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, Wang B, Xiang H, Cheng Z, Xiong Y, Zhao Y, Li Y, Wang X, Peng Z (2020) Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. J Amer Med Assoc 323(11):1061
4. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, Qiu Y, Wang J, Liu Y, Wei Y, Xia J, Yu T, Zhang X, Zhang L (2020) Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 395(10223):507–513
5. Jiang F, Deng L, Zhang L, Cai Y, Cheung CW, Xia Z (2020) Review of the clinical characteristics of coronavirus disease 2019 (COVID- 19). J Gen Internal Med 35:1545–1549
6. Patel M (2020) Antimicrobial paper embedded with nanoparticles as spread-breaker for corona virus. Virus 3(1):001–012
7. Pelaez E, Loayza F (2020) A deep learning model to screen for Corona Virus Disease (COVID-19) from X-ray chest images. In: 2020 IEEE Andescon. IEEE, pp 1–6