BLOCKCHAIN INTEGRATION IN HEALTHCARE MANAGEMENT

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Abstract---A blockchain-based healthcare management device leveraging SHA-256 encryption a sturdy solution for securely dealing with digital fitness statistics (EHR). This device contains wonderful modules for affected persons and doctor registration, in conjunction with functionalities tailored to each user. Doctors possess their blockchain, providing vital records such as block ID, identified sicknesses, patients referred, uploaded EHRs, and corresponding hashes for integrity verification. They can seamlessly add patient information by generating keys, encrypting information, generating hashes, and uploading facts, ensuring statistics safety. Furthermore, they could update or delete the affected person's information as vital, preserving accuracy and relevance. Patients additionally keep their blockchain, containing comparable data factors along with block ID, diagnosed diseases, referring docs, uploaded EHRs, and hashes. The EHR module within this device helps green control of affected person information, with separate blockchain structures for patients and docs. Patient blockchains document diagnoses, referring doctors, uploaded facts, and hashes, whilst doctor blockchains track referred patients, uploaded EHRs, and hashes.

Keywords: Patient Monitoring, Health, security, EHRs, Block Chain

1. INTRODUCTION

The use of sensor-based data analytics has become a game-changer in the field of contemporary healthcare, changing patient monitoring in linked healthcare applications. This paradigm change allows for the real-time gathering and analysis of a variety of patient data, including vital signs and activity levels, by utilizing sophisticated sensor technology. The smooth incorporation of sensors into medical equipment enables an ongoing flow of data, promoting a thorough awareness of a person's health state. This method not only improves patient monitoring's precision and timeliness, but it also gives medical staff members useful information for proactive, individualized actions.

1.1 PATIENT MONITORING

A vital component of modern healthcare is patient monitoring, which is a dynamic and essential method of following and evaluating a person's health. In a time of rapid technological development, patient monitoring has expanded beyond conventional limits to include a wide range of advanced equipment and sensors that continually gather and evaluate critical health data. This attentive observation covers a wide range of physiological parameters, such as blood pressure, oxygen saturation, heart rate, and more, giving medical staff a thorough and up-to-date picture of a patient's health. Continuous patient monitoring has an impact on remote and home-based healthcare in addition to acute care settings. It provides a proactive way to spot possible problems, optimize treatment plans, and eventually promote a more individualized and flexible approach to healthcare delivery.

1.2 HEALTH

A ubiquitous and priceless feature of human existence, health includes people's total physical, mental, and social well-being in addition to the absence of disease. It is a human necessity and a fundamental right that cuts beyond social, cultural, and economic divides. Over time, our knowledge of health has changed, shifting from a solely biological viewpoint to one that takes a more holistic approach and takes into account the complex interactions between social, mental, and physical aspects. The pursuit of health, whether at the individual or societal level, is a dynamic and always changing subject of study and practice because it incorporates many complicated factors, including access to healthcare, the caliber of healthcare services, preventive measures, and the wider determinants of health.

A vital component of human existence, security is essential to the welfare of people, groups, and society as a whole. It is the guarantee of safety from a plethora of possible dangers and hazards that can interfere with our daily routines. Every aspect of our everyday lives is impacted by security, from the locks on our doors to the encryption on our digital communications. It includes maintaining social order, protecting private information, and ensuring one's physical safety. Security challenges have become more intricate in a more interconnected and dynamic world, requiring a thorough grasp of the constantly changing environment of dangers and the implementation of solutions to mitigate them. This introduction lays the groundwork for a thorough examination of the complex field of security, highlighting the importance of security in our daily lives, the dynamic nature of threats.

1.4 EHRs

EHRs, or electronic health records, have become a major influence in modern healthcare, changing the way that patient data is collected, maintained, and disseminated. They signify a fundamental change from conventional paper-based medical records to digital systems that improve healthcare data accessibility, accuracy, and efficiency. EHRs are intended to be all-inclusive databases that hold a person's test results, treatment plans, medical history, and more, providing medical professionals with a comprehensive picture of a patient's health journey. An overview of the vital role electronic health records (EHRs) play in healthcare is given in this introduction, which also highlights the importance of EHRs in facilitating interoperability across healthcare systems, enhancing clinical decision-making, and expediting patient treatment.

2. RELATED WORK

Tran Le Nguyen et al.[1]. discuss the rise of Bitcoin and cryptocurrencies in payment systems, highlighting the widespread adoption of Blockchain technology in banking, healthcare, and mathematics. Their study focuses on creating a conceptual model for a medical app using blockchain to manage patient and physician databases during surgeries. By addressing the scarcity of blockchain models in healthcare, they aim to provide a valuable resource for medical professionals. They gather data from previous studies and US-based company websites to inform their conceptual model.

Tanesh Kumar et al.[2]. explore blockchain's role in healthcare beyond finance, emphasizing transparency and trustlessness. They discuss smart contracts' importance and blockchain's potential in supply chain management, logistics, and IoT. By offering a secure database, blockchain reduces reliance on third parties, enhancing data security. Through cryptographic measures, it ensures secure data sharing, addressing patient privacy concerns. Their research highlights blockchain's decentralized solutions, improving healthcare quality and empowering patients with data control in the face of advancing internet technology.

blockchain's impact beyond Bitcoin, highlighting its versatility as a decentralized database technology. They emphasize its application in smart contracts and hyper ledger, extending to various purposes beyond finance. The study aims to implement blockchain in electronic health records, ensuring patient privacy while facilitating access to health records. It sheds light on blockchain's diverse applications and the associated challenges.

Noor Adilah Rashid et al.[4]. discuss the adoption of electronic health record systems (EHRS) in emerging nations and propose a web-based EHRS with a feedback mechanism. The prototype includes features like feedback pages, allergy sections, and doctor background information. Developed on the Laravel platform, the project undergoes rigorous testing for functionality. EHRS improves medical data storage and enhances public healthcare surveillance. Transitioning to EHRS resolves issues like inconsistent records and misdiagnoses, with the proposed feedback mechanism aiming to enhance system efficiency and patient outcomes.

Richard NueteyNortey et al.[5]. discuss advancements in EHR and the rise of big data in healthcare, addressing both benefits and privacy concerns. They propose using blockchain for EHRS management to ensure patient privacy and demonstrate its effectiveness in creating secure sharing networks through simulations. With EHRS containing sensitive medical data, blockchain's distributed ledger system offers secure recording without third-party reliance. They advocate for integrating blockchain into cloud computing for enhanced EHRS security, emphasizing the need for simplified implementation processes as blockchain technology evolves.

Vidisha Bhatt et al.[6]. discuss the adoption of EHR systems, acknowledging their benefits but also the challenges of manual data entry. They introduce DocPal, aiming to improve accuracy and efficiency in data entry, enhancing patient care and reducing administrative burdens. Emphasizing efficient patient-provider interaction, they propose integrating voice assistants like Amazon's Alexa. Their implementation involves developing HIPAA-compliant Alexa skills to facilitate verbal instructions for medical professionals, promising enhanced workflow efficiency.

Sai Mounika Tadaka et al.[7]. explore blockchain's transformative potential across industries, focusing on its applications in healthcare. They highlight its role in preventing fraud, managing EHR, and improving efficiency in Industry 4.0. Emphasizing its decentralized nature, they underscore its transparency and security. Originating in 1991, blockchain has evolved to include various types, promising significant advancements despite challenges, notably in anti-fraud systems in healthcare and projects in South Africa's healthcare sector.

Zuobin Ying et al.[8]. present an innovative solution to bolster the security of EHR shared via e-healthcare cloud systems. They introduce the black-box traitor tracking method, employing attribute-based encryption to protect against malicious users. This approach effectively limits access to encrypted EHRs, ensuring privacy and deterring unauthorized breaches. Utilizing recent technological advancements, their system aims to facilitate the secure sharing of medical resources among healthcare

EHR data. The proposed e-healthcare TIPT system utilizes traitor-resistant encryption, enhancing security in the e-healthcare cloud environment, particularly for patient monitoring and diagnosis.

Mohammad I. Zarour et al.[9]. examine how blockchain technology revolutionizes healthcare systems by ensuring secure sharing of sensitive medical data, especially in EHR systems. Their study, involving input from 56 healthcare experts, evaluates different blockchain models using decision models like Fuzzy Analytical Network Process (F-ANP) and TOPSIS. Despite challenges, their findings provide valuable insights into selecting suitable blockchain solutions for secure EHRs, with the decentralized nature of blockchain offering transformative benefits. Various models, including private, public, and hybrid, show promise in enhancing healthcare data security and efficiency.

Suparat Yongjoh et al.[10]. introduce Internet-of-Healthcare Systems, a specialized platform for securely storing patient medical data using blockchain technology. Currently utilized by over 350 hospitals, these systems efficiently manage data from various sources, integrating seamlessly with existing health information systems. Mobile apps provide secure access to patient data stored in the blockchain, ensuring robust security measures. Medical staff feedback highlights satisfaction with the system's user-friendliness, installation, maintenance, and security. This initiative aligns with Thailand 4.0, aiming to digitize public health information systems recognized by organizations like the World Health Organization.

3. PROBLEM IDENTIFICATION

In recent years, the vital for stable change of scientific information has been underscored, because it drastically complements individuals' high-quality of life through optimizing care and treatment. However, reaching interoperability across the expansive healthcare environment is beset by demanding situations, compounded using the ever-looming dangers to the safety of healthcare facts. Amidst this backdrop, Blockchain generation has emerged as a promising answer, albeit with complexities and alternate-offs, especially in reconciling security with interoperability. Addressing the troubles calls for navigating the complex panorama of Blockchain-primarily based totally answers, which can be daunting for healthcare organizations. While such answers maintain the capacity to protect privacy and foster seamless statistics, they entail sizeable developmental costs and processing overheads, posing hurdles for sizeable adoption.

The proposed integration of Blockchain into healthcare management structures presents a decentralized, immutable ledger making sure facts are secure and integrity through strong encryption mechanisms. Leveraging the SHA-256 set of rules bolsters gadget resilience against tampering and unauthorized access, at the same time as standardized formats and smart contracts foster interoperability amongst numerous healthcare structures. By putting in location a private Blockchain community dominated by company stakeholders, the proposed technique seeks to foster obvious and green facts revocation and dispute decision bolster administrative efficacy, addressing demanding situations of organization manipulation within an untrusted cloud surrounding. Despite the fragmented nature of the healthcare organization and the inherent worrying situations of scalability and regulatory compliance, the proposed approach gives a promising avenue inside the direction of overcoming those hurdles, paving the manner for extra steady and interoperable healthcare surrounding.

4. METHODOLOGY

The proposed device for integrating the blockchain era into healthcare control structures is a decentralized, immutable, and secure ledger for storing and sharing healthcare facts. It uses the SHA-256 algorithm to encrypt and hash information, making it extraordinarily difficult for malicious actors to compromise. Standardized records formats and clever contracts are used to facilitate interoperability among disparate healthcare structures. One manner to enforce this gadget would be to create a personal block chain network for the healthcare enterprise. This community might be governed via a consortium of healthcare carriers, insurers, and different stakeholders. Each player in the community could have a node at the block chain, and all transactions might be established by the bulk of nodes. To store and percentage affected person EHRs, the system would use a clever contract. This clever contract might outline the guidelines for accessing and sharing EHRs, including who is legal to get entry to them and what varieties of get entry to they've. Patients would be able to use the smart contract to furnish healthcare companies get right of entry to to their EHRs.

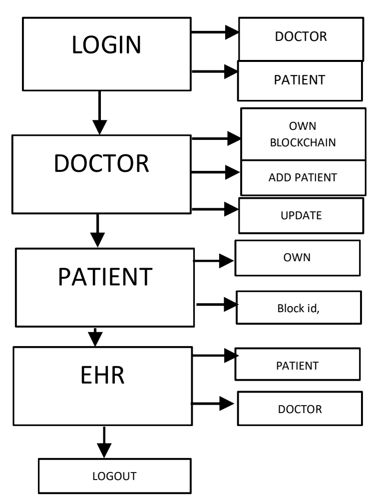


Figure 1. Block Diagram

4.1 MODULES DESCRIPTION

4.1.1 REGISTER MODULE

The "Register" module encompasses the tactics via which docs and patients are enrolled within the healthcare control device. Within this module, doctors functionalities tailor-made to their professional roles. Simultaneously, patients are registered, permitting them to securely save and control their scientific records inside the platform.

4.1.2 DOCTOR MODULE

The "Doctor" module is dedicated to facilitating the activities and facts control specific to healthcare professionals. Doctors preserve their block chain, a virtual ledger containing crucial information along with diagnosed diseases, referred sufferers, and uploaded Electronic Health Records (EHRs). Through this module, docs can seamlessly upload, update, or delete affected person facts, ensuring accuracy and relevance in scientific records control.

4.1.3 PATIENT MODULE

The "Patient" module is designed to empower individuals to manage their fitness statistics securely inside the healthcare control gadget. Patients maintain their block chain, which serves as a digital repository for storing diagnoses, information of referred medical doctors, and uploaded EHRs. This module enables patients to actively participate in dealing with their clinical history, making sure comprehensive and reachable healthcare facts control.

4.1.4 EHR MODULE

The "Electronic Health Record (EHR)" module orchestrates the green control of patient facts inside the healthcare system. It encompasses separate block chain systems committed to sufferers and doctors. Patient block chains report diagnoses, referring docs, and uploaded facts, while doctor block chains tune referred sufferers and uploaded EHRs. This module guarantees the integrity and confidentiality of electronic fitness information, facilitating seamless interactions among sufferers and healthcare companies within a stable digital environment.

5. ALGORITHM DETAILS

A. Sha256 Hashing Algorithm

SHA 256 algorithm (sometimes called digest) is a kind of signature for a text or a data file. SHA-256 generates an almost-unique 256-bit (32-byte) signature for a text. A hash is not' encryption'–it cannot be decrypted back to the original text (it is a cryptographic' one-way' feature, and is a fixed size for any source text size). This makes it ideal when comparing' hashed' versions of texts, rather than decrypting the text to obtain the original version

Basic Initialization will be done for 8 items

Step 1: Information is an array of 8 things in length where everything is 32 bits.

Step 2: out is an array of 8 things in length where everything is 32-bit.

qualities. Allude to them by work name

Step: 4 Store input, right moved by 32 bits, into out. Now, in the out exhibit, E is an inappropriate worth and A is unfilled

Step: 5 Store the capacity boxes. Presently we have to compute out E and out A. Note: Supplant the modulo orders with a bitwise AND 2^ (32-1)

Step: 6 Store (Input I + CH + ((XT+YT) AND 2^31)) AND 2^31 As Mod1

Step: 7 Store (Sum1 + Mod1) AND 2^31 as Mod2

Step: 8 Store (b + Mod2) AND 2^31 into out E Presently Out E is right and all we need is out A

Step: 9 Store (NA + Mod2) AND 2^31 as Mod3

Step: 10 Store (Sum0 + Mod3) AND 2^31 into output A

SHA-256 Pseudocode

function sha256(message)

Initialize hash values:

(first 32 bits of the fractional parts of the square roots of the first 8 primes 2..19):

h0 = 0x6a09e667

h1 = 0xbb67ae85

h2 = 0x3c6ef372

h3 = 0xa54ff53a

h4 = 0x510e527f

h5 = 0x9b05688c

h6 = 0x1f83d9ab

h7 = 0x5be0cd19

Initialize array of round constants:

(first 32 bits of the fractional parts of the cube roots of the first 64 primes 2..311):

k = [0x428a2f98, 0x71374491, 0xb5c0fbcf, ..., 0xc67178f2]

Pre-processing (Padding):

append the bit '1' to the message

append '0' bits until the message length in bits ≡ 448 (mod 512)

append length of the message (before pre-processing), in bits, as a 64-bit big-endian integer

Process the message in successive 512-bit chunks:

for each 512-bit chunk of the message

$w[i], 0 \leq i \leq 15$

Extend the sixteen 32-bit words into sixty-four 32-bit words:

for i from 16 to 63

s0 = (w[i-15] right rotate 7) xor (w[i-15] right rotate 18) xor (w[i-15] right-shift 3)

s1 = (w[i-2] right rotate 17) xor (w[i-2] right rotate 19) xor (w[i-2] right-shift 10)

w[i] = w[i-16] + s0 + w[i-7] + s1

The main loop of SHA-256 uses the current 512-bit block and updates the hash values using the following operations:

for =0 to 63 do: for t=0 to 63 do:

$T1=h+\Sigma1(e)+Ch(e,f,g)+K[t]+W[t]$

$T2=\Sigma0(a)+Maj(a,b,c)$

$h=g$

$g=f$

$f=e$

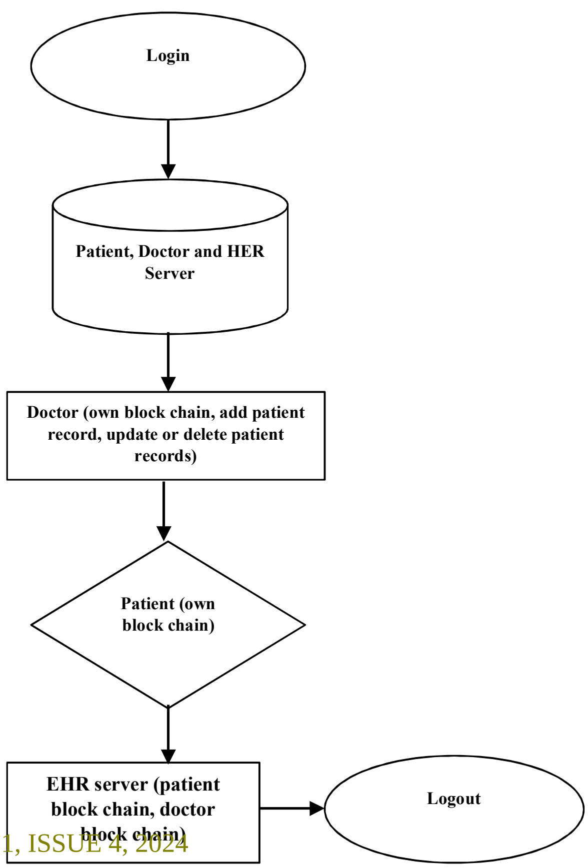
$1e=d+T1$

$d=c$

$c=b$

$b=a$

$a=T1+T2$



6. RESULT ANALYSIS

The end result evaluation of the proposed blockchain-based healthcare control device showcases its efficacy in addressing essential demanding situations in the healthcare enterprise. By leveraging SHA-256 encryption and blockchain generation, the device guarantees the steady garage and management of Electronic Health Records (EHRs), safeguarding affected person's confidentiality and records integrity. Through distinct modules for medical doctors and affected person registration, the machine streamlines access to healthcare services at the same time as supplying tailor-made functionalities to meet the particular desires of both stakeholders. Doctors benefit from seamless report management competencies, permitting them to feature, update, or delete patient facts with self-assurance in data protection and accuracy. Patients, in turn, benefit from extra manipulation of their medical facts, actively participating in its control inside a secure virtual environment.

Parameters	Blockchain 1.0	Blockchain 2.0	Blockchain 3.0	Baiju [48]	Asma Khatoon [47]	Proposed System
SHA-256	No	Yes	Yes	Yes	Yes	Yes
Data secure	Digital currency		Finical	Medical data	Medical data	Medical data
Scalability	NO	NO	NO	NO	NO	YES
Level of decentralization	Low	HIGH	HIGH	HIGH	HIGH	HIGH
Interoperability	NO	NO	YES	NO	NO	YES
Human readable address	NO	YES	NO	YES	YES	YES
Deposit time	10-15 min	5 min	Near to instance 5 min	5 min	5 min	Near to instance
Data privacy	NO	NO	YES	NO	NO	YES
Transaction time 14 s 1–2 s	2–4 min	14 s	2 s	14 s	14 s	1-2 s
Time complexity n log n O(n + d)	O(n2)	n log n	O(n + d)	n log n	n log n	O(n + d)
Space complexity	O(n)	O(n)	O(n)	O(n)	O(n)	O(n)

Figure 3. COMPARISON TABLE

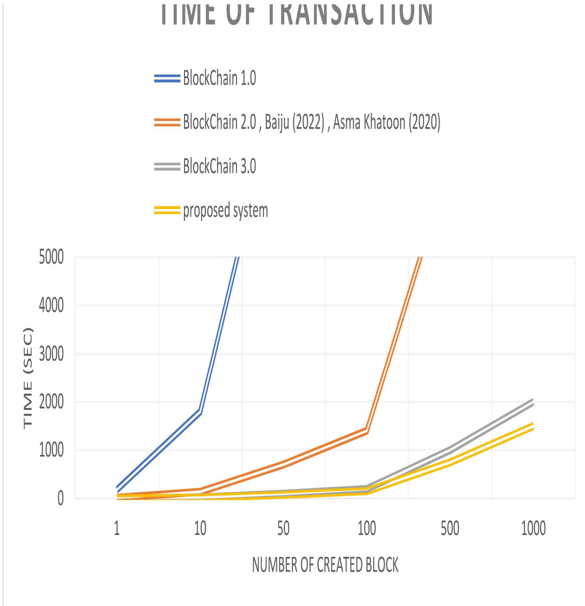
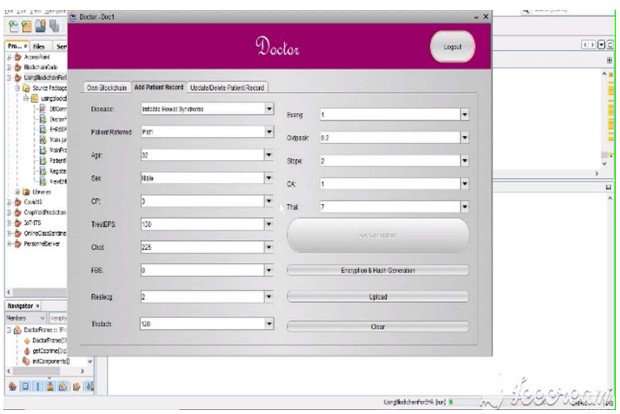
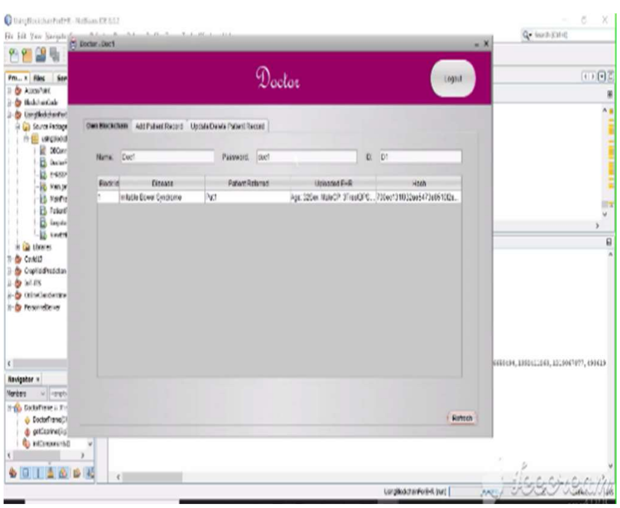
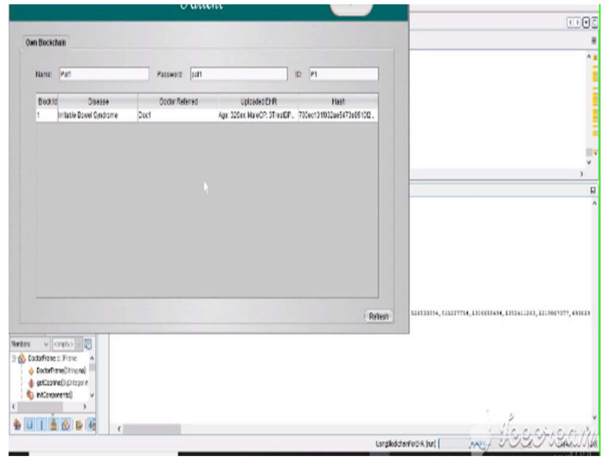


Figure 1 .COMPARISON GRAPH







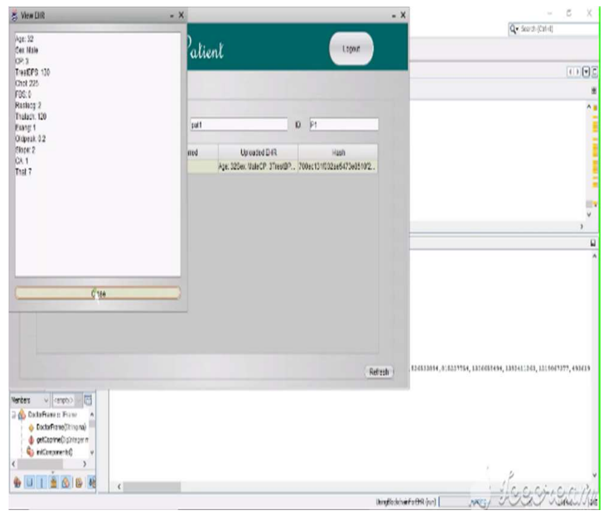


Figure 2. Output screenshot

7. CONCLUSION

In conclusion, the block chain-primarily based healthcare control machine, fortified with SHA-256 encryption, presents a transformative technique to the demanding situations plaguing the healthcare industry. By imparting a secure and green platform for managing Electronic Health Records (EHRs), the machine empowers both docs and patients with unprecedented manage over their clinical information. Through streamlined registration approaches and tailored functionalities, healthcare stakeholders can seamlessly interact inside a tamper-resistant digital atmosphere, fostering believe and transparency. The implementation of separate block chain structures for patients and doctors guarantees records integrity and confidentiality, paving the manner for advanced healthcare consequences. With its capability to revolutionize medical facts management and trade, the proposed system heralds a brand new era of affected person-centric care, riding innovation and resilience in the healthcare landscape.

8. FUTURE WORK

Looking in advance, there are several avenues for destiny work and improvements to further increase the abilities and effect of the blockchain-primarily based interoperability standards to facilitate seamless integration with existing healthcare infrastructure and structures may want to beautify accessibility and adoption. Additionally, research into superior encryption strategies and consensus mechanisms ought to bolster the record's safety and scalability, accommodating the growing extent of medical statistics. Moreover, incorporating machine mastering and artificial intelligence algorithms can allow predictive analytics and personalized remedies, unlocking new insights for healthcare providers and patients alike. Furthermore, fostering collaboration among stakeholders, including healthcare professionals, regulatory bodies, and technology experts, is vital for navigating felony and moral issues surrounding records privacy and governance. Finally, conducting actual-world pilot studies and personal remarks sessions can provide treasured insights for refining the machine's usability and effectiveness in various healthcare settings. By embracing these future instructions, the blockchain-primarily based healthcare management system has the potential to revolutionize healthcare shipping, enhance affected person effects, and pressure innovation within the future years.

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