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# HYBRID USABILITY APPROACH OF BLOCKCHAIN IN HEALTHCARE SYSTEM

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**Abstract**

The blockchain is a safe mechanism for storing and distributing data due to its transparency. Every block of the chain serves as both an individual component that has its data as well as a dependent connection inside the shared network, so this duality provides networks organized by users who keep and share data instead of the third party. Blockchain has several uses in healthcare, including the improvement of applications for mobile health monitoring devices, the distribution and storage of electrical-medical-records, clinical research data, as well as the storage of insurance information. Blockchain analysis throughout insurance is currently limited, but the blockchain is at the frontlines of trying to transform the medical system; throughout its distributed concepts, blockchain could even keep improving patient records availability and privacy. This article presents a solution for managing identity and access in a digital system that makes use of blockchain technology to help with entity authentication and permission. Using the Permissioned Blockchain architecture, a prototype illustrates the use of blockchain in access and identity management. It gives a proof-of-concept centered on some use cases involving Electronic-Health-Records from the health sector in which an immutable and traceability record for information related to patients is desired. Blockchain has the implicit to meet specific unique criteria, similar to confidentiality and invariability, and so might be employed in a wide range of operations.

**Keywords:** Patients, Healthcare Center, Distributed Database, Health Tracker Prototype

## 1. INTRODUCTION

Blockchain invention was planned by Nakamoto, the essential study was to have cryptographically gotten and decentralized currencies that would be useful for fiscal deals. At last, this study of blockchain was being employed in different fields of life; the

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medical care area likewise is one of their plans to use it. Colorful specialists have anatomized this area, these considerations works center around the way that exercising blockchain for medical care areas is presumptive or not. They also distinguish the benefits, troubles, issues, or difficulties related to the application of this invention. Many judges likewise examined the difficulties that would be looked at while executing this for a bigger compass [1]. Blockchain has been an intriguing exploration area for an unexpectedly long time, and the benefits it provides have been used by a variety of associations. Likewise, the clinical benefits sector stands to gain significantly from blockchain advancement due to nearly safe, security, protection, and decentralization [2]. Healthcare systems are getting decreasingly digitized to grease data operation and access. Still, sequestration is essential. Enterprises have also been expressed regarding patient data. Blockchain technology is a fairly new technology that's being used to develop new results in a variety of diligence, including healthcare. In a healthcare system grounded on blockchain Patient information records are stored and sent through a technological channel. From colorful healthcare installations, testing labs, specifics, and croakers, among other effects. Likewise, blockchain is critical for detecting fraud in clinical trials [3]. Developing a good data storehouse armature with the loftiest security measures available can help palliate enterprises about data manipulation in clinical operations. In healthcare, colorful information and communication technologies are used, raising security, sequestration, and interoperability enterprises. Between 2008 and 2021, over 500 million case records were stolen and blurted [4]. The culprits stole not only bank information, but also stole health and inheritable test results. Healthcare Information Planning is the most effective system for collecting digitized health information. This information can range from electronic case records used in the development of routine checks to scrutinized handwritten sanitarium records stored in a digital library. Over 176 million case records were exposed in data breaches between 2009 and 2017 [5]. Health Data Monitoring is trusted for further than just managing health information [6]. It’s also trusted for combining and combining it and allowing its evaluation to ameliorate patient safety and gain perceptivity that can ameliorate healthcare issues while maintaining information confidentiality [7]. Further options for standard medical data operation, similar as allowing cases to gain and bandy their health information, as well as the development of digitized health-related data collection, pall healthcare information storehouse, and patient information sequestration protection programs Develop [8]. Permitting technology-grounded effectiveness and production enterprises to drive health planning, on the other hand, is giving in to the technical imperative because e-health is fraught with a slew of potentially disastrous issues [9].

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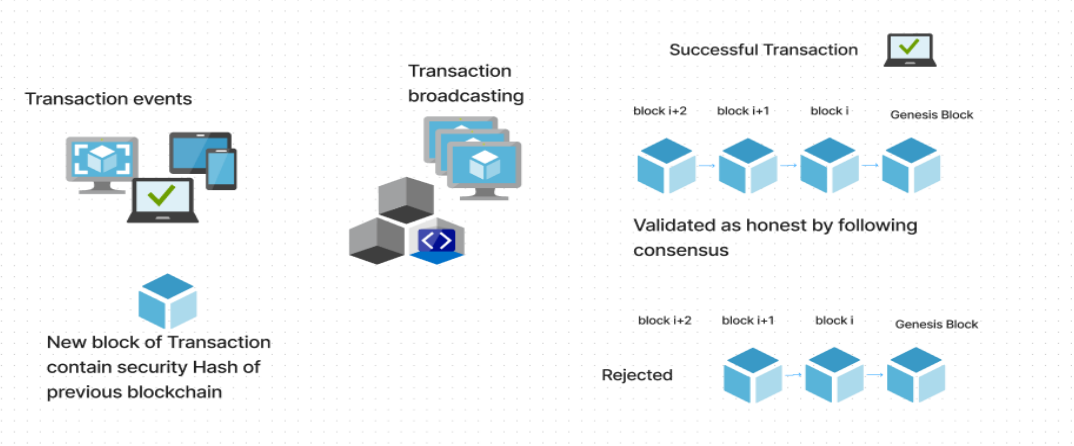


**Fig 1: Transaction Process**

2021 — Dubai has all administration activities and record-keeping procedures on the blockchain as a feature of the Smart Dubai 2021 drive [10]. By utilizing public-key cryptography and other cryptographic techniques, the cryptocurrency Bitcoin enables its users to maintain a high level of anonymity hashing. Although typical, anonymity [11]. Blockchain development is viewed as an applicable record development for participated( P2P) networks advanced data trades that can be directly or subtly passed on to all guests, allowing any type of data to be handled explosively and incontrovertibly. Clinical benefits are one of the most egregious operations of blockchain advancement. The supposed hash, which is made using a cryptographic one-way hash work, is used to link all of the blocks in the blockchain (e.g., SHA256). It also ensures the block's obscurity, invariability, and traditionalism [12]. A customer who wishes to attract to the blockchain communicates with the blockchain network via a knot. Because all miners must work a fully precious knot, the lately appertained to excavators are a subset of bumps. As a result, while every miner is a knot, not every knot is also a miner. This situation is known from a specific public blockchain type that employs the PoW (evidence-of-work) agreement (inclining further toward this latterly in this member). Different types of square chain associations that use other agreement types, similar to PoS, don't bear mining (evidence of stake) [13]. Blockchain in medical services can overcome the obstacles related to data security, protection, sharing, and storage. One of the requirements for medical care assiduity is interoperability. Two people or machines can exchange information or data definitively, effectively, and reliably. The thing of interoperability in medical services is to grease the exchange of health-related data, for illustration, electronic health records (EHR), among medical care suppliers and cases so that the information can be participated throughout the terrain and circulated by colorful clinic fabrics [14].

The thing of interoperability in medical care is to unite on the exchange of health-related data, similar to electronic health records (EHR), among medical care suppliers and cases so that information can be participated throughout the terrain and distributed by colorful sanitarium fabrics [15]. EHR fabrics have been enforced in colorful exigency conventions around the world due to the benefits they give, specifically an increase in

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security and cost acceptability. They're regarded as an essential element of the medical services sector because they give a lot of benefits to medical services [16]. This paper proposes a system that creates a decentralized stage for storing patient clinical records and furnishing access to those records to providers or concerned individuals, i.e., cases. When planned, development and structures aren't made to be as important and adaptable as to take care of the prerequisites of different spaces, as is the situation with Blockchain invention [17]. This allows it to work on the exhibition, security, and translucency of clinical information sharing in the medical services frame. This invention will help clinical associations gain understanding and ameliorate clinical record disquisition [18]. Blockchain is a decentralized and public computerized record that records exchanges on multitudinous PCs so that no record included can be modified retroactively without changing any blocks a short time latterly.

Blockchain is verified and connected to the former block,' shaping a long chain. Blockchain has many pivotal rates like information being circulated among all capitals over 1the ade-unified network, information in blocks being infeasible to abolish or modify and everything being transparent [19]. Blockchain assists advertisers with keeping a figure of the particulars employed in drugs. Medicinals and health will dispose of fake conventions exercising Blockchain advances, empowering the following this multitude of meds. It finds the reason for misrepresentation. Blockchain can insure the sequestration of case records; when clinical history is created, Blockchain can likewise store it, and this record cannot be altered. This decentralized association is employed with all product outfits in the medical clinic [20]. Blockchain invention facilitates patient-driven progress toward interoperability by allowing cases to partake clinical material plus access procedures.

This provides lesser control over the private data of patients while also perfecting brackets and security. The estimation and prosecution of value by directors, as well as perpetration, are delicate. Blockchain operations could break any of these technical issues throughout the business [21]. Blockchain titles will help executive experts in distinguishing between authorized and impure specifics. This ensures that all authorized parties trade motorized exchanges containing the case's particulars. Cases that change clinical professionals may only modernize a single agreement to trade their entire records. With an adding rate of acceptance, blockchain has arrived in the medical services assiduity. Likewise, in the early stages, individualities in the health natural system fete the advances well [22]. Blockchain enables secure and secure data sharing and operation mechanisms in which all parties are apprehensive of deals [23].

Utmost insurance companies presently calculate on centralized systems and technologies to store and reuse data [24]. Throughout the life of a health insurance policy, several third parties or mediators are generally involved. Likewise, knowledge is power in insurance assiduity. It's distributed among colorful stakeholders, making it a time-consuming and laborious process. Moment’s medical insurance systems are riddled with inefficiencies [25]. Blockchain technology has the implicit to break the problem of interoperability. Smart contracts can automatically collect agreement records, deals, and other information, potentially leading to better executive processes

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[26]. Smart contracts can also help descry false or inflated insurance claims. Another benefit of blockchain technology is that it allows croakers to see their cases' health insurance content. Blockchain can help to simplify the health insurance process and ameliorate provider directory delicacy through agreement protocols. As a result, blockchain is an extremely precious offer for health [27].

In today's environment, everyone is more concerned with improving their health. Numerous new ailments have emerged as the number of ails in hospitals has risen. Cases are fascinated by the promise of receiving treatment at colorful hospitals and, as a result, leave their medical records spread throughout colorful hospitals for the rest of their life. They're having difficulty acquiring access to previous health records. As a result, cases interact with health records in a disjointed manner, resulting in poor health record functioning. [28]. the blockchain is composed of a series of blocks, each representing a set of deals. A blockchain is a type of data structure comprised of inflexible blocks. Each block contains the block number, the digital hand, the antedating hash, and the block hash or communication abridgments. Block 0 is the original block on the blockchain. It's known as the birth block. The former hash of the birth block must be zero [29]. The blockchain's birth block and block composition modifying the contents of any block (n) would have the same impact on the blockchain network for pointless data as block (n) hash and antedating hash. Blockchains are divided into two type’s private and public [30]. Smart contracts are extensions to blockchain technologies like Ethereum and Hyper ledger Blockchain that give instructions for explicitly covering transfers of digital information between healthcare providers under specified conditions or contracts made between the parties [31].

Blockchain is a new and arising technology with new operations in healthcare perpetration. Across all major platforms, data sharing and delivery are flawless and effective. Members of the network and healthcare providers contribute to the development. Numerous conditions bear both low-cost and sophisticated treatments. This will quicken the growth of healthcare in the coming times [32]. The operations of blockchain technology in the logistics assiduity have lately been revealed, and they demonstrate the benefits of the healthcare sector. Blockchain technology is being used to integrate a workflow process for the healthcare culture and fiscal sphere. It offers several significant and emotional openings for healthcare assiduity, ranging from wisdom and logistics to interpersonal connections [33]. Blockchain's significant operations in healthcare are bandied by cases and interpreters. Piecemeal from conventional healthcare administration systems, blockchain's part is to record all feathers of deals in a decentralized record. It's precise and straightforward, saving time, trouble, and plutocrat and, as a result, lowering directorial trouble. The most important problem affecting the healthcare business is the leakage of pivotal data and its posterior use for dangerous bias and other special interests, which executions of this technology may fleetly fix [34].

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## 2. LITERATURE REVIEW

Our system offers colorful benefits to the healthcare business. Because of the perpetration of blockchain, cases, healthcare interpreters, experimenters, and others will be suitable to gain correct information in a timely way. There are now centralized Electronic Medical Records systems, or data is saved in paper lines at croakers ' services. This information can take numerous days, if not a week, to gain. A blockchain system offers colorful advantages to healthcare providers, individuals, experimenters, and anyone involved in the business [35]. Access to expansive medical data is needed for healthcare experimenters to gain a better knowledge of ails, speed up drug discovery, and make treatment strategies grounded on [36] information about cases from colorful ethnical origins and geographical locales. It can gather health information on a case throughout their life. Blockchain technology might allow for real-time data access, perfecting clinical care collaboration and mainly perfecting clinical treatment in an exigency circumstance [37]. This technology will help to exclude healthcare breaches and ameliorate care collaboration, performing better overall health issues [38]. Blockchain is distributed and decentralized technology and has large operations in the medical services sphere. Substantially blockchain introduces to the finance and banking sectors [39]. The blockchain gives a responsible and secure system of information sharing and the director’s factors where all gatherings are aware of exchanges [40]. To gain superior clinical treatment outside of the nation, the specific case's clinical history must be understood, for illustration, whether the case has any type of perceptivity to certain conventions or information about his/ her new drug. The clinical history can therefore be attained safely by the service provider. Blockchain technology is being employed to record and maintain patient healthcare histories. For illustration, cases may visit disconnected exigency conventions, and as a result, the overall chain of clinical history is doubtful to be accessible or followed up with (due to irregularity and attainability of records). To address similar enterprises, blockchain might be useful in maintaining a patient history record for each visit to any clinic. Likewise, because of the attainability of many disentangled pieces of information associated with clinical/ lab results, cases must repeat a similar clinical test. It'll not only increase the cost of repeating a similar exploration center test, but it may be dangerous to repeat some tests with strong radiations. Blockchain technology has several operations in healthcare. Several extant trials and publications are demonstrating blockchain-enabled healthcare operations, and each section will explore many particular software results.

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## Summary of characteristics of included studies

Table 1 shows the extension techniques along with their advantages and disadvantages.

**Table 1: Existing techniques**

| Ref | Application of Blockchain | Type of Blockchain used | Advantages | Limitations |
|---|---|---|---|---|
| [26] | Patient Monitoring/ Electronic Health Record (ERH) | Private-Blockchain | The data and use of patient data are much relevant | The most important factor is time, yet there is some lag while confirming every block throughout the Blockchain. The key problem is also to keep each node secure. |
| [48] | Managing medical records and other data | Public | It guarantees the patient that no unlawful conduct will be carried out. It is concerned with record transparency and data security. | Transaction speed is a critical factor in healthcare devices. This platform doesn't always value transaction time. |
| [49] | Managing medical records and other data | A Blockchain variant is employed in personal health care, and also an outside Blockchain used for keeping records. | A better society via accurate and effective health-care-system | Only proposed work. Implementation is not performed |
| [50] | Patient Monitoring/ Electronic Health Record (ERH) | There is no Blockchain that I prefer. | Attempt to remove hurdles and provide more secure system. | Only proposed work. Implementation is not performed |
| [51] | Managing medical records and other data | Consultation on Blockchain | Security-related paper works | It can’t address all issues of IoT security. It is unable to evaluate IoT threats. |
| [52] | Patient Monitoring/ Electronic Health Record (ERH) | Public- Blockchain | Healthcare gadgets that monitor patients' health status and exchange that data to approved doctors and hospitals over a secured Public blockchain. | Poor communications between the servers and the device |

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## 3. METHODOLOGY

### Problem

Patients frequently visit different laboratories for medical examinations so it's veritably delicate to maintain the records because each laboratory has its online gate and not easy for the cases to keep all records for a long time. For illustration, medical examinations are performed by Chugtai Lab, Agha khan, Shaukat Khanum, etc. There isn't any platform that connects Hospitals and Croakers around the globe on a single channel. So the need is to give a platform in which patient history was stored safely and securely.

### Solution

Health Tracker is a Platform that allows cases and their attendants to keep all their medical history organized. The health shamus connects the sanitarium, the Croakers, and the Cases on a single channel. Then we use a decentralized database like blockchain because a secure decentralized and inflexible database gives us different functionalities like single record trustable, individual control of data. Medical staff credential verification, briskly agreement. The usability approach is enforced in a decentralized database rather than a traditional bone. We will continue our strategy of laboriously interacting with healthcare, and also we will construct a prototype to store all patient records exercising a decentralized database. A case can see his record in a mobile app and it's veritably easy for croakers to take a patient history. Blockchain is distributed database it works encyclopedically so patient records will save and secure in any sanitarium.

### Prototype Development

The world is in the midst of a health-tracking revolution, with inventions appearing at a pace no way seen ahead, from smart watches to phones, earbuds, and smart rings, among others. So if you've decided to get into keeping track of your health, a health shamus comes in handy. With numerous health trackers available, it's essential to understand what they are, what benefits they offer, and what to consider when buying one. Our thing is to give you the key to the new quantified you.

### Sample size

A sample is a precise group from whom you'll collect data. The data was gathered from colorful hospitals. We take the patient history of 60 people manly and womanish age groups 20 to 55 and also we produce Questionnaires that were handed to 75 replies, with the completed responses being registered and the deficient recordings being discarded. A check of repliers was taken, and the responses collected came from cases, croakers treating them, and IT specialists.

### Target Audience

It is not specific to any special group of people. A participant can be routine patients aged from 20 years to 50 years.

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### Sample group and task

We take three categories of different groups

**G1 20** - 30 General patients

**G2 35** - 60 diabetes patient**s**

**G3 35** - 60 Cardio patients

G1's first group is general cases they're active survivors with low threat and their complaint is caused because of rainfall changes and a hygienic diet. G2 is a diabetic case and this type of complaint caused due to genetics, taking too important consumption of sugar in the diet, due to age factor. G3 is cardio cases these types of conditions be because of hypertension.

Of sugar in the diet, due to age factors. G3 is cardio cases these types of conditions be because of hypertension.

### Information to be collected at the time of registration

The following information must be collected from the patient through the registration form like blood group, bate of birth, gender, type of disease, address and email address. The screenshots are shown in Figure 2, 3, and 4.

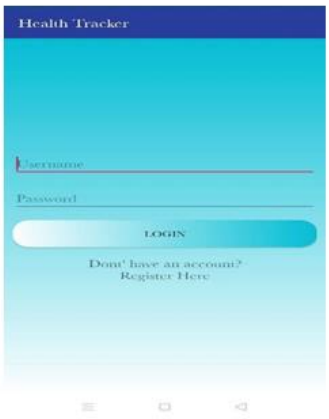




**Fig 2: Patient Registration** **Fig 3: Patient Login** **Fig 4: Patient Details**

**Patient Info:** Health records, case notes, issues, details, vital signs, previous medical history, vaccines, laboratory test results, and radiological reports are all part of this information.

**Medical history:** A file containing details on a patient's identity. Information concerning disinclinations, ailments, operations, vaccinations, and the outcomes of physical exams and tests may be included in a specific medical history.

**Health Index:** A Health Index is a model tool that assesses a wide variety of risks to health and risk factors across time and various geographic regions.

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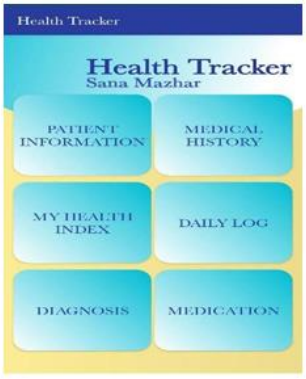
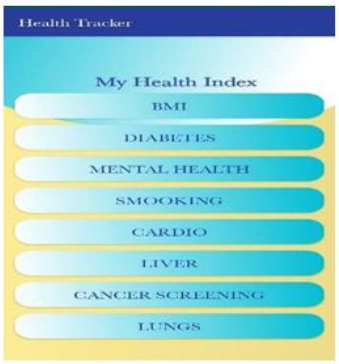
**Daily Log:** The daily log is a record of key events, incidents, and advancements achieved on a project site in a construction operation.

**Diagnosis:** Determining a problem, ailment, or damage based on its signs and indicators. To aid with the diagnosis, a patient's medical record, physical examination, and testing including blood tests, diagnostic examinations, and tissue samples may be employed. Figure 5, 6 and 7 are shown health tracker, my health index, and daily log.



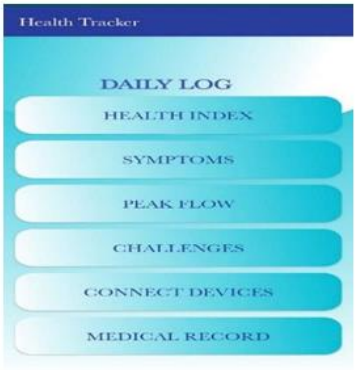




**Fig 5: Health Tracker** **Fig 6: My Health Index** **Fig 7: Daily Log**

### 4.2.2 Daily Log

The daily log is a record of key events, incidents, and advancements achieved on a project site in a building project.

**Health Index:** A Health Index is a product instrument that evaluates a wide range of health concerns and environmental triggers across time and for various regions.

**Peak Flow:** Peak expiratory inflow (PEF) is used to assess peak expiratory inflow or PEF. While scores in older women can be reduced and remain acceptable, the usual range for adult peak inflow is between 400 and 700 liters per nanosecond. What matters mainly is if your score is typical for you.

**Challenges:** A difficulty is something brand-new and delicate that demands a lot of effort and perseverance.

**Medication:** Any medication or substance used to cure or avoid disease is referred to as a drug. Anti-anxiety drugs are highly specialized kinds of anxiety medication. To manage recurring pain, there are many various geographical options accessible. Any drug or treatment used to treat or prevent disease is referred to as a drug. Figure 8 and 9 are shown medication and diagnose patient problem & report.

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**Fig 8: Medication** **Fig 9: Diagnose patient problem & Report**

**Table 2: System entities of the proposed system No System entities**

| | |
|---|---|
| 1 | Patient |
| 2 | Doctor/clinical authority |
| 3 | Administration/ Supplier |
| 4 | Blockchain data storage/ source |

Any P2P blockchain system healthcare service provider can interact with the registered case for follow-up exams after completing the registration process in the proposed EHR robotization platform. In the current proposal, the user is in charge of sending specific health data to the system as the info transmitter. The data sender is crucial to data security [41].

### Deployments of blockchain smart contract

The whole participant information is saved using this interface on the medical record homepage and the doctor register homepage, respectively, which have been constructed. The system enables the registered user to join the system when the login and registration steps are complete by identifying with both the patients and producing n samples for environmental assessment. As stated, a portal for updated patient health records has been built. Updates or adjustments to a patient's medical record are made utilizing an append interface, which gives participants a recommendation link for adding new health information. All health information and treatment histories are shown in a patient EHR management dashboard

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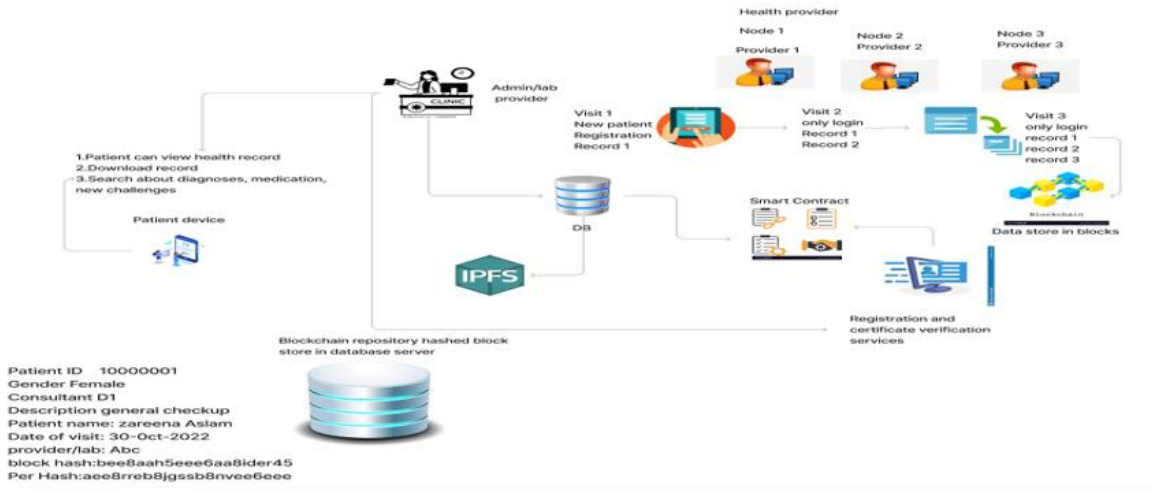


**Fig 10: Peer to peer network of blockchain**

## Deployments of blockchain smart contract

The whole participant information is saved using this interface on the medical record homepage and the doctor register homepage, respectively, which have been constructed. The system enables the registered user to join the system when the login and registration steps are complete by identifying with both the patients and producing n samples for environment assessment [42]. As stated, a portal for updated patient health records has been built. Updates or adjustments to a patient's medical record are made utilizing an append interface, which gives participants a recommendation link for adding new health information. All health information and treatment histories are shown in a patient EHR management dashboard. A method for ensuring the accuracy of recorded medical files in the suggested system is the viewing contract. Patients will have the ability to access their health information for home care and preventive treatment once physicians, patients, and providers of health care services have joined the blockchain P2P network and all smart contracts have already been properly executed [43]. To review all of their prior medical records, cases must have viewing authority. The power to adapt threshold scenarios that will be monitored and adjust specifics will be available to doctors with special director access to their cases' accounts. For cases to obtain watching access from the blockchain protocol, a viewing authorization contract is incongruously constructed for this reason.

Login At first, the login process was set up as described. This login mechanism was used by all users of the system [44].

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As stated, a portal for updated patient health records has been built. Updates or adjustments to a patient's medical record are made utilizing an append interface, which gives participants a recommendation link for adding new health information [45].

## 4. USABILITY EVALUATION

We have three parameters for the measurement of performance of the usability as Effectiveness, efficiency, and Satisfaction [28]. Although, ASQ uses to evaluate for the post-assignment assessment to quantify the client's fulfillment Blunders might be accidental activities, slips, missteps, or exclusions that a client makes while performing a task [29]. Effectiveness is how much something is effective in delivering an ideal outcome achievement and it is measured as:

### Efficiency

Currently, the mobile device offers a variety of Applications along with many adaptive features highlights. The adaptiveness gives huge convenience to defeat the existing issues and extent that effectiveness, data over-burdening. In this research, we conduct a survey patients of from different hospitals using this health tracker application and give answers to our questions. It indicates particular questions designed to help in understanding our goals from their perspective. In this survey, the total number of participants is 75 of which 54 participants are male and 45 are females.

The next question is would this application will be useful for patients? 89% agreed in which 52% strongly agreed and 36% agreed and 2% are neutral. Our next question is Do you think such an application would be helped to store patients' data? And we see that 93.3% of people think that this application helps store data. Our next question is Would this application help you for knowing your current condition we see 97.3% of results are positive means 97.3% of people think that this application helps them know their current condition. Our next survey question is would this application evaluate your overall health? And we see overall 94% of people give positive responses. Our next survey question is about the usability of the application is this application easy to use? Our next survey question is how much you would be satisfied with this application? And we see 98% of People give a positive response they are satisfied with this application. Our next survey question is Do you think that the contents of this app help you to remind routine checkups? And we see the results that 96% of people give positive responses. Our next survey question is this application would help you with new challenges? 81.3% are satisfied 14% think maybe and only 2% are not agreed. Our next question is whether this application would help you with new challenges. With the help of this application, we give awareness to people from new challenges. Like covid-19 is a good example our last question is whether this application would answer my needs. And after the use of this application, 92% of people think that this app would answer my requirements.

This survey gives us real-time suggestions based on our health data and connects you to health professionals when needed [46-54].

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| Questionnaire | Satisfied | unsatisfied | Natural |
|---|---|---|---|
| Total number of participants 75 | | | |
| Would this application will be useful for patients? | 91% | 7% | 2% |
| Do you think such an application would helped for store patient data? | 93.3% | 6.7% | 0% |
| Would this application help you for knowing your current condition? | 97.3% | 2.7% | 0% |
| Is this application easy to use? | 92% | 2% | 5.3% |
| Do you think that this application would allow me to have better control over task? | 78.4% | 2.7% | 18.9% |
| How much you would be satisfied from this application? | 98.7% | 1.3% | 0% |
| Do you think that the contents of this app help you to remind routine checkup? | 96% | 2.7% | 1.3% |
| This application would help you for new challenges? | 81.3% | 4% | 14.7% |
| This application would answer my needs? | 92% | 8% | 0% |

## 5. CONCLUSION

Systems that are centralized and vulnerable are being replaced with distributed, decentralized, and secure systems that may help enhance the quality of medical and other related services. The blockchain-based health service has demonstrated its ability to transform traditional health record administration in a secure, efficient, accessible, uniform, and decentralized manner. The complete work in this article illustrates the design, implementation, and efficacy of Healthcare professionals who might benefit from blockchain-based EHR administration. The suggested system, using unalterable logs, allows patients, physicians, careers, and healthcare operators to securely and openly access, study, and exchange health data, as well as the whole life cycle of individual health records... The suggested system aims for openness, security, and privacy.

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