

# Investigation of Blockchain for COVID-19: A Systematic Review, Applications and Possible Challenges

Shah Hussain Badshah<sup>1</sup>, Muhammad Imad<sup>1</sup>, Muhammad Abul Hassan<sup>2,\*</sup>, Naimullah<sup>1</sup>, Shabir khan<sup>1</sup>, Farhatullah<sup>3</sup>, Sana Ullah<sup>4</sup> and Syed Haider Ali<sup>5</sup>

<sup>1</sup>Department of Computing and Technology, Abasyn University Peshawar, onlinesoftteach@gmail.com, Imadk28@gmail.com, Naimnan.15@gmail.com, mshabirkhan1993@gamil.com

<sup>2</sup>Department of Information Engineering and Computer Science, University of Trento, Italy, muhammadabul.hassan@unitn.it

<sup>3</sup>School of Automation, Control Sciences and Engineering, China University of Geosciences, Wuhan, 430074, China farhatkhan8398@gmail.com

<sup>4</sup>Department of Computer Science, Qurtuba University of Science and Technology, Peshawar Pakistan, sunnykhan3304@gmail.com

<sup>5</sup>Department of Electrical Engineering, University of Engineering and Technology Peshawar, engrsyedhaiderali@yahoo.com

## Abstract

Smart city is emerging application in which many Internet of Things (IoT) devices are embedded to perform overall monitoring and perform processing automatically. In smart city the authenticity is key problem and many users in the smart city has faced challenges during COVID-19. The COVID-19 epidemic, a deadly virus, first appeared in the globe in 2019. The World Health Organization (WHO) states that it is almost certainly feasible to contain this virus in its early phases if some precautions are taken. To contain the infection, most nations declared emergencies both inside and outside their borders and prohibited travel. Artificial intelligence and blockchain are being used in smart city applications to monitor the general condition in the nation and reduce the mortality rate. Blockchain has also made it possible to safeguard patient medical histories and provide epidemic tracking. AI also offers the ideal, wanted answer for correctly identifying the signs. The primary goal of this study is to fully investigate blockchain technology and artificial intelligence (AI) in relation to COVID-19. A case study that was recently developed to identify and networked pathogens acquired important knowledge and data. Additionally, AI that can handle massive quantities of medical data and perform difficult jobs will be able to reduce the likelihood of intricacy in data analysis. Lastly, we highlight the present difficulties and suggest potential paths for addressing the 19 diseases in future circumstances.

**Keywords:** Smart City, Blockchain, Covid-19, Virus, Artificial Intelligence (AI), Pandemic, Machine Learning, Deep Learning

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## 1. Introduction

Today, security is more important than ever, as numerous organizations, both private and public, have experienced costly losses and reputational damage because of hacking and other forms of cybercrime especially in smart city [1]. The adoption of blockchain technology has made it much simpler and faster to implement security patches and other updates to websites, social media platforms, and other

types of online infrastructure. As a result of COVID-19 in smart city application, more people than ever before are communicating with their loved ones via social networking sites, but it is incredibly difficult to stop criminal activity or counteract fake information spread via the web. Blockchain technology is used by public and commercial (hired) agencies to address the problems of plagiarism and other forms of fake material on these sites. The European Centre for Disease Prevention and Control estimates that 10 million people are affected with this virus every year [2-20], making prevention efforts difficult due to a lack of

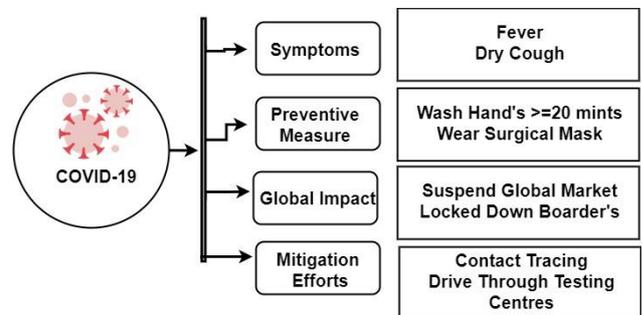
available tools like immunizations and a COVID-19 protection package [21-30]. Numerous studies demonstrated that X-rays are crucial in the initial phases of diagnosis of the virus. As a result of the prevalence of online transmission of medical records, it is crucial that this sensitive information be safeguarded to prevent the spread of inaccurate data [31-35]. Machine learning and deep learning are two approaches being used to combat the spread of misinformation online, especially in the smart city. Distributed ledger technology, or blockchain for short, keeps records in several separate systems and links them together in a decentralized, peer-to-peer network. Blockchain transactions are protected by a cryptographically strong mechanism, such as a digital signature, for example. In the last few years, the COVID-19 epidemic has affected the health and lives of people all over the world [36]. The pandemic has expanded to around 150 nations. The European Centre for Disease Prevention and Control estimates that up to 10 million individuals are infected due to the virus's ease of spread, lack of effective immunizations, and the unreliability of commercially available COVID-19 test tools [3]. New studies have demonstrated the importance of diagnostic tests like X-rays in the diagnosis of coronavirus illness. Also, academics have prohibited unorganized information from social networks and stressed using blockchain technology to defend against and identify fake news and hoaxes [37]. Researchers and medical specialists from all over the world are scrambling to find a new tool to combat the Covid-19 pandemic. Unverified claims in the media and hearsay can be exposed with the help of machine learning and Deep Learning techniques. Bitcoin technology expedites the transfer of data used to monitor physical possessions. Four primary levels are built into the blockchain architecture to ensure that anomalous spread is being stopped. All incoming communications on the web are constantly monitored by the four levels (computer, network, blockchain, and device) [38]. The speculative meaning becomes clear and will play an important role in the future of the digital world if one considers blockchain technology, which is presently required for cryptocurrencies. It is imperative that this technology continues to advance and become more user-friendly so that it can be used to solve future security problems in a wide variety of industries and institutions. In order to anticipate the results of the covid-19 test and identify the patients who will be negatively impacted by the discrimination, machine learning categorization methods are indispensable [39].

In the article [40], the authors examine the categorization of the covid-19 dataset and point out where various classifiers perform poorly on the corona dataset. The chosen classification algorithms will be use, and their classification performance will be measured across a number of metrics including accuracy, sensitivity, false-positive rate, and F-measures. To get the best outcomes possible from machine learning methods, we compare the efficiency of various categorization classifiers on the coronavirus dataset [41]. As a result of their difficulties, Chinese scientists have had to delve deeply into the virus

to determine the best way to deal with the coronavirus enigma. Tests of different techniques for classifying models yield information about their predictive success [42], but these tests can lead to model confusion. To ensure that CT scan picture quality is detected at an early stage, the model is being optimized using deep learning. It appears that illnesses all over the world, such as AIDS, TB, Hepatitis, and Measles, will be severely impacted by the Covid-19 epidemic, prompting the World Health Organization to proclaim an emergency. The World Health Organization (WHO) and other study institutions face an enormous workload, which could be greatly alleviated with the aid of machine learning algorithms.

### 1.1 Symptoms

The documented signs of COVID-19 are diverse. Some people may experience symptoms as soon as 14 days after contracting a virus. FIGURE 1: COVID-19 symptoms and indications, including temperature, congestion, shortness of breath, exhaustion, loss of flavour or scent, headache or bodily pain, trouble breathing, vertigo, and diarrhea [43]. There is a higher chance of more severe consequences from COVID-19 infection in older individuals who already have pre-existing medical problems, such as heart disease, pulmonary disease, diabetes, or persistent illnesses. Acute renal damage, organ failure, cardiac problems, and bacterial infection are all potential complications that can result in mortality.



**Figure 1.** COVID-19 symptoms, preventive measures, its global impact, and mitigation efforts.

### 1.2 Preventive Measures

Preventive measure is important to stop the spreading of the virus and reduce the risk of countering. Currently, preventive measures are washing hands with soap for 20 seconds, keeping a social distance in a crowded place of at least 2 meters, wearing a surgical mask, and avoiding touching your face, nose, and eyes. Another preventive measure is cleaning the house regularly, staying home and not going outside unnecessarily, covering coughs and sneezing, and monitoring health issues.

### 1.3 Global Impact

In addition to having an impact on human existence, COVID-19 also has an impact on the world economy. Many nations have issued stringent lockdowns and advised citizens to remain at home, but as a result, COVID-19 regulations have shut down workplaces, marketplaces, and other businesses. The COVID-19 shutdown had a major effect on business and the world economy [13], as well as public transportation, building, tourists, supply chain disruption, unemployment, and food shortages.

### 1.4 Mitigation Efforts

The government and organizations have implemented relief strategies in addition to protective ones to halt the infections. Many apps have been created in different nations to increase the effectiveness of the viral detection procedure and track the covid-19 patients by using a phone app to track and identify the virus. These apps made use of Bluetooth or the internet to keep the patient's data in protected form, allowing the medical officials to quickly get in touch with each one of them separately. In addition to alerting users when an infectious individual is nearby, these apps also inform users of health problems [14]. Section 1 of the literature survey discusses the contrast of linked papers. The following is the paper's primary contribution:

- The poll included a thorough analysis of blockchain technology's ability to combat the COVID-19 outbreak and discover cures for these diseases.
- This essay compares various bitcoin research studies and emphasizes their models, goals, contributions, and flaws.
- The COVID-19 epidemic was noted in this survey's potential research obstacles and future directions for blockchain technology by study experts and users.

The following is how the document is set up: A overview of the blockchain literature is presented in Section 2. The role of blockchain technology in the fight against the COVID-19 epidemic was covered in Section 3. The blockchain's materials and techniques will be covered in Section 4. In the framework of COVID-19, Section 5 addressed the Blockchain Technology Issues and Future Plans. The end is presented in section 6 to finish.

## 2. Literature Review

To improve the effectiveness of blockchain methods created for the retrieval and storage of jointly managed data, Yuting Wu et al. conducted research. Additionally, the system guards against data manipulation when various businesses and groups' data is processed. reducing unrelated data by proofing the supply chain [15]. Researchers

Radhya Sahal and Saeed H. Alsamhi concentrated on the use of blockchain technology for the Covid-19 pandemic warning use case, which used collaboratively built digital clones for a decentralized smart pandemic. The Internet of Things (IoT) and Artificial Intelligence (AI) transformation are being greatly aided by the new technologies of blockchain, especially in the healthcare industry. data exchanged between medical cyber-physical systems and safe real-time data processing for the COVID-19 epidemic [16]. Figure 1 compares various study projects pertaining to bitcoin and COVID-19.

Table 1. Comparison of our survey paper with existing works.

Ref	Algorithm / Models Applied	Purpose	Contribution	Weakness Limitation
[15]	RF, KNN, AdaBoost, GBDT algorithm, XGBoost, RF, LR,	Classification, Confusion Matrix, Data Tamper Proofing Mechanism	Improved Previous techniques	Security loopholes still exist
[16]	Practical Byzantine Fault Tolerance (PBFT) algorithm, Blockchain framework, Decision Tree	Data Security, Data Integrity, Real-Time Data Analytics, Predictions, Data Sharing, Data Splitting, Model Evaluation	To increase speed, the architecture dispersed warning use case.	Numerous smart gadgets with numerous communication issues Technology beyond the Fifth Generation (5G) or Sixth Generation (6G).
[17]	RF, MLR, RN, NBG, SVM, NB, C5	BCN, BCH, SLR, TZS, XRP, EOS, CDO	To improve precision, eliminate any background data.	improper handling of a large collection
[18]	DDN Neural Network, FED, Blockchain	EHRs, SQLite, API, Feature Extracted	More work is required to manage large data and increase precision.	The algorithm could be improved to face unimportant characteristics.
[19]	AI, Machine Learning Techniques	Utilization AI and Blockchain technology used for the Covid-19 Pandemic.	Survey Type	The security problems with blockchain technology still need to be monitored.

[20]	ML, AI, Supervised, unsupervised and reinforcement. Linear Regression	Visualization, Analyze	Parallel Analysis of Tools and Programs	small collections of training data
[21]	Federated learning, Data abstraction	Classification, Peer-to-peer network blockchain technology, simulation,	Improved tiny nodes are required	Problems arise with large Storage files.
[22]	Artificial Intelligence Models; Machine Learning, federated learning	Analysis, Detection,	Researchers are still trying to make the systems more responsive.	Internet access is not widely accessible . how to gather statistics on the impacted COVID-19 patients.
[23]	Blockchain technology with federated learning, Deep Learning, Data Normalization, Routing Algorithm, VGG, ResNet, MobileNet, DenseNet	Segmentation, detection, classification	Improve using the structure of modern CT scans	Lack of a suitable sample for training data
[24]	AI, ML Models, Data Mining methods, Blockchain Approaches	SWOT analysis, Analysis,	Boost protocol effectiveness for a specific risk management security.	High operating costs, the potential for splits, a dearth of freedom, and the requirement for more data storing capacity on local computers
[25]	ML, DL, Blockchain, AI, Robotics, Big Data	Detection, Segmentation, Classification, radiography and computed tomography (CMT)	Model should also employ other ideal methods.	additional need to manage huge information

[26]	Machine Learning Algorithms,	Flexibility and scalability	Determine the success of the program.	The system's major flaw is that it depends on users having and using smartphones.
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### 3. Blockchain Technology in Smart City application against COVID-19 pandemic

The Covid-19 pandemic may push the medical system to its breaking point and prevent the development of effective treatments. An accurate data supervision system that would instantly be compatible with medical treatment systems instruction that demands potential outbreaks is being reduced in the movement. The current COVID-19 data, however, comes from disparate sources like clinical labs, hospitals, and the public and contains large amounts of data for evaluation without being thoroughly coordinated. It contains careless information because it complicates attempts to determine potential outbreaks and COVID-19 quarantines. Contrarily, a limitation is a time-consuming covid-19 data recognition method that typically requires a few hours to finish testing for viruses to improve precision. The challenge is how to accelerate a covid-19 identification while maintaining high precision. Like how it is difficult to manipulate COVID-19 data, which has intricate arrangements and large volumes, using human-dependent medical tools [27]. Figure 2 displays the information about applications for blockchain and AI technology.

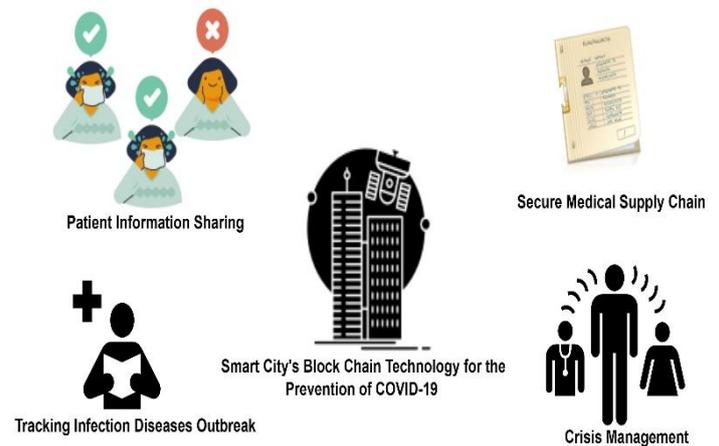


Figure 2. Blockchain Applications in fighting COVID-19.

### 3.1 Patients information sharing

To study COVID-19 and determine the illness and viral signs, it is crucial to exchange patient data with medical research facilities both domestically and globally. Blood records and prescription information are acceptable if the private of the patients' data is protected and no violations of national and foreign data exchange regulations are made. Different IoT devices and blockchain technology can be used to gather data, making it simpler to share it with various institutions and medical experts.

### 3.2 Tracking Infectious Disease Outbreaks

The public health statistics for contagious diseases like COVID-19 are processed quickly by blockchain technology, which also provides a more precise summary and adequate reaction. Additionally, this will help us keep track of viral activity, early symptom identification, potential new cases, and pandemic levels of transmission.

### 3.3 Securing Medical Supply Chains

Bitcoin is useful for monitoring and identifying medical supply networks as well as documenting and analysing the demand for logistical materials and supplies. The supply chain includes several parties, including documents of the process and verifying evidence for each party to monitor each step separately.

## 4. Methods and Materials

To provide a summary of the inquiry into the use of blockchain technology and artificial intelligence in the battle against the coronavirus epidemic, the suggested comprehensive studies emphasized research methodologies and included the following crucial stages. We start by keeping in mind the shortcomings of the current healthcare system and choosing the motivational step for why COVID-19 and AI should be used instead. Researching all pertinent scientific articles related to the study topic is the second stage. We examine research on the technological applications of blockchain and artificial intelligence in supporting initiatives to prevent the spread of the coronavirus. In this case, we use research threads like machine learning strategies [28][29], blockchain technology, deep learning methods [30], and COVID-19 to delve into and prioritize the most acceptable technical papers for our analytical examination. Next, we choose the relevant information for the specified queries. We made the decision to highlight peer-reviewed, excellent studies that were given in books, journals, symposiums, seminars, and symposia that dealt with the subject of the study. The third part is all connected articles essential to their titles. We read the main idea out loud, select the main buzzwords, and draw attention to the abstract idea that draws contributions

of pertinent data to the paper. Then, for the purpose of comparing the studies, we cycled the terms into groups and by sections. The final step is data extraction, which gathers all the information required to examine the technological terminology and blockchain and AI advances in relation to the Coronavirus outbreak [31][32].

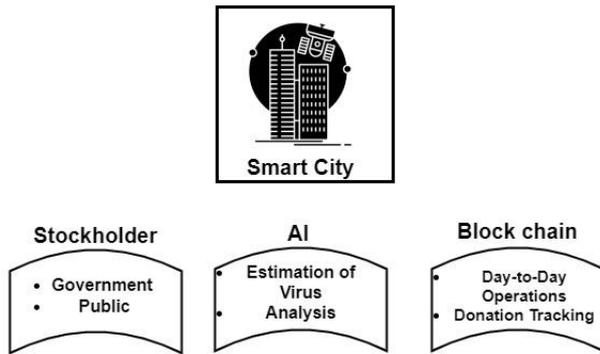
### 4.1 Proposed Blockchain-AI Architecture for Coronavirus Fighting

With the aid of models, covid-19 illnesses can be fought by integrating blockchain and AI technology. Stakeholders, blockchain functions, AI classifiers, and constant COVID data sources are the four key stages that are outlined below in Figure 3 [33]. To create and monitor useful data from the raw data to acquire the information, academics have been using databases from clinical laboratories, social networks, and institutions for experimental observation. Each scholar should be familiar with handling data and the methods for gathering information. Additionally, coronavirus statistics include radiography pictures and X-rays of historically infected impacted regions to gather the information from various websites, clinical laboratories, social media, publications, government accounts, the World Health Organization, and other resources. The Chinese government alleges that we are currently creating a sizable database system to keep daily patient data and quickly assess contaminated cases in each region of information or data gathered by the National Health Commission with recommended time severe [34]. The national directory is presently linked to the society living in the digital age. Websites keep and disseminate data about CT scans and X-ray pictures [35]. If you pay attention, you will notice that the government offers data centres for academics who need to conduct additional research and determine the best trial given the present scenario of a disease epidemic expanding rapidly. Because it involves identifying the important data from the provided information, covid data analysis is not a simple job. Blockchain, on the other hand, can analyse 19 connection services, such as recording donations, analysing outbreaks, and safeguarding the daily medical supply chain. The blockchain-based security data is evaluated using insightful AI-based findings. Large amounts of data can be gathered from Covid-19 sources to forecast the best answer and perform precise analysis. Five key uses of AI, including epidemic covid-19 detection, vaccine development, projection, coronavirus analytics, and forecast of any future covid-like outbreak, can highlight assistance for covid-19 combat.

### 4.2 Combining Blockchain and AI For Combating COVID-19

In the movement, blockchain technology and artificial intelligence can be combined to create potential future treatments for the epidemic. For instance, experts laboured

to determine the best answer and forecast coronavirus development [36]. To protect public life, the government released directions urging citizens to maintain a safe distance and abide by the law. Deep learning design can estimate the model's performance criteria based on the patient's description, medical history, and current therapies. To categorize the data and produce correct findings, data is generating crucial guidelines. AI algorithms would assist government officials in building a gadget to educate the public about quarantine and social segregation practices regarding final choices [37].



**Figure 3.** Blockchain and AI for Coronavirus Fighting in Smart City

## 5. Challenges and Future Directions

To combat the COVID-19 epidemic, blockchain technology offers a hopeful solution. The poll also notes that when using these methods in the context of the healthcare industry, various obstacles are carefully considered. We also talked about the difficulties and potential paths for this area.

Bitcoin technology should be thoroughly examined in the healthcare industry and disseminated in accordance with legal and governmental requirements. Concerns with copyright violation and slander as well as legal issues related to content and personal information can determine what laws apply to blockchain operations. The monitoring application for COVID-19 is typically used to monitor and halt the spread of the epidemic, but because user privacy is so crucial, particularly when it comes to private data, it must be protected. However, according to new study studies, blockchain technology poses security risks to software used in the medical and healthcare industries [38] [39][40]. The dearth of information about the viral outbreak, such as infectious cases, normal cases, medical supply state, and tools to recognize the virus, presents a difficult job in the COVID-19 pandemic. Most of the COVID-19 data originate from social media, the gathering of medical records, and the tracking of app health; however, the data are insufficient for extensive AI operations. To operate the blockchain software, sophisticated tools and storage were needed. Therefore, it is crucial to create hardware to track COVID-19 and

quickly examine data inside a blockchain network computer.

The systems that support blockchain technology should be enhanced and made better to perform well from a variety of technological angles, including speed, delay, resource usage, and PDR. Security problems still exist with blockchain. Blockchain storage was subject to a 51% assault on block mining and a double spending strike. As a result, data protection through blockchain should be enhanced. Blockchain and AI should be merged to create more effective healthcare system technology with improved efficiency and enough machinery to address pandemic problems.

## 6. Conclusions

Smart City has caught attention from both industry and academia but still some security related issues need to be addressed and moreover the false spreading of information over social media in COVID-19 situations are very challenging. The Covid-19 epidemic has spread illnesses like AIDS, tuberculosis, hepatitis, and measles throughout the globe, prompting the World Health Organization (WHO) to proclaim a public health emergency. The massive load placed on the WHO as well as scholars and experts can be lessened with the aid of machine learning algorithms. To recognize and address the COVID-19 epidemic, we have provided a summary of blockchain technology utilized in smart city in this research article. We have talked about the crucial role that blockchain technology can play in combating the COVID-19 epidemic and outlining difficult future work paths for the preservation of patient privacy.

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