# COVAC: A Blockchain-Based COVID Testing And Vaccination Tracking System

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***Abstract***.
*Blockchain is an emerging technology based on a distributed digital ledger system. Decentralized trust is one of the key factors behind the blockchain-based system. The transparency of such a system is better than a conventional centralized ledger system. By using a blockchain-based transaction system, any business organization can harness key benefits like data integrity, confidentiality, and anonymity without involving any third party in control of the transactions. Since the blockchain is used in numerous applications, the horizon is expanding at an unprecedented pace. It was found that tracking COVID vaccination in a transparent and accountable way is an emerging need, especially after the pandemic outbreak around the world. The blockchain platform is a good match for such applications. In this study, a blockchain-based COVID-19 testing and vaccination tracking system, called COVAC, has been designed to manage the COVID testing and vaccination process for local organizations. The "Prototype Software Development" approach was used to determine the system requirements according to the practical knowledge obtained through the vaccine monitoring and screening tests process and then communicated with local healthcare facilities to determine whether these requirements were satisfied. The blockchain-based implementation ensured the system transparency, integrity, and security of data on COVID-19 testing and vaccination*

***Keywords:*** *Block chain, COVID-19, Data integrity and immutability, Tracking system.*

## I. INTRODUCTION

Coronavirus disease 2019 or COVID-19 for short, also known as SARS-CoV-2, is a zoonotic septic respiratory disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This virus is very close to the SARS virus. The new virus was first detected in the Chinese city of Wuhan in 2019, and has since spread around the world, causing the global coronavirus pandemic. Since the beginning of the pandemic until today, more than 194,890,998 million cases of coronavirus have been reported in all countries of the world, resulting in more than 4,171,501 million deaths [1]. The ratio of the number of deaths to the number of diagnosed injuries is estimated at 3.4%, but it varies according to age and the presence of other diseases [2].Common symptoms of the disease include fever, cough, and shortness of breath. Muscle aches, sputum production, and sore throat are not common. While most infections follow a benign, asymptomatic course, a number progress to more serious forms such as severe pneumonia and multiple organ dysfunction.

While the majority of cases have mild symptoms, people with acute respiratory distress syndrome (ARDS) may experience organ failure, septic shock, and blood clots. The time between exposure to the virus and the onset of symptoms ranges from two to 14 days, with an average of five days. Long-term damage to organs (particularly the lungs and heart) has been observed, and there is concern about a large number of patients who have recovered from the acute phase of the disease but still have a range of symptoms - including extreme fatigue, memory loss and other cognitive problems, mild fever and weakness. Muscles, shortness of breath, and other symptoms - for several months after recovery [3] The virus usually spreads between people during close contact, often through small droplets of droplets produced by coughing, sneezing, and speaking. These droplets usually fall to the ground or to surfaces rather than traveling through the air over long distances. In less common cases, some people may become ill by touching contaminated surfaces and then touching their face. The virus is most contagious during the first three days after symptoms appear, although infection can occur before these symptoms appear and from people who do not show symptoms of the disease. In addition, the use of a face covering is recommended for those who suspect they have the virus and those who care for them. The recommendations for covering the face that people use conflict with the recommendations of some authorities, some against them, and some advise them to use it.

There is limited evidence for or against the use of masks (medical or other) by healthy individuals in our community. The infection is usually transmitted from person to person by respiratory droplets resulting from coughing or sneezing [4]. The time between exposure to the virus and the onset of symptoms ranges from two to 14 days, with an average of five days. The standard diagnostic method is to perform a smear (PCR) taken from the nasopharynx or from the throat. The infection can also be diagnosed by combining symptoms and risk factors with a CT scan of the chest that shows signs of pneumonia [5]Measures to prevent infection include frequent hand washing, social distancing (maintaining adequate distance between individuals) and avoiding touching the face. Medical masks are recommended for those suspected of carrying the virus and for people who care for them, while the general public is not. Currently, both the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) now recommend masks for the general public in public places, (at Although both organizations reported the exact opposite at the beginning of the epidemic). This change may have confused the general public about the usefulness of masks. But health experts say the evidence is becoming clear that masks can help prevent the spread of the pandemic and that the more people wearing masks, the better. Masks should not be worn by children under the age of two (or even five) or anyone Has difficulty breathing or a person is incapacitated or unable to remove the mask without assistance and some other special cases [6] It took around a decade for the distributed ledger technology to reinvent the concept of digital lineaments. Blockchain technology redefines the fundamental concepts of secure online business transactions. Its potential application has expanded to different domains, such as healthcare, government services, industrial production, agriculture, etc. [7].

The term ‘blockchain’ was first mentioned and utilized in Bitcoin cryptocurrency, although the core concept was proposed in 1991 with the idea of timestamping [8]. Satoshi Nakamoto, who authored the bitcoin white paperback in 2008 and created bitcoin’s original reference implementation, developed the official blockchain. It is a peer-to-peer electronic transaction method that transfers the payments directly to the intended recipients without relying on any third party [9] In simple terms, a blockchain refers to a decentralized transaction and data management technology through the internet. It maintains a list of data records in the form of blocks that are growing continuously due to new transactions and are managed by the participating nodes. It provides anonymity and data integrity without any third-party interference in control of the transactions. Moreover, all the blockchain platforms provide high-level privacy and security, as the technology was designed initially for cryptocurrency [10] [11] With this property of trusted transactions, many businesses are trying to be on the blockchain map and take advantage of its attractive features, including reducing paperwork, transferring money without commissions, and confirming identities more easily. More importantly, it increases security with a shift from centralized data security to a more decentralized network processing with high efficiency [12]. Consequently, transactions are faster, secure, and more transparent. These reasons make the leading IT companies and institutions, like IBM, race to develop different types of blockchain platforms. Their rigorous research and rapid development efforts enabled the blockchain platforms to serve various domains within a short period, such as the internet of things, healthcare, government, Industry, and others [13] Even during the Covid-19 pandemic, the blockchain has continued its dynamic roles. For instance, IBM participated in ‘The Food Trust’ program that uses a decentralized model to allow multiple food supply chains (growers, suppliers, and retailers) to share processing data and shipping information. This initiative keeps track of the food to reduce waste. In June 2020, the foundation members increased from 11 to 300 suppliers and buyers on the network, with 6 million packed and shelved food products available [14].Blockchain and its infrastructure technology have expanded rapidly in the last decade and are in high demand, but there is a lack of comprehensive studies on those platforms. In this study, a program using Hyperledger blockchain has been developed to track down the COVID vaccination process.we structured this paper as following: section 2 are taking about literature review, section 3 pervious work section 4 the requirement of that application , section 5 testing and section 6 will be the security issues and finally the conclusion and acknowledgment.

## II. LITERATURE REVIEW

Governments worldwide are currently coping with the COVID19 pandemic, an epidemic of the SARSCoV2 virus that has wreaked havoc on the lives of individuals and economies in more than 190 nations, resulting in more than 82 million cases and over 4 million fatalities as of the time of writing this piece (July 2021).Apart from COVID19 mitigation measures, each government, organization, and individual are focused on restarting the economy. One of the issues facing governments and public bodies is successfully managing their economies, opening workplaces, authorizing travel, and preventing new outbreaks of infection. Indeed, a sizable proportion of service sector businesses may not reopen as a result of the financial crisis. They are desperate for a solution that protects the environment while allowing their businesses to remain open and their consumers delighted. As governments strive to gradually reintroduce normalcy, there is an urgent need for solutions capable of mitigating the severity of the losses.Numerous technological alternatives are suggested, most notably movement documentation and traceability apps [15], [16]but all are susceptible to fraud and falsification, may impinge on fundamental liberties, or are socially unacceptable. Because of the nature of traceability apps, public concern over privacy has stymied prior solutions [7].

Personal data privacy and confidentiality are particularly jeopardized as a result of the Google/Apple 7 contact tracing technologies. Additionally, Bluetooth-based traceability Apps require the user device to be in an active broadcasting mode, which depletes the battery. Meanwhile, Bluetooth technology has security problems, including a susceptible wireless interface and the identification and exposure of physical hardware. Additionally, there is a strong possibility of replay attacks against the traceability network, which could result in widespread fear among people [7]. A viable option is to use a so-called "health certificate"/"immunity passport"/"risk-free certificate" or any other highly secure health document. The underlying concept is that a COVID19 test or confirmation of vaccination might serve as the basis for a certificate exempting an individual from the most severe government requirements. It seeks to provide everyone who has obtained an approved PCR/Antibody test result or has been vaccinated with a certificate in a tamper-proof, universally verifiable digital but printable format. As a result, this health certificate may enable public authorities to restrict access to critical or sensitive facilities, such as health care facilities, retirement communities, schools, government offices, workplaces, and businesses, while also taking into account the virus's continuing uncertainty, changing health policies, and the validity period of the test result. Furthermore, in comparison to traceability apps, the health certificate protects the user's privacy by being scanned only at checkpoints (i.e., airports, hospitals, and schools), which saves the user's battery life because it may be used offline mode and consumes no energy.

Certain countries, including China, Chile, Estonia, the United States, the United Kingdom, Italy, Germany, and France, have already indicated their intention to experiment with such credentials [17]. Unfortunately, these government-tested and implemented solutions [18]contain scant technical specifics and so cannot be completely understood or examined. It is well recognized, however, that some of them are centralized 9 or rely on third parties, posing security and privacy concerns.In light of the interest demonstrated by some governments and the emergence of a variety of commercial solutions [19] an academic examination for COVID-19 health certificates is required. It is critical, in particular, to present specific technical solutions and to acknowledge current constraints, so that healthcare authorities may make educated decisions. Additionally, there are a large number of developing countries that lack the technical and economic capabilities necessary to win this battle. How is it possible to leverage technology and solutions to help these countries grow through the adoption of a global standard? To aid in the fight against this global health pandemic, Blockchain technology [20]has the potential to play a critical role not only in illness reduction but also in facilitating the implementation of governmental regulations and standards while maintaining trust between all parties. Indeed, the emerging Blockchain technology, which is a distributed, immutable, and tamperproof ledger database with a global computational infrastructure (i.e., smart contracts), has the potential to provide efficient COVID 19 solutions that are based on high levels of accuracy and trust, owing to its critical properties of transparency, integrity, and resilience [21].

## III. PREVIOUS WORK

Traditional vaccination methods employ a technique known as number labeling [22], which does not provide for precise vaccine traceability. When numbers are labeled, there are simply estimated numbers for a situation, with no way of knowing if these numbers accurately reflect reality. For example, a government may be aware of the amount of vaccine doses available per region and the number of doses used; yet, they may be unaware of who is vaccinated in a certain neighborhood or city.The vaccination process is fraught with difficulties. For example, records can be faked to conceal the true number of vaccinated individuals, or vaccination dosages can be taken [22]. When dealing with a high volume of immunizations without centralized data, it is necessary to overcome computational challenges. It is possible to lose critical data as a result of a data tampering attack [23]. Additionally, there may be instances where individuals move to another region to obtain the vaccine, affecting resource allocation [24]. It is critical to coordinate vaccine transportation and manufacture, as well as to supervise vaccine distribution [25].

Additionally, the absence of documented records can complicate vaccination campaigns [26].Yong et al. [22]presented a work that incorporates Blockchain and machine learning into a management system for vaccine supply oversight. The primary objective is to establish a dependable mechanism for tracing vaccine production issues such as vaccine expiration and vaccine record falsification. Additionally, the system makes a vaccination suggestion, allowing for the identification of the optimal vaccine in a given context. Despite offering an architecture, the authors provide no mention of the tool's duties or protocols.Peng et al. [23]discuss their work on ensuring the safety of vaccine production through the use of a Blockchain-based system of oversight. The objective is to maintain private enterprise and public information on products and vaccines (e.g. vaccine name, expiration date). The work illustrates a preliminary use of Blockchain; however, it does not explain the roles involved in the proposed process. Eisenstadt et al. [26]offer a certification approach based on Blockchain technology and mobile devices.

## IV. SYSTEM DESIGN AND REQUIREMENTS

The "Prototype Software Development" approach was utilized in this project due to the lack of details on the currently used system and lack of required communication with concerned stockholders, such as health care facilities and the Ministry of Health. Efforts were made to ensure those system requirements are put according to the knowledge obtained through the vaccine monitoring and screening tests process. After that, the system requirements were discussed with local healthcare facilities to determine whether these requirements are fit.

### *A. Overview of COVAC*

COVAC was developed based on the vaccination systems now in use in a Saudi hospital adjacent to the COVID testing centers. The new system was developed to implement significant process modifications necessary to comply with COVID regulations. When a family needs to vaccinate their child under the traditional vaccination system (i.e., child vaccination system), they simply visit the hospital to add the vaccine and relevant information to the child's immunization card record. Adults received the COVID vaccination using the same way, as they are needed to visit a hospital to get vaccinated. Additionally, COVAC was created to include a screening test methodology that verifies vaccination history and test results and may be used to screen travelers at airports around Saudi Arabia. The system profited from Sehaty's [27]project, which replicated the appointment reservation process, registered patient information, and sent it to patients' mobile devices without the need to retrieve legal documentation.

### *B. Requirements and System Design*

As a result of the recent outbreak of the COVID pandemic, the researcher discussed the importance of developing a system for monitoring and controlling COVID vaccination and testing. The program is designed to manage and monitor COVID records, such as test results and vaccine doses. This is an attempt to create an application that will ensure that all intended objectives are met in a secure, formal, validated, and applicable manner. The blockchain-based system being created is planned to be used in a variety of settings, including hospitals, ministries, schools, and airports.

*1) User Requirements*

The user requirements, which define each participants' role, are described in the scenarios listed in the table (4.1)

**Table 1.** User Requirements

| Requirement ID | Requirement |
|---|---|
| **R1** | As a health admin, I want to create a new vaccine record for a passenger.<br>• Health admin adds passenger information including his name and his national ID.<br>• The passenger must have active permission. |
| **R2** | As a health admin, I want to register a new participant to the system.<br>• Each participant should be assigned to a specific type (ex. hospital, passenger, doctor, physician, laboratory or checkpoint). Their access privilege depends on their type.<br>• Each participant has a username and password. |
| **R3** | As a health admin or a hospital reception, I want to see the history of the vaccine record and test record.<br>• Health admin can see all history of that records. |
| **R4** | As a health admin, I want to change all participation permission from active to not active and vice versa.<br>• The health admin can change the permissions for all participants. |
| **R5** | As a Passenger, I want to see all details of previous visits.<br>• Passengers can see the history of their records and tests. |
| **R6** | As a hospital receptionist, I want to create a vaccine record and add the Passenger information for the visit.<br>• A new vaccine record is created for the passenger and add his name, ID, username, vaccine details, age, DOP<br>• The hospital can write the date of the next visit. |
| **R7** | As a doctor, I like to alter test results about the passenger status.<br>• The doctor can edit the test result if he enters the wrong data or needs to repeat the test. |
| **R8** | As a doctor, I want to see the passenger's record information.<br>• Passenger's states, weight, height and body temperature are needed for diagnoses. |
| **R9** | As a doctor, I like to write notes about the passenger status.<br>• The doctor can edit the note if he enters the wrong data. |
| **R10** | As a physician, I like to digitally sign in passenger vaccine records.<br>• Passenger's information is the passenger's name, age, status if its mix with affected, weight, height, vaccine name, doctor name and physician name.<br>• The physician must read the doctor's note before he vaccinates the passenger.<br>• The physician can write the remaining vaccine if the passenger did not take all vaccines. |
| **R11** | 1) As a laboratory technician, II want to create a COVID test record and add the Passenger information for each visit and signed it digitally.<br>• A new test record is created for the passenger record. passenger's information is the passenger's name, age, weight, height, test results, doctor name and laboratory name.<br>• The laboratory must take the passenger information before testing it.<br>• The laboratory can write the test result for each passenger. |
| **R12** | As a checkpoint guard, I want to see a passenger's vaccine record for approval and test results.<br>• Checkpoint can see the vaccine details for each user.<br>• Checkpoint can see the COVID test for each user. |

*2) System Requirements*

The system requirements were identified according to the stakeholders' needs as shown in table (4.2).

**Table 2.** System Requirements

| Requirement ID | Requirement |
|---|---|
| **R13** | Individual authentication using the username and password.<br>• The username is unique. |

| | |
|---|---|
| **R14** | Accommodate different types of participants.<br>• Each type has different system permissions and privileges. |
| **R15** | Registering a new doctor, laboratory, hospital or physician should be linked with the hospital they worked in.<br>• Permission access for the hospital includes the doctor, the laboratory and the physician. |
| **R16** | Hospitals, admin and checkpoints can find a specific record by searching by passenger's username.<br>• Search results should show only the records which have permission access from the health admin. |
| **R17** | Health admin can change access permission (for each participant)<br>• Chang permission should be for health admin only.<br>• All participants with no active permission should not appear in the select menu. |
| **R18** | The doctor can edit or delete his note and a physician and laboratory reports can edit without creating a security loophole.<br>• Each modification is stored in a new block.<br>• All modifications are stored in blockchain history. |
| **R19** | The hospital should have multiple tests for the passenger without altered.<br>• The test is mutable we should create a new test for each visit |

*3) System Architecture*

As shown in figure (4.1), the system includes three main layers that are the user interface (UI) layer, the cloud middleware layer and the blockchain layer.

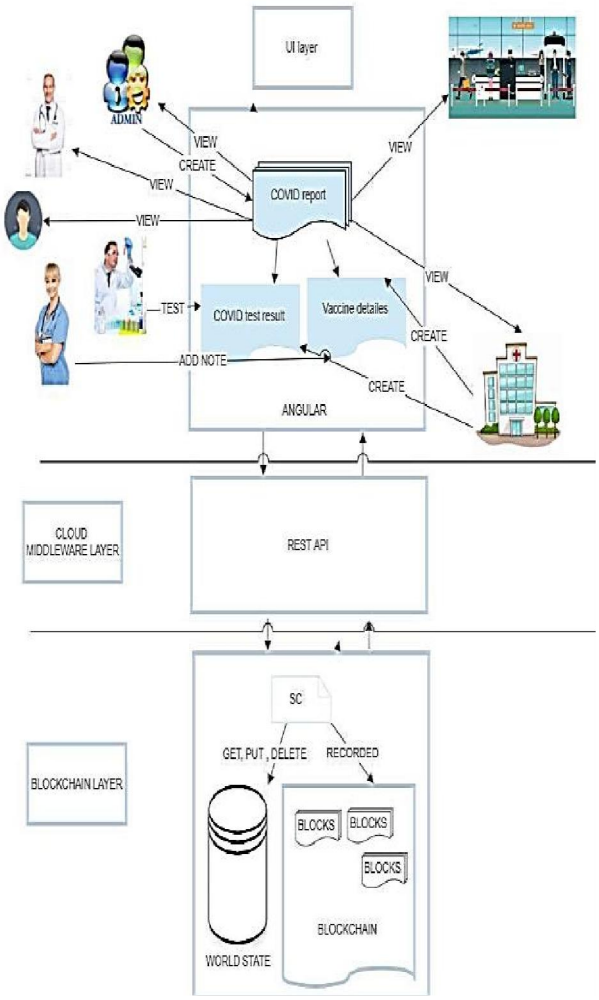


**Fig 4.1.** System Architecture

**The First Layer:** Participants can communicate with the system by reading information or sending new transactions using Angular. The health administrator has the ability to create a new COVID record. The hospital or airport checkpoint will view the immunization record history after obtaining permission from the

health administration. Additionally, the hospital will generate a fresh immunization report for each visit, which will include the doctor's notes on the patient's current status. Additionally, the hospital may prepare a new COVID evaluation for each visit, which incorporates the laboratory results and current statuses. Each immunization is assigned a unique vaccine record.

**The Second Layer:** In comparison to a centralized setup where one dedicated server hosts the middleware architecture, the Cloud Middleware Layer, the intermediate between layers 1 and 2, ensures that there is no single point of failure. To get the data, the REST API connects to Angular and then stores it to the Blockchain by contacting layer three. Dedicated smart contracts employ a suitable API to interface with these smart contracts.

**The Third Layer:** The Blockchain Network Layer consists of a state database, a peer-to-peer network, and a block management service. The Blockchain databases are append-only, which means that once data is entered, it cannot be withdrawn or updated. Data is encoded during transactions. This might be new code for a smart contract or a call to a smart contract functionality. Blocks include a collection of transactions. Each block contains a hash of the previous block, which enables the complete data set to be checked and validated. Each new block is regarded as an update to the state of the network. Transactions may necessitate additional computation processes that affect or create a new intelligent contract.

### *C. Design Approach*

When a passenger requests a COVID report, the health administrator generates one. The system associates the record with the passenger's username and ID and authorizes the hospital to see or modify the vaccine record during each vaccination appointment. When the hospital creates a fresh COVID report using the passenger's information, it indicates the passenger's status and whether or not the passenger has recently been into contact with infected individuals. The hospital then assigns the COVID test to certain doctors and laboratories. When the hospital produces a new vaccine record, the specifics of the visit are recorded, including the vaccine's name, the physician's name, and the physician who will supervise the operation. By associating the doctor's name with the vaccination's information, the respective doctor gains access to the vaccine records. The passenger next visits a physician to obtain the required vaccine and signs the vaccine form to confirm the appointment. For the next visit, this process repeats as shown in Figure (4.2).

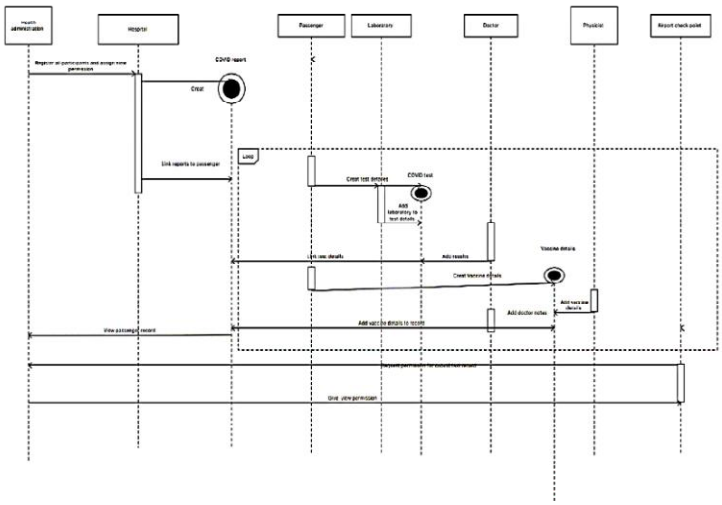

**Fig 4.2.** COVID Reporting Process

### *D. Data Structure*

A blockchain transaction is similar to a transaction in a conventional database, consisting of a series of independent activities. The Blockchain data structure is a back-linked list of blocks produced using hash pointers. A block contains a list of transactions, and a hash identifies and secures each block from the preceding block. The first block is referred to as the "genesis block," and all subsequent blocks reference the genesis block. A blockchain is based on a decentralized distributed node network, which means that each node in the network stores a copy of the blockchain. The traditional database is recursive, whereas the blockchain is not; it is merely appended.

*1)* Core Tools and Platforms

There are numerous blockchain platforms and frameworks available for developing applications in a blockchain environment. Some are simple, while others have additional features to fulfill the programmer's design objective. There was a strong platform that produced excellent outcomes in terms of application development; Hyperledger with its various release networks and Ethereum. The Hyperledger platform was selected for a number of reasons: Hyperledger is a private blockchain platform, in contrast to Ethereum, which is a public blockchain platform. Hyperledger, on the other hand, is a permissioned platform, whereas Ethereum is not.

Finally, Hyperledger is an open-source platform developed by IBM and backed by Linux. Additionally, the Hyperledger Fabric release was chosen for its rapid release, ease of support and maintenance, and ease of use. Additionally, Hyperledger Fabric releases make it simple to determine participants' identities and roles, which is advantageous and consistent with the healthcare industry's standards.Node.js: Node.js is a platform that developers could adopt to enable them to use the JavaScript language to create a command to be used for server-side scripting responsible for running server-side scripts to generate dynamic website content before sending the bag to the web browser of the user. [28]Angular was also used to allow app construction on the web, tablet, or desktop. By using templates instead of writing scripts, a framework helps create a high-performance web application. With the most recent JavaScript, angular code has been written.

*2)* User Interface (UI)

The interface has three primary pages; the first one for registration, and the second one for login. The last one is the default home page with seven tabs. Each tab supports a certain system function and opens differently based on the user type and their rights. The First tab is for modifying the permission of each participant - to make someone active or passive. The second supports registering any worker into the COVAC system. The third one is for registering the general viewers of the system. The fourth shows the immunization test records. The next one is for vaccine details, followed by the testing results insertion tab.The last one is for showcasing the history of a specific participant.The Get history page (Figure 4.3) is the main query option in COVAC. To see each passenger's records, there is a need to enter the username as a search key value. It shows all the vaccine data and COVID test information related to that particular passenger. The page can be accessed by admins, hospital authorities, airport checkpoint guards, and the passengers themselves.

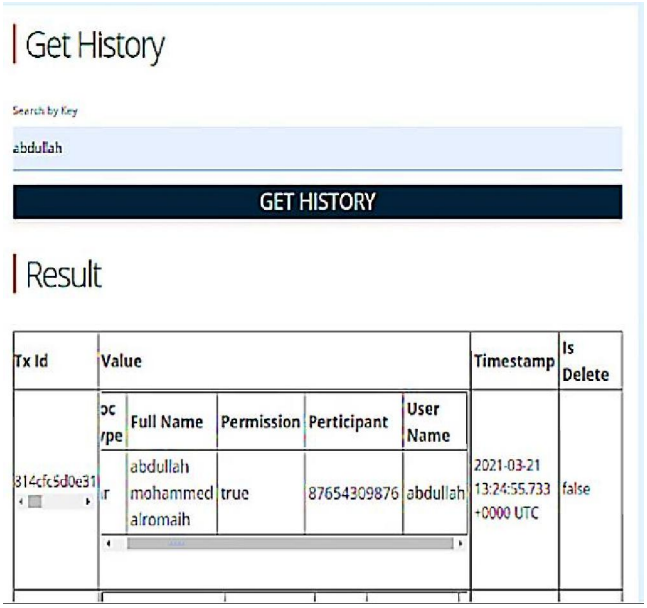


**Fig 4.3.** Get history method

## V. TESTING AND RESULTS

To ensure the quality of the vaccination record system, few validation and verification processes were performed as shown in the following subsections.

### *E. Performance Testing*

Performance testing is considered a confidence test since it illustrates how the system will perform. A performance test is a test performed to examine how a system performs under a certain workload regarding responsiveness and stability. Load testing is a simple sort of performance testing used to understand the system's behavior at a given expected load. For this objective, DevTools [29] and Chrome tools were used to measure the time needed to upload frames and the reaction time of the COVAC system.

To test render response time, all register functions' runtime performance was recorded. This test shows frames per second (FPS), CPU chart, and time rendering. The performance chart in figure (5.1) shows that the FPS of the Register function is higher (i.e., the green bar is higher), and the CPU was not maxed out during the recording (i.e., the CPU chart is not full of color). Furthermore, the network Tab in figure (5.2) illustrates an empirical test to measure the server response time for system functions such as login and registration functions. For this, response time for functions was measured. The average response time was 0.711 seconds, a perfect response time as long as it does not exceed 5-10 seconds [30]. Moreover, it was found that those numbers are the same as performance in approximately all functions in the whole system as shown in figure (5.3).

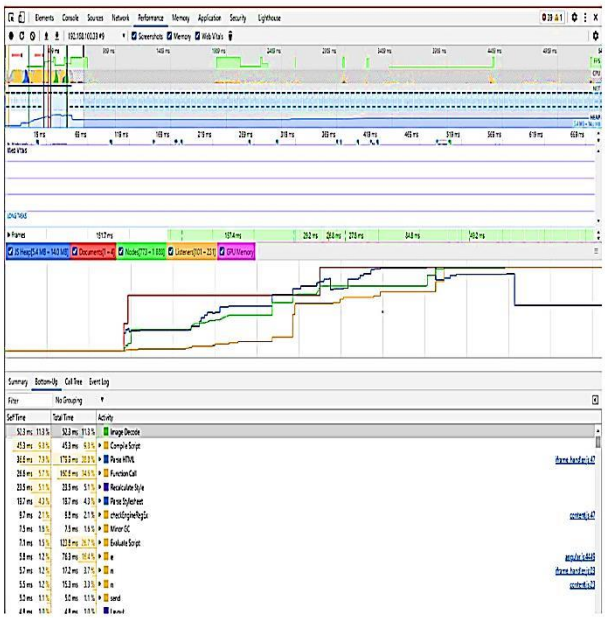

**Fig 5.1.** Testing results of the registration process

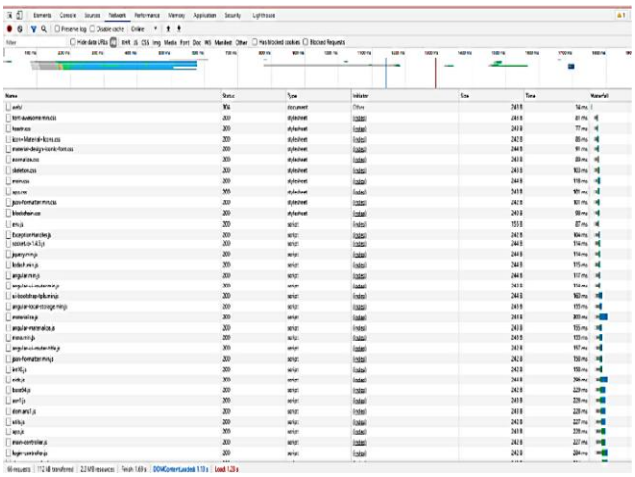

**Fig 5.2.** Response time testing

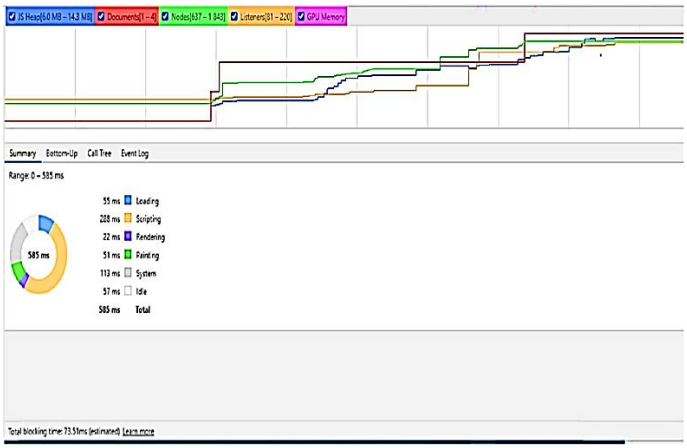


**Fig 5.3.** Performance test for permission function

## VI. SECURITY AND PRIVACY FEATURES

COVAC is currently a prototype that relies on the built-in privacy and security features of Hyperledger fabric, node.js, and angular. Critical to Hyperledger security is the accurate and conscientious use of PKI and certificates. By default, all transactions in the fabric system are encrypted. A secure MVP and production system would use either Apache Kafka, which is configured as a fault-tolerant system, or Raft, the production-grade fault-tolerant ordering service.

Additionally, it utilizes the integrated crypto-certificate for encryption, key management, and workload isolation, among other functions, via IBM secure service containers. To preserve Hyperledger's privacy, the fabric developers implemented several privacy-enhancing codes, like as Segment sensitive data via channels; Off-chain storage of sensitive data is critical for use cases covered by HIPPA and GDPR. Checksum audits can detect and trigger corruption alarms when external off-chain data is corrupted or updated. Prevent the transmission of sensitive data by utilizing Zero-Knowledge proofs. Additionally, the system utilizes VPN access with SSH credentials to provide Ansible-playbook access to configuration tooling [22].

## VII. CONCLUSION

Blockchain technology has been implemented in several areas to enhance the application's quality and functionality. It guarantees the system's execution in a more trustworthy and secure way. Immutability is one of the blockchain's key features that ensure transaction transparency. Besides, it is a decentralized mechanism that helps manage and safeguard compassionate private data. COVAC is a blockchain application that ensures the confidentiality and protection of data using the permissionless property of Hyperledger blockchain.

Furthermore, the application protects vaccine details from threats more safely by providing decentralized blockchain ledgers. Hyperledger Convector is, however, modern architecture and is rapidly evolving; so many flaws make it difficult to implement complex applications. The current system is planned to be enhanced through implementations that are more functional and deploy this experience in heath passport experience. For the future researcher, the researchers recommend examining the practical application of the Covid-19 related software programs – to know their results and extent of success. Besides, it is essential to develop tools that employ other techniques in dealing with the health sector's data efficiently. Finally, additional studies should focus on enhancing digital tools or modern technology in the health sector to enable its development and ensure good performance in this sector.

## VIII. ACKNOWLEDGEMENTS

Many thanks to all people how help us in that application . This application was developed and accomplish in ideal environment which we a provide to reach our idea so, the testing results was not simulate a real environment but it gives us good expectation when we implement it.

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