Nwozor, Blessing. U, 2024, 12:5
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology

An Open Access Journal

An Improved Big Data-Based Electronic Health Record (EHR)

Nwozor, Blessing. U, Asheshemi Nelson Oghenekevwe
Department of Computer Science
Federal University of Petroleum Resources, Effurun Delta State

Abstract- The application of electronic health record management (EHR) system proved to be a viable replacement for the manual system for handling medical records. However, there has been concerns over data confidentiality and security in the healthcare sector, given the need for immediate review of the traditional centralized database systems that has so failed to meet this expectation. This project therefore proposed the development an improved blockchain based electronic health record (EHR) management system using a patient-centered approach, blockchain- based system that efficiently manages and safeguards health-related data of an individual. The proposed system was implemented using the object-oriented analysis and design methodology (OOADM) which applies object orientation for the analysis and design of a software project development. The system was developed visual studio code (VS Code) hypertext preprocessor (PHP), making use of the Ethereum network and tools like web3.js and Ganache, adopting an approach that overcomes the constraints of the existing systems. A key component of blockchain technology, smart contracts provide the foundation for decentralized patient data processing and storing. These smart contracts ensure patient privacy and data security by conducting transactions in a safe manner. Especially, any changes made to a transaction can be validated and spread throughout the whole distributed network, improving data integrity. To enhance this system, a cryptocurrency wallet such as MetaMask can be used, which offers a centrally managed repository where medical records are securely accessible to authorized users, such as patients and doctors, at any time. With a robust framework for securely storing data with customized access permissions and facilitating the safe transfer of patient medical records, the new system outperforms the old one in terms of efficiency, credibility, and accessibility within the healthcare domain.

Keywords- artificial intelligence; machine learning, Electronic health records, privacy, security, quality improvement

I. INTRODUCTION

The healthcare system plays a crucial role in improving socioeconomic well-being, as a healthy population drives economic growth (ECPI, 2023). A significant topic in healthcare is information management, particularly in safeguarding sensitive patient data. Health records must remain private due to the potential for abuse and discrimination against those with medical conditions (Krylov, 2023). Proper management ensures that authorized individuals can access information while preventing unauthorized use (Rezaeibagha et al., 2015).

Technological advancements, including the rise of electronic health records (EHR) and big data analytics, have significantly impacted healthcare. These technologies allow for personalized therapy and predictive models for better patient care (Dash et al., 2019). However, the digital shift has raised concerns regarding data security and patient privacy (Demirdogen et al., 2023).

EHR systems are essential for effective healthcare administration, requiring vast amounts of patient data to provide quality care. These records encompass various types of information, including clinical and genomic data, which contribute to improved patient outcomes (Pandey & Pandey, 2018). Ensuring that sensitive data remains confidential while enabling its appropriate use is key to modern healthcare information management.

Healthcare shifts toward value-based models, leveraging big data is crucial for clinical decision support and cost management (Rai & Srivastava, 2014). The evolution of healthcare information technology (HIT) has opened new opportunities for enhancing care delivery, while also presenting challenges in maintaining data security.

II. RELATED WORK

The increasing reliance on digital systems globally has made information security a critical concern. Organizations and businesses must interact with various individuals and groups both online and offline, making it essential to secure data integrity and confidentiality. To address these concerns, many organizations develop and distribute information security policies to educate employees on best practices. As Marshet al. (2013) suggest, computers, once used to share information with only a select few, now expose private data to a larger audience, making the safeguarding of information crucial, especially in sectors like healthcare.

In healthcare, where big data plays a significant role, protecting sensitive information is a matter of life and death. Cybersecurity breaches in this domain can have severe consequences, prompting discussions about how best to secure information systems from internal and external threats. The responsibility of information security in healthcare includes not only protecting the data but also the tools used to access it, as adversaries seek to exploit vulnerabilities for financial gain or amusement.

The Theory of Reasoned Action (TRA), developed by Fishbein and Ajzen in 1975 and 1980, helps explain the factors that influence technology acceptance in businesses. TRA posits that behaviour is determined by an individual's intention, which in turn is shaped by attitudes and subjective norms. When a positive intention is formed, individuals are more likely to act accordingly (Ambali & Bakar, 2015). TRA is highly relevant in information security, as employee attitudes towards security measures can significantly impact their behaviour and the organization's overall security posture.

TRA consists of four key elements: behaviour, intention, attitude, and subjective norms. It assumes that individuals carefully consider the consequences of their actions before engaging in any behaviour. As Ajzen and Fishbein (1975) note, intentions are influenced by how society views a particular behaviour, leading individuals to assess their actions as positive or negative. Applying TRA in the ICT space helps organizations shape employee attitudes toward security practices, thereby improving compliance and communication (Khando et al., 2021).

Actor-network theory (ANT), originally developed in science and technology sociology, is another useful framework for understanding information systems in healthcare. ANT focuses on the creation and evolution of heterogeneous networks, which include both social and technical components (Hanseth et al., 2006). In the context of information security, ANT views a security breach as part of a network comprising both human and non-human actors, such as systems, policies, and users. By examining these connections, ANT helps trace how different actors interact to create stability and order within a network (Hedström et al., 2010).

When applied to healthcare, ANT offers insights into how electronic health record (EHR) systems coordinate patient care, manage work habits, and ensure information security. Though not a traditional explanatory theory, ANT provides a detailed perspective on how networks function and the processes that maintain stability (Cresswell, 2019). By understanding these dynamics, organizations can better navigate the complexities of information security, especially in critical areas like healthcare.

TRA and ANT offer valuable frameworks for improving information security, especially in sectors like healthcare, where protecting sensitive data is paramount. Through careful analysis of behaviour and network dynamics, organizations can enhance security practices and better protect their systems from cyber threats.

Overview of Healthcare Information Management

Healthcare Information Management (HIM) involves managing patient data to support diagnosis, treatment, and prevention of diseases. Traditionally, healthcare relied on paper records, which posed risks such as data loss (Perlmutter, 2014). However, with the rise of Electronic Health Records (EHR), healthcare providers now have efficient, secure access to patient information. EHRs improve collaboration, reduce errors, and ensure continuity of care (Jackson & Kogut, 2013). EHRs provide real-time access to patient data, streamlining decision-making for healthcare professionals. This has enhanced patient privacy and increased treatment accuracy across primary, secondary, and tertiary care (Brenya & Addo, 2021). With the integration of technology, the healthcare system has become more efficient, lowering costs and improving health outcomes. A comprehensive EHR system allows for better management of healthcare information, which is essential for the evolving demands of modern healthcare (Bouayad et al., 2019). Healthcare institutions greatly benefit from the transition to digital record-keeping, enhancing service delivery and patient empowerment. As patient health records evolve, they continue to play a vital role in improving healthcare management and reducing operational inefficiencies (Kareem et al., 2017).

ICT in Healthcare Information Management

The Fourth Industrial Revolution has significantly transformed healthcare delivery through technologies like 3D printing, used in creating prosthetics, surgical tools, and replicas of organs (Melo & Araújo, 2020). Virtual reality has also impacted areas like medical diagnostics, cognitive rehabilitation, and surgical procedures (Sony et al., 2023). Additionally, the adoption of health information systems and electronic health records (EHRs) has automated many manual processes in healthcare (Golinelli et al., 2020).

By 2040, global healthcare spending is expected to reach $18.28 trillion, making it one of the fastest-growing industries (Negash et al., 2018). Technologies like blockchain, cloud computing, and RFID are enhancing healthcare efficiency (Chong et al., 2022). Health information management supports decision-making by providing timely, accurate data, improving the quality of care (Russell, 2011). Electronic records must meet national standards to ensure proper information exchange and patient care (Omosanya, 2016).

The Electronic Health, Medical and Patients Record (EHR), (EMR) and (EPR)

Electronic health records (EHR), electronic medical records (EMR), and electronic patient records (EPR) are computerized systems for storing patient data. In developing countries, these systems are being gradually adopted, allowing health information to be shared across various locations.

EHRs include demographic details, medical history, and test results, enabling more accurate, secure, and accessible data storage (Sahney & Sharma, 2018). The digital format of EHRs reduces the risk of data duplication and loss, benefiting healthcare professionals and improving patient care.

The adoption of EHRs has optimized medical data storage and distribution, enhancing physician efficiency and patient safety (Yanamadala et al., 2016). While EHRs have not drastically improved patient outcomes, they have been linked to reduced in-patient mortality, and readmissions, and improved patient safety when fully implemented (Alobo et al., 2020). They also streamline documentation, communication, and billing processes, minimizing errors like incorrect prescriptions (Antwi, 2022). Additionally, EHRs help lower healthcare costs by reducing medical errors and improving record-keeping (Abdulai & Adam, 2020).

EMRs, a key component of EHR systems, store non-redundant health data over a patient's lifetime, enhancing care efficiency. They also enable communication between healthcare providers and assist in administrative tasks, such as billing and risk management (Siang et al., 2009). EMRs improve diagnosis, reduce errors, and offer tools like AI-powered analytics and telemedicine integration. However, challenges include high costs, user adoption issues, and data security concerns (Arora et al. 2024). EPRs, which are used within a single healthcare organization, offer financial benefits through better efficiency, lower prescription costs, and reduced billing errors (Campanella et al., 2016). EPRs improve healthcare quality by enhancing real-time access to patient data and improving documentation (Mohsin-Shaikh et al., 2019). Despite these advantages, successful implementation of EPRs requires IT skills and proper training to avoid errors (Pontefract & Wilson, 2019).

Big Data

In recent times data has become essential for business development and they are generated spontaneously from every sector of the world economy like a torrent. Businesses generate a staggering amount of transactional data every day, gathering millions and billions of bytes of information about their clients, partners, and internal processes. In the era of the internet of things, millions of networked sensors are being incorporated into the real world in gadgets like smart energy metres, mobile phones, cars, and industrial machinery that perceive, produce, and communicate data. In fact, a vast amount of digital "exhaust data," or data produced as a byproduct of other activities, is generated by businesses and organizations as they conduct business and engage with people. The volume of Big Data available has increased exponentially due in large part to the growing volume of multimedia content, which has been made possible by social media sites, smartphones, and other consumer electronics like PCs and laptops. Billion people worldwide have been able to contribute to this amount of data (Oguntimilehin & Ademola, 2014).

According to Elliot et al. (2023) big data refers to the massive amounts of structured and unstructured data that organizations acquire on a regular basis. The examination of this data can result in operational insights that enable improved business decisions.It can also be defined as a collection of data from traditional and digital sources both inside and outside the company that serves as a foundation for ongoing detection and analytics.Bernard (2016), further asserts that big data is a quantity of data that is exceedingly relative and cannot be controlled using traditional approaches. Judith et al. (2013), describes it as a group of old and current technologies that support businesses in obtaining actionable perceptions. It has a vast amount of heterogeneous data that may be processed in real time for analysis and response. Furthermore, Schroer (2024) asserts that it is data that is generated continuously and keeps expanding in size, making it too large, complicated, and fast for conventional data management systems to handle. It is utilized in practically every industry to train AI and machine learning models, gain insights, conduct analytics, and support data-driven business choices. Big data has beencharacterized as an enormous amount of data (Baig et al. 2019). Big data facilitates the analysis, visualization, and other types of data processing operations and activities. Based on the definitions provided above, it is possible to deduce that data is considered as big data if it cannot be stored or processed by common system capabilities or if it exceeds those capabilities. The powerful services in this modern sector are constantly increasing volumes of data, and technological improvements ensure that the data may always be mined for commercial objectives (Al-Dulaimi & Ku-Mahamud, 2020).

Figure 1: The 5V's of Big Data (Source: Al-Shiakhli, 2019)

Big Data in Healthcare information Management

The global healthcare sector is one of the largest and most rapidly growing industries. Recent shifts have moved healthcare management from a volume-based model to a value-based, patient-centered care approach (Huang et al., 2015). This transition is driven by the belief that healthcare should provide better outcomes at reduced costs. Increasingly, healthcare companies are leveraging big data to enhance decision-making and improve patient-centered care (Feldman et al.,2015). The management and analysis of large, diverse health data sets are now essential for delivering effective, data-driven treatment. However, traditional data management systems have become inadequate for handling the expanding volume and complexity of healthcare data, necessitating the development of new big data tools and technologies (Senthilkumar et al., 2018).

The potential applications of big data analytics in healthcare are vast, encompassing patient care, disease diagnosis, monitoring, and treatment optimization. Big data provides the ability to analyze detailed, dynamic, and diverse data sets to generate sophisticated healthcare solutions (Kamble et al., 2019). Its significance lies in transforming decision-making from data-scarce to data-rich, offering accurate simulations for various healthcare challenges (Khanra et al., 2020). Enhanced risk profiling, such as through Bayesian multitask learning, can improve clinical procedures by minimizing errors and reducing delays in preventive care (Lin et al., 2017). Furthermore, healthcare organizations stand to benefit financially from a strategic adoption of big data analytics (Wang et al., 2018).

However, scholars note that a balance has yet to be achieved between leveraging the benefits of data-driven healthcare and addressing privacy concerns (Kim et al., 2017).

Blockchain Technology in Health Information Management

Blockchain is a decentralized digital ledger that records transactions across multiple computers, ensuring that data cannot be altered without affecting subsequent blocks. This design makes blockchain highly secure, transparent, and immutable. Each block in the blockchain contains transaction data and is linked to the previous block using cryptographic hashes, forming a chain of blocks. The decentralized nature of blockchain ensures that data is not stored in one central location, which enhances its resistance to hacking and tampering (Khezr et al., 2019).

In blockchain, once data is entered, it cannot be changed without consensus from the entire network, providing accountability and integrity. This makes it ideal for applications that require high security, such as healthcare, where sensitive information like electronic health records (EHRs) must be securely managed (Chelladurai & Pandian, 2022). Blockchain can be particularly useful in healthcare for maintaining EHRs by enabling secure and immutable storage, ensuring privacy, and preventing data breaches (Elliot & Damingo, 2024). Moreover, smart contracts—self- executing contracts coded with predefined rules—enhance blockchain's functionality by automating data transactions, further securing patient data and improving system efficiency (Dutta & Barman, 2024).

Blockchain technology also improves interoperability, allowing seamless and secure sharing of medical data between different healthcare systems. This solves traditional EHR challenges such as data security, privacy concerns, and lack of interoperability (Shrestha & Panta, 2023). Using cryptographic hashing and public-key cryptography, blockchain protects the integrity and confidentiality of patient data, reducing the risk of unauthorized access (Haleem et al., 2021). As blockchain continues to evolve, its application in healthcare will improve data management, enhance patient care, and reduce costs by streamlining record-sharing processes.

Types of Blockchain

Public Blockchain

Open to anyone and fully decentralized, allowing users to read, write, and audit the blockchain.

Private Blockchain

Permissioned and restricted to certain users, making it more centralized but faster and more secure.

Consortium Blockchain

Semi-decentralized, managed by a group of organizations, ideal for business collaborations.

Hybrid Blockchain

Combines elements of both public and private blockchains, allowing selective data sharing.

III. RELATED WORKS

The use of Electronic Health Record (EHR) systems has transformed healthcare, enabling easier access to patients' medical histories for informed diagnoses and treatments. EHR systems support the shift toward patient-centered care, allowing physicians to access records remotely, offering seamless treatment across regions. Research into EHR technologies has led to groundbreaking developments but also revealed challenges, particularly around security and implementation.

Abouelmehdi et al. (2018) highlighted privacy concerns related to big data in healthcare, reviewing encryption-based solutions, but no concrete implementations were tested. Similarly, Kamil (2024) proposed a security threat model for healthcare data, suggesting approaches like data encryption and access control, but again, these were theoretical proposals.

Several studies have focused on improving EHR efficiency and accuracy. Zaied (2015) reviewed EHR applications and their potential for supporting clinical decision-making, but implementation challenges remained. Sikder et al. (2018) developed a phenotypic term binding technique within an EHR system to enhance disease prediction. While this method showed promise in trials, the system still required automation for faster diagnosis.

Sankaranarayanan and Udayasuriyan (2020) addressed security by proposing biometrically secured EHRs, balancing user convenience with protection against data breaches. Meanwhile, Pandey et al. (2023) explored the use of RFID technology to streamline patient identification and data management, emphasizing the system's real-time synchronization capabilities.

EHR systems offer significant advantages in improving healthcare delivery by making patient data accessible and enhancing decision-making processes. However, security, privacy, and full system integration remain areas that need further research and development.

IV. METHODOLOGY

In software development, various methodologies can be employed based on the nature of the project and its functional requirements. Factors that influence the choice of methodology include the complexity of the problem, the type of data being managed, the required development tools, and the specific system requirements (Pressman, 2014). Among the many software development methodologies available, Object-Oriented Analysis and Design Methodology (OOADM) is particularly well-suited for developing blockchain-based electronic health record (EHR) management systems. OOADM provides a structured approach for modeling a system as a collection of interacting objects, making it ideal for complex, distributed systems like blockchain (Elgabry, 2017).

OOADM comprises three main components: Object-Oriented Analysis (OOA), Object-Oriented Design (OOD), and Object-Oriented Programming (OOP). Each of these stages plays a specific role in the software development life cycle. Object-Oriented Analysis focuses on identifying the system's requirements and defining key objects within the problem domain, which will interact to fulfill these requirements (Booch, 2002). During the design phase (OOD), the architecture is translated into programming constructs such as interfaces, classes, and methods, ensuring that the system can be implemented seamlessly. Finally, Object-Oriented Programming applies these constructs in the coding phase, where the system is built using object-oriented programming languages like Java or C++.

OOADM, initially developed by Grady Booch, employs object-oriented principles to model software systems through visual representations such as class diagrams, sequence diagrams, and state diagrams. This methodology effectively manages the complexity of large systems by breaking them down into modular, reusable components (Booch, 2002). According to Elgabry (2017), OOADM provides clear distinctions between the logical view of the system (classes and objects) and its physical implementation (modules and processes). This separation allows for better abstraction, encapsulation, and code reuse, all of which are critical for developing robust, maintainable software systems.

A key tool in OOADM is the Unified Modeling Language (UML), which has become the industry standard for object-oriented design. UML offers a graphical approach to modeling software, enabling developers to visualize and communicate the structure and behavior of a system throughout its development (Rumbaugh et al., 2005). UML diagrams, such as class and use case diagrams, are particularly useful for capturing requirements and facilitating communication among stakeholders, developers, and end-users.

In the context of blockchain-based EHR systems, OOADM's modularity and scalability make it ideal for handling the distributed nature of blockchain technology. The methodology supports prototyping, where developers can build components to validate functionality, test the system under real-world conditions, and make necessary adjustments before final implementation. This iterative approach is critical for ensuring that the blockchain solution meets the high security, privacy, and performance standards required in healthcare applications (Elgabry, 2017).

OOADM offers a comprehensive framework for analyzing, designing, and implementing software systems. By modeling the system as a collection of interacting objects, developers can better manage complexity and ensure that the final product aligns with user requirements. The methodology's use of UML further enhances its effectiveness in capturing system requirements and guiding development. This makes OOADM a highly suitable choice for developing advanced, secure, and scalable systems, such as blockchain-based electronic health record management solutions.

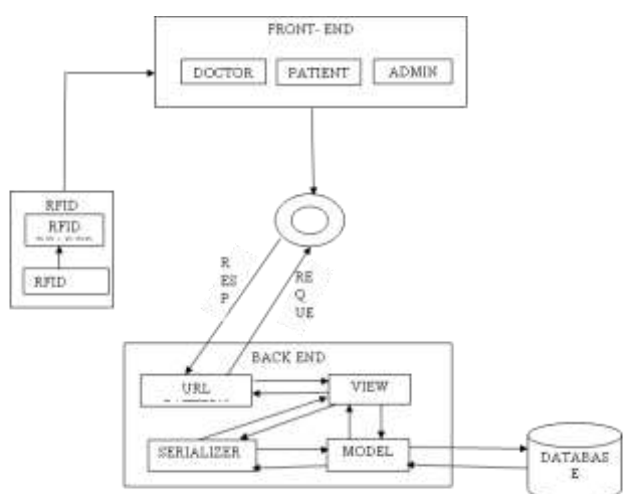

Figure 2 Architecture of the Existing System
(Source: Pandey et al., 2023)

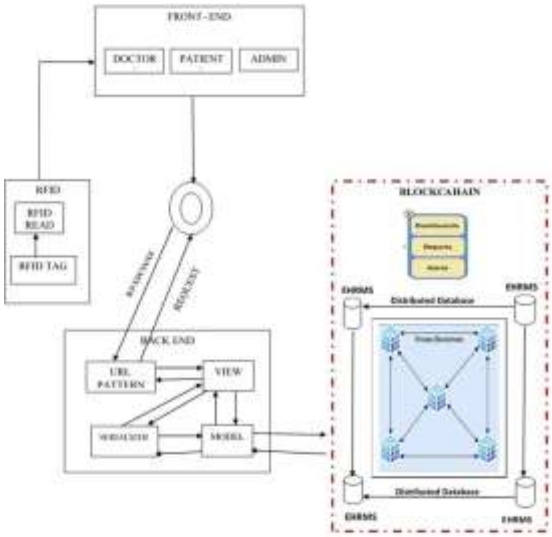

Figure 3 Architecture of the proposed System

Flowchart of the Proposed System

The flowchart give a pictoral or diagramatical flow flow of the design of a given system making it easy to undersstan and explain even for a novice in information systems design. The proposed system flowchart will be broken into three phases which include the admin, patient and physician flowcharts respectively in figure 4, 5 and 6 respectively.

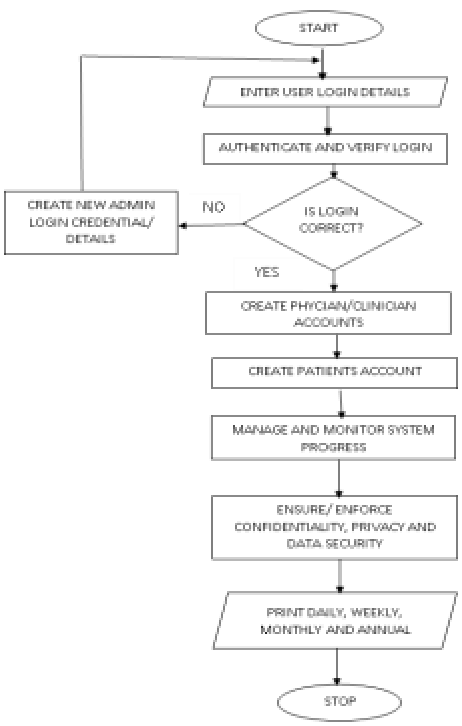

Figure 4 Admin Flowchart of the Proposed System

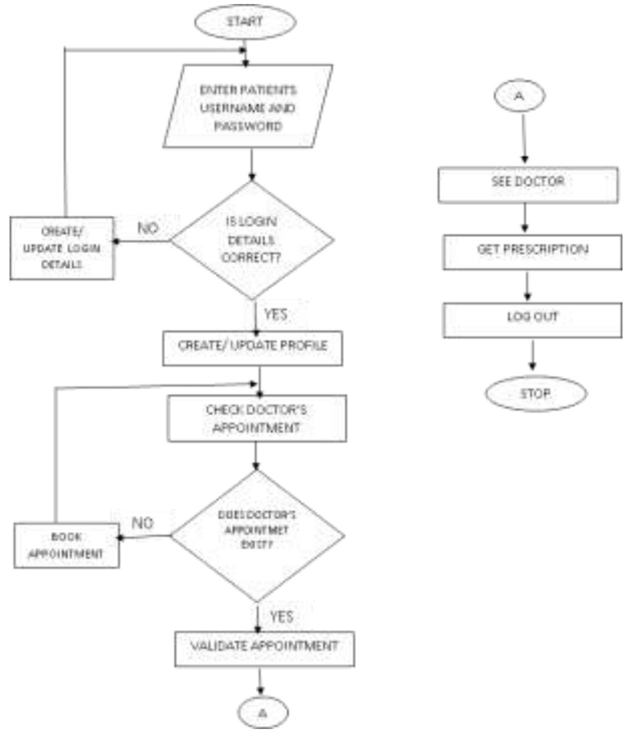

Figure 5 Patients Flowchart of the Proposed System

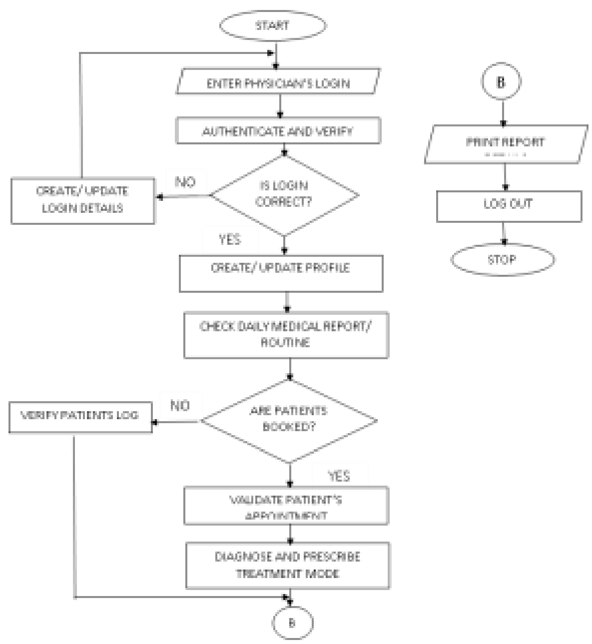

Figure 6 Physicians Flowchart of the Proposed System

Design Specification

The design specification of the proposed system spell out how the system will be designed from the front-end to the back-end component and the different security architecture that will be implemented to ensure for strict adherence to security, confidentiality and privacy on the healthcare information on the system.

Security Design Specification of the Proposed System

The security design specification for the proioised system takes into consideration that the Ethereum data storage which are design for the storage of very large structures and unstructured data have inbuilt data security and confidentiality mechanism therefore the system is design with specific node and terminals to enforce and adhere to strict security check to ensure that unauthorised access to user and administrative information does not occur. Figure 7 depicts the basic security design for the proposed system.

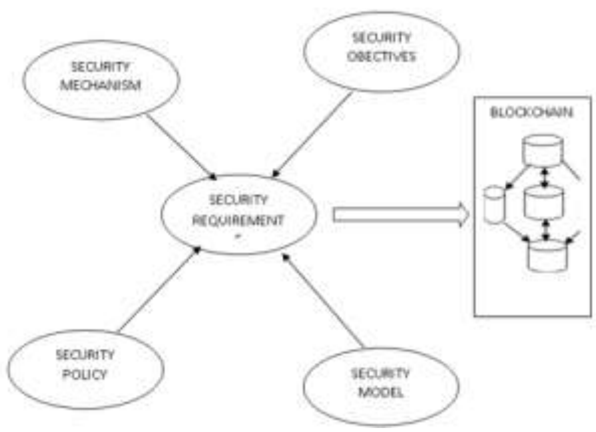

Figure 7 Security Design of the Proposed System

V. RESULTS AND DISCUSSION

This paper explores the development and integration of a blockchain-based Electronic Health Records (EHR) system using the Next.js web framework and Ethereum blockchain. The system's key objective was to enhance patient data security, privacy, and integrity by leveraging blockchain's decentralized structure and cryptographic principles. The system employed Web3.js to connect to the Ethereum network using Hypertext Transfer Protocol (HTTP) through an Ethereum node. This node was deployed locally, using a wallet such as MetaMask to facilitate Ethereum transactions. MetaMask, as a browser extension, allowed secure user authentication and interaction with Ethereum, offering a simple and intuitive interface for account management.

Each activity within the healthcare system corresponds to specific aspects of a patient's medical history. These aspects include hospital visits, diagnosis reports, treatment records, lab findings, and prescriptions, all of which demand high levels of privacy and integrity. Access to this sensitive data is controlled through a permission-based system. Medical practitioners can only access a patient's data with explicit permission, granted when patients schedule appointments via the web portal. This mechanism provides patients with full control over their medical records, aligning with privacy regulations like the General Data Protection Regulation (GDPR).

The system comprises three modules:

- **User Management Module:** This handles user authentication and role assignment (patient, doctor, or administrator) to ensure that only authorized personnel access specific features.
- **EHR Storage Module:** This securely stores patients' medical data on the Ethereum blockchain, ensuring data immutability and preventing unauthorized tampering.
- **EHR View Layer Module:** This module displays medical data, allowing healthcare professionals to view patient records upon receiving access rights.

Analysis of Result

This blockchain-based system introduces a novel approach to managing EHRs by using decentralized technology to secure sensitive medical data. Traditional EHR systems, which store data in centralized databases, are vulnerable to data breaches and tampering. Blockchain, however, eliminates these vulnerabilities by distributing records across a network, making it harder for malicious actors to alter or access data without permission from a majority of participants. The use of Web3.js and MetaMask to establish secure connections between users and the Ethereum network enhances the integrity of user interactions. Patients have full control over their data and can selectively grant access to healthcare providers, offering transparency and privacy. Additionally, the modular structure of the system allows for scalability and adaptability to different healthcare needs.

However, potential drawbacks include the scalability of blockchain in handling large amounts of data and the transaction fees (gas fees) required for processing transactions on the Ethereum network. Future work should focus on optimizing the system for efficiency and exploring alternative blockchain platforms or layer-2 solutions to reduce costs and improve transaction speed.

VI. CONCLUSION

The proposed Blockchain-Based Electronic Health Record Management System marks a significant advancement in healthcare technology. By leveraging blockchain technology, this system transforms the way patient data is secured and managed, fundamentally enhancing data integrity and patient privacy. The decentralized nature of blockchain effectively eliminates unauthorized access, ensuring that sensitive medical information remains protected.

Furthermore, the system facilitates seamless sharing of Electronic Health Records (EHRs) across various healthcare organizations, improving coordination and collaboration among providers. This interconnectivity enhances patient care by enabling healthcare professionals to access comprehensive patient histories, thereby facilitating informed decision-making.

The integration of smart contracts within the system automates patient consent processes and ensures compliance with regulatory requirements. This automation reduces administrative burdens, allowing healthcare providers to focus more on patient care rather than bureaucratic tasks.

The Blockchain-Based Electronic Health Record Management System not only demonstrates the potential of blockchain technology to optimize healthcare delivery but also emphasizes the importance of data security in providing patient-centered services. As we stand at the forefront of healthcare technology transformation, this system exemplifies how innovative solutions can create a more efficient, secure, and patient-focused healthcare environment.

REFERENCES

1. Abdulai, A. F & Adam, F. (2020). Health providers' readiness for electronic health records adoption: A cross-sectional study of two hospitals in northern Ghana. PloS one, 15(6), 1- 18.
2. Abouelmehdi, K., Beni-Hessane, A & Khalouf, H. (2018). Big healthcare data: preserving security and privacy. Journal of Big Data, 5(1), 1-18.
3. Adebisi, O.A., Oladosu, D. A., Busari, O.A & Oyewola Y.V. (2015). Design and Implementation of Hospital Management System. International Journal of Engineering and Innovative Technology (IJEIT), 5(1), 31-34.
4. Adeleke, I.T., Erinle, S.A., Ndana, A.M., Anamah, T.C., Ogundele, O.A & Aliyu, D. (2015). Health Information Technology in Nigeria: Stakeholders' Perspectives of Nationwide Implementations and Meaningful Use of the Emerging Technology in the Most Populous Black Nation. American Journal of Health Research, 3(1), 17-24.
5. Agarwal, M., Adhil, M & Talukder, A.K . (2015). Multi-omics multi-scale big data analytics for cancer genomics. International Conference on Big Data Analytics (pp. 228-243). Springer International Publishing .
6. Al-Barashdi, H & Al-Karousi, R. (2019). Big Data in academic libraries: literature review and future research directions. Journal of Information Studies and Technology, 2(13), 1-16.
7. Al-Dulaimi, HBA & Ku-Mahamud, K.R. (2020). Big data: definition, characteristics, life cycle, applications, and challenges. The 6th International Conference on Software Engineering & Computer Systems (pp. 234-249). IOP Conference Series: Materials Science and Engineering.

8. Alkhaldi, N. (2021). Big Data in healthcare: where does the value come from? Retrieved from itrex: https://itrexgroup.com/blog/big-data-in-healthcare-examples-problems-benefits/
9. Alobo, I.G., Soyannwo. T., Ukponwan, G., Akogu, S., Akpa, AM & Ayankola,. K. (2020). Implementing electronic health system in Nigeria: perspective assessment in a specialist hospital. African Health Sciences, 20(2), 948-954.
10. Alolayyan, MN., Alyahya, MS., Alalawin, AH., Shoukat, A & Nusairat, FT . (2020). Health information technology and hospital performance the role of health information quality in teaching hospitals. Heliyon, 6(10), 1-12.
11. Al-Shiakhli, S. (2019). Big Data Analytics: A Literature Review Perspective. Luleå University of Technology, Information Security. Luleå University of Technology. Retrieved from https://www.diva-portal.org/smash/get/diva2:1320182/fulltext01.pdf
12. Amanat A, Rizwan M, Maple C, Zikria YB, Almadhor AS & Kim SW. (2022). Blockchain and cloud computing-based secure electronic healthcare records storage and sharing. Frontier in Public Health, 10(6), 1-11.
13. Ambali, A & Bakar, A. (2015). Theory of Reasoned Actions (TRA) and its Relation to ICT Adoption. In A. &. Ambali, ICT Adoption and Application in the Malaysian Public Sector (pp. 82-95). IGI Global.
14. Anish, A., Selshiya, M.A & Shyla, S.I. (2021). A Review on the Types and Components of Blockchain Technology. International Journal of Advanced Research in Science, Communication and Technology (IJARSCT, 2(1), 39-44.
15. Anpan, P., Udasi, R., Jagtap, S., Thakre, S & Kamble, C. (2020). Hospital management System. International Research Journal of Engineering & Technology, 4(7), 56-67.
16. Antwi, F. (2022). A Case Study on Impact of Electronic Health Records System (EHRS) on Healthcare Quality at Asamankese Government Hospital. Preprint, 1-44. Retrieved from https://www.researchsquare.com/article/rs-2023326/v1
17. Archenaa, J & Anita, E.M. (2015). A survey of big data analytics in healthcare and government. Procedia Computer Science, 50(1), 408-413.
18. Arora, K., Yasam, D., Roy, M & McElroy, R. (2024). Best EMR Software Of 2024. Retrieved from Select Hub: https://www.selecthub.com/c/emr-software/
19. Asaph, A., Ekblaw, A., Vieira, T & Lippman, A. (2016). Medrec: Using blockchain formedical data access and permission management. 2nd international conference on open and big data (OBD) (pp. 25-30). IEEE.
20. Babatunde, F. (2016). Dynamic Software Development Method (DSDM. Retrieved from VIBLO: https://viblo.asia/p/dynamic-software-development-method-dsdm-PDOGqXgzvjx
21. Baig, M.I., Shuib, L & Yadegaridehkordi, E. (2019). Big data adoption: State of the art and research challenges. Information Processing & Management, 56(6), 126-139.
22. Beckmann, M., Dittmer, K., Jaschke, J., Karbach, U., Köberlein-Neu, J., Nocon, M... Pfaff, H. (2021). Electronic patient record and its effects on social aspects of interprofessional collaboration and clinical workflows in hospitals (eCoCo): a mixed methods study protocol. BMC Health Service Research, 21(37), 1-10.
23. Belmonte, E.M., Tortosa, S.O., Ortega, L & Gutiérrez-Martínez, J. (2023). Healthcare Information Technology: A Systematic Mapping Study. Healthcare Information Research, 29(1), 4-15.
24. Benjelloun, F & Lahcen, A.A. (2015). Big Data Security: Challenges, Recommendations and Solutions. In K. M.-M. Munir, Handbook of Research on Security Considerations in Cloud Computing (pp. 301-313). IGI GlobalEditors:.
25. Berman, J. J. (2013). Principles of big data: Preparing, sharing, and analyzing complex information. Morgan Kaufmann Publishers Inc.
26. Bernard, M. (2016). Big data in practice: How 45 successful companies used big data analytics to deliver extraordinary results. John Wiley & Sons, Inc.
27. Blauwet, J & Bell, M. (2018). Technology’s role in quality improvement and operational

efficiency. Front Health Service Management, 34(3), 3-15.
28. Booch, G. (2002). Object Oriented Analysis and Design with Application (2 ed.). Redwood City.
29. Bouayad, L., Ialynytchev, A & Padmanabhan, B. (2019). Patient Health Record Systems Scope and Functionalities: Literature Review and Future Directions. (345-359, Ed.) Journal of Medical Internet Research, 19(11).
30. Brenya, E & Addo, L. (2021). Electronic Management of Records in the Health Institutions of Ghana and Its Effects on Healthcare Delivery: A Review of Record Automation Processes of Trust Hospital and Midway Clinic. International Journal of Public Health and Health Sciences, 3(1), 45-57.
31. Campanella, P., Lovato, E., Marone, C., Fallacara, L., Mancuso, A & Ricciardi, W. (2016). The impact of electronic health records on healthcare quality: A systematic review and meta- analysis. European Journal of Public Health, 26(1), 60-64.
32. Chaudhuri, A. (2020). Flowchart and algorithm basics: The art of programming. Mercury Learning and Information.
33. Chelladurai, U., & Pandian, S. (2022). A novel blockchain based electronic health record automation system for healthcare. Journal of Ambient Intelligence and Humanized Computing, 13(1), 693–703.
34. Chen, M., Mao, S & Liu, Y. (2014). Big data: A survey. Journal of mobile networks and applications, 19(1), 171-209.
35. Chong, A.Y.L., Blut, M & Zheng, S. (2022). Factors influencing the acceptance of healthcare information technologies: A meta-analysis. Information & Management, 59(3), 56-68.
36. Cresswell, K. (2019). Using Actor-Network Theory to Study Health Information Technology Interventions. Applied Interdisciplinary Theory in Health Informatics, 263(1), 87-97.
37. Dash, S., Shakyawar, S.K., Sharma, M & Kaushik, S. (2019). Big data in healthcare: management, analysis and future prospects. Journal of Big Data, 54(6), 1-25.
38. Demirdogen, G., Işık, Z & Arayici, Y. (2023). BIM-based big data analytic system for healthcare facility management. Journal of Building Engineering, 64(2), 45-56.
39. Demirol, D., Das, R & Hanbay, D. (2023). A key review on securityand privacy of big data: issues, challenges, and future research directions. Signal, Image and Video Processing. Signal, Image and Video Processing, 17(1), 1335-1343.
40. Deniswara, K., Handoko, B.L & Mulyawan, A.N. (2020). Big Data Analytics: Literature Study on How Big Data Works towards Accountant Millennial Generation. International Journal of Management, 11(5), 376-389.
41. Detmer, D. (2014). Recent US Experience with Health ICT. In M. W. Rosenmöller, Managing eHealth (pp. 202–214). Palgrave Macmillan.
42. Dhiman, K.S., Shatma, A & Kaur, A. (2012). Comprehensive Study of Object Oriented Analysis and Design by using the concept of OOSE. International Journal of Research in Education Methodology, 1(1), 14-16.
43. Dutta, J & Barman, S. (2024). Smart contract and blockchain-based secured approach for storing and sharing electronic health records. Multimedia Tools and Applications, 45(12), 45-65.
44. ECPI. (2023). Importance of Information Management in Healthcare. Retrieved from ECPI: https://www.ecpi.edu/blog/importance-of-information-management-in-healthcare
45. Elevon, D. (2023). The Top Challenges of Big Data: Volume, Velocity, Variety, and Veracity. Retrieved from LinkedIn: https://www.linkedin.com/pulse/top-challenges-big-data- volume-velocity-variety-veracity-elevondata
46. Elgabry, O. (2017). Object-Oriented Analysis And Design — Introduction Part 1. Retrieved February 13, 2020, from Medium: https://medium.com/omarelgabrys-blog/object- oriented-analysis-and-design-introduction-part-1-a93b0ca69d36
47. Elliot, K.N & Damingo, L.A.S. (2024). Application of Blockchain Technology for Secure Signal Processing. Recent Innovations in Wireless Network Security, 6(2), 19-31.
48. Elliot, N.K., Damingo, A.S., Luckyn, B & Nwankwo, W. (2023). Big Data and Internet of

Things (IoT) in Autonomous Navigation. International Journal of Technology and Engineering Studies, 9(1), 45-50.
49. Elragal, A., & Klischewski, R. (2017). Theory-driven or process-driven prediction? Epistemological challenges of big data analytics. Journal of Big Data, 4(19), 1-20.
50. Erl,T., Khattak,W & Buhler, P. (2016). Big Data Foundamentals: Concepts, Drivers and techniques. Prentice Hall.
51. Fadlallah, H. (2018). Big Data Integration. Retrieved from Toward Data Science: https://towardsdatascience.com/big-data-integration-9a2fb2d78529
52. Federal Ministry of Health [FMoH]. (2010). National Strategic Health Development Plan (NSHDP) 2010- 2015. Federal Ministry of Health. Retrieved from www.NSHDP_inside_pages_23_12_10.pdf
53. Feldman, K., Davis, D & Chawla, N.V. (2015). Scaling and contextualizing personalized healthcare: A case study of disease prediction algorithm integration. Journal of Biomedical Informatics, 57(1), 377-385.
54. Feldstein, D.A., Hess, R., McGinn, T., Mishuris, G.R., McCullagh, L., Smith, P.D...Mann, D. (2017). Design and implementation of electronic health record integrated clinical prediction rules (iCPR): a randomized trial in diverse primary care settings. Implementation Science, 12(37), 1-11.
55. Fishbein, M., & Ajzen, I. (1975). Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. Addison-Wesley.
56. Gandomi, A & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. International Journal of Information Management, 35(2), 137-144.
57. Garg, S., Goel, T & Dung, S. (2022). STS Hospital Management System. International Research Journal of Modernization in Engineering Technology and Science, 4(6), 1399-1404.
58. Gimba, A.M., Ahmad, S.K., Abubakar, I., Faseki, N.F & Jafar, U.A. (2022). Design and Implementation of Web-Based Patient Management System Using C#. IOSR Journal of Computer Engineering (IOSR-JCE), 24(4), 69-72.
59. Golinelli, D., Boetto, E., Carullo, G., Nuzzolese, A.G., Landini, M.P & Fantini, M.P. (2020). Adoption of Digital Technologies in Health Care During the COVID-19 Pandemic: Systematic Review of Early Scientific Literature. Journal of Medical Internet Research, 22(11), 1-23.
60. Gorule, V.V., Gaikwad, S.S., Chougule, Y.S., Ekande, H & Mali, V. (2023). The Hospital Management System. International Research Journal of Modernization in Engineering Technology and Science, 5(12).
61. Grover, P & Kar, A.K. (2017). Big data analytics: a review on theoretical contributions and tools used in literature. Global Journal of Flexible Systems Management, 18(3), 203-229.
62. Haleem, A., Javaid, M., Singh, R.P., Suman, R & Rab, S. (2021). Blockchain technology applications in healthcare: An overview. International Journal of Intelligent Networks, 2(1), 130-139.
63. Hanseth, O., Jacucci, E., Grisot, M & Aanestad, M. (2006). Reflexive standardization: sideeffects and complexity in standard making. MIS Quarterly, 30(1), 563-581.
64. Harshini, V.M., Danai, S., Usha, H.R & Kounte, M.R. (2019). Health Record Management through Blockchain Technology. 3rd International Conference on Trends in Electronics and Informatics (ICOEI) (pp. 1411-1415). Tirunelveli, India: ICOEI.
65. He, K.Y., Ge, D & He, MM. (2017). Big data analytics for genomic medicine. International Journal Molecular Science, 18(2), 1-18.
66. He, X., Tao, H., Liu, C & Zhu, J. (2018). Single-shot color image encryption based on mixed state diffractive imaging. Optics and Lasers in Engineering, 107, 112–118.
67. Hedström, K., Dhillon, G & Karlsson, F. (2010). Using Actor Network Theory to Understand Information Security Management. IFIP International Information Security Conference, 330, pp. 43-54.
68. Huang, T., Lan, L., Fang, X., An, P., Min, J & Wang, F. (2015). Promises and Challenges of Big Data Computing in Health Sciences. Big Data Research, 2(1), 2-11.

69. Huihui, Y & Yang, B. (2017). A blockchain-basedapproach to the secure sharing of healthcare data. Norwegian informationsecurity conference, (pp. 100-111). Oslo, Norway.
70. International Business Machine [IBM]. (2023). Data Integration. Retrieved from IBM: URL: https://www.ibm.com/analytics/data-integration
71. Jackson, AN & Kogut, S. (2013). Use of electronic personal health records to identify patients at risk for aspirin-induced gastrointestinal bleeding. Consult Pharm, 28(5), 313-318.
72. Joseph, B., Maigana, W & Agu, E. (2020). Design and Implementation of a Secured Web based Medical Record Management System: A Case Study of Federal University Wukari (FUW) Clinic. International Journal of Computer Applications., 17(3), 23-35.
73. Judith, H., Alan, N., Fern, H & Marcia, K . (2013). Big data for dummies . John Wiley & Sons, Inc. Kamil, A. (2024). Big healthcare data: enhancing security and privacy. Journal of Management Information and Decision Sciences, 27(1), 1-11.
74. Kareem, R.O., Ademoyewa, G., Fagbohun, O.L & Arije, B.R. (2017). Impact of Federal Government's Healthcare Expenditure on Economic Growth of Nigeria. Journal of Research in Business, Economics and Management (JRBEM), 8(1), 1329-1343.
75. Keshta, I & Odeh A. (2021). Security and privacy of electronic health records: Concerns and challenges. Egyptian Informatics Journal, 22(2), 177-183.
76. Khando, K., Gao, S., Islam, S.M & Salman, A. (2021). Enhancing employees information security awareness in private and public organisations: A systematic literature review. Computers & Security, 106(1), 34-49.
77. Khanra, S., Dhir, A., Islam, AM..N & Mäntymäki, M. (2020). Big data analytics in healthcare: a systematic literature review. Enterprise Information Systems, 14(7), 878-912.
78. Khezr, S., Moniruzzaman, M., Yassine, A & Benlamri, R. (2019). Blockchain technology in healthcare: a comprehensive review and directions for future research. Applied Sciences, 9(9), 1736.
79. Kim, S. H., Kim, N. U., & Chung, T. M. . (2013). Attribute relationship evaluation methodology forbig data security. International Conference on IT Convergence and Security (pp. 1-4). IEEE.
80. Kim, S., Lee, H & Chung, Y.D. (2017). Privacy-preserving data cube for electronic medical records: an experimental evaluation. International Journal of Medical Informatics, 97(2), 33-42.
81. Kruse, CS & Beane, A. (2018). Health Information Technology Continues to Show Positive Effect on Medical Outcomes: Systematic Review. Journal of Medical Internet Research, 20(2), 41-50.
82. Krylov, A. (2023). Importance of Data Privacy in Healthcare: Data Security Standards. Retrieved from Kodjin: https://kodjin.com/blog/the-value-of-data-privacy-in-healthcare/
83. Kvartalnyi, N. (2023). Complete Guide to Predictive Analytics and Big Data Analytics. Retrieved from inoxoft: https://inoxoft.com/blog/complete-guide-to-predictive-analytics-and-big- data-analytics/
84. Laney, D. (2001). 3D data management: Controlling data volume, velocity and variety. META group research note, 6(3), 1-4.
85. Lastovetska, A. (2021). Blockchain Architecture Basics: Components, Structure, Benefits & Creation. Retrieved from MLSDev: https://mlsdev.com/blog/156-how-to-build-your-own- blockchain-architecture
86. Lin, Y. K., Chen, H., Brown, R.A., Li, S.H & Yang, H.J. (2017). Healthcare predictive analytics for risk profiling in chronic care: a Bayesian multitask learning approach. MIS Quarterly, 41(2), 473-495.
87. Liu, C., Zhang, X., Liu, C., Yang, Y., Ranjan,R., Georgakopoulos, D., & Chen, J. (2013). An iterative hierarchical key exchange scheme for secure scheduling of big data applications in cloud computing. 12thIEEE International Conference on Trust, Security and Privacy in Computing and Communications (pp. 9-16). IEEE Computer Society.
88. Lubrano, F., Stirano, F., Varavallo, G., Bertone, F & Terzo, O. (2021). HAMS: An Integrated Hospital Management System to Improve Information Exchange. In F. S. Lubrano,

Complex, Intelligent and Software Intensive Systems (pp. 334-343). Elsevier.

89. Mao, T & Chen, J. (2022). Smart Contract in Blockchain. 2022 International Conference on Bigdata Blockchain and Economy Management (pp. 345-359). IEEE.
90. Marr, B. (2021). What are the 4 Vs of Big Data? Retrieved from Bennard Marr: https://bernardmarr.com/what-are-the-4-vs-of-big-data/
91. Marsh, S., Basu, A & Dwyer, N. (2013). Security Enhancement with Foreground Trust, Comfort and Ten Commandments for Real People. In A. &. Kayem, Theories and Intricacies of Information Security Problems (pp. 1-7). Universitätsverlag Potsdam.
92. Melo, J.A. & Araújo, N.M.F. (2020). Impact of the Fourth Industrial Revolution on the Health Sector: A Qualitative Study. Health Information Research, 26(1), 328-334.
93. Middelburg, J. (2023). The 4 Characteristics of Big Data. Retrieved from Big data framework: https://www.bigdataframework.org/the-four-vs-of-big-data/
94. Mohapatra, N & Bhuvana, J. (2022). Online HealthCare System. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 10(11), 1459-1461.
95. Mohsin-Shaikh, S., Furniss, D., Blandford, A., McLeod, M., Ma, T & Beykloo, MY. (2019). The impact of electronic prescribing systems on healthcare professionals' working practices in the hospital setting: a systematic review and narrative synthesis. BMC Health Service Review, 19(1), 742-749.
96. Najafabadi, M.M., Villanustre, F., Khoshgoftaar, T.M., Seliya, N., Wald, R & Muharemagic, E. (2015). Deep learning applications and challenges in big data analytics. Journal of Big data, 2(1), 1-21.
97. Narang, M. (2023). Big Data Management: Definition, Architecture, Best Practices. Retrieved from Knowledge Hut: https://www.knowledgehut.com/blog/big-data/big-data- management
98. Negash, S., Musa, P., Vogel, D & Sahay, S. (2018). Healthcare information technology for development: improvements in people's lives through innovations in the uses of technologies. Information Technology for Development, 24(2), 189-197.
99. Norton, PT., Rodriguez, HP., Shortell, SM & Lewis, VA. (2019). Organizational influences on healthcare system adoption and use of advanced health information technology capabilities. American journal of managed care, 25(1), 21-25.
100. Noteboom, C. B., Motorny, S. P., Qureshi, S & Sarnikar, S. (2020). Meaningful Use of Electronic Health Recordsfor Physician Collaboration: A Patient Centered HealthCare Perspective in System Sciences (HICSS). 47th Hawaii International Conference (pp. 656-666). IEEE.
101. Oguntimilehin, A & Ademola, O. (2014). A Review of Big Data Management, Benefits and Challenges. Journal of Emerging Trends in Computing and Information Sciences, 5(6), 433-438.
102. Olusanya, O.O., Elegbede, A.W & Ogunseye, A.A. (2019). Design and Implementation of Hospital Management System Using Java. IOSR Journal of Mobile Computing & Application (IOSR-JMCA), 2(1), 32-36.
103. Omar, I.A., Jayaraman, R., Salah, K., Yaqoob, I. & Ellahham, S. (2021). Applications of blockchaintechnology in clinical trials: Review and open challenges. Arabian Journal for Science and Engineering, 46(4), 3001-3015.
104. Pandey, G., Sunar, A., Yogi, J., Poudel, N & Koirala, K. R. (2023). Electronic Health Record Management System using RFID: Improving Efficiency and Accuracy in Healthcare. Journal of Information Technology and Digital World, 5(3), 274-290.
105. Pandey, S & Pandey, R. (2018). Medical (Healthcare) Big Data Security and Privacy Issues. International Journal of Scientific & Engineering Research, 9(2), 180-182.
106. Pedrouzo-Ulloa, A., Troncoso-Pastoriza, J.R & Perez-Gonzalez, F. (2018). Number Theoretic Transforms for Secure Signal Processing. University of Vigo, Vigo Spain, Department of Signal Theory and Communication. University of Vigo.

107. Pendyala, VS & Figueira, S. (2017). Automated medical diagnosis from clinical data. IEEE 3rd International Conference on Big Data Computing Service and Applications (BigDataService) (pp. 185-190). IEEE.
108. Perlmutter, C. (2014). Traditional Patient Records vs Electronic Health Records (EHR). Retrieved from Record Nations: https://www.recordnations.com/blog/traditional-paper-records-vs- ehr/
109. Pontefract, S.K & Wilson, K. (2019). Using electronic patient records: defining learning outcomes for undergraduate education. BMC Medical Education, 19(30), 45-59.
110. Pune, M., Gawade, R., Chavan, P., Shitole, A & Jogdand, S. (2019). Hospital Management System. International Journal of Innovative Research in Technology, 5(9), 33-34.
111. Rahman, M. (2018). Using RFID Technology for Managing Patient Medical File. American Journal of Computer Science and Information Technology, 6(4), 1-4.
112. Rai, B.K & Srivastava, A.K. (2014). Security and Privacy Issues in healthcare information system. International Journal of Emerging Trends & Technology in Computer, 3(6), 248-252.
113. Rathert, C., Porter, TH., Mittler, JN & Fleig-Palmer, M. (2019). Seven years after Meaningful Use: Physicians' and nurses' experiences with electronic health records. Health Care Management Review, 44(1), 30-40.
114. Raymond, Y.K., Lau, J., Zhao, L., Chen, G & Guo, X. (2016). Big data commerce. Information Management Journal, 53(8), 929-933.
115. Revathy, R. (2022). Secure Health Care Website Portal. International Journal of Research Publication and Reviews, 3(2), 1099-1100.
116. Rezaeibagha, F., Win, KT & Susilo, W. (2015). A systematic literature review on security and privacy of electronic health record systems: technical perspectives. Journal of Health Information Management, 44(3), 23-38.
117. Riahi, Y & Riahi, S. (2018). Big Data and Big Data Analytics: Concepts, Types and Technologies. International Journal of Research and Engineering , 9, 524-528.
118. Ristevski, B & Chen, M. (2018). Big Data Analytics in Medicine and Healthcare. Journal of Integrated Bioinformatics, 15(3), 1-5.
119. Sahney, R & Sharma, M. (2018). Electronic health records: A general overview. Current Medicine Research and Practice, 8(1), 67-70.
120. Saimanoj, K., Poojitha, G., Dixit, K.D & Jayannavar, L. (2020). Hospital Management System using Web Technology. Journal of Test, Engineering and Management, 83(1), 4493-4496.
121. Sakhipov, A.A. & Baygozhanova, D.S. (2020). Blockchain Technology in Education. Scientific Evolution, 1(1), 36-39.
122. Sankaranarayanan, S & Udayasuriyan, V. (2020). Biometric Secured Electronic Health Record. In
123. I. R. Association, Virtual and Mobile Healthcare: Breakthroughs in Research and Practice (Vol. 2, pp. 221-248). IGI Publishers.
124. Saranto, K & Kinnunen, UM. . (2009). Evaluating nursing documentation - research designs and methods: systematic review. Journal of Advanced Nursing, 65(3), 464-476.
125. Sarkar, S. (2024). Types of Electronic Health Record (EHR) Systems. Retrieved from Select Hub: https://www.selecthub.com/medical-software/ehr/types-of-ehr/
126. Schroer, A. (2024). Big Data: What It Is, Why It Matters, How It Works. Retrieved from Built in: https://builtin.com/big-data
127. Senthilkumar, SA., Bharatendara, K.R., Meshram, A.A., Gunasekaran, A & Chandrakumarmangalam, S. (2018). Big Data in Healthcare Management: A Review of Literature. American Journal of Theoretical and Applied Business, 4(2), 57-69.
128. Shah, Y., Shaikh, A & Naik, N. (2022). Hospital Management System. International Journal of Creative Research thoughts, 10(1), 1-2.
129. Shaik, N., Shaik, M., Mohammad, N.A & Alomari, F.A. (2018). Information Security in Big Data.
130. International Journal of Engineering Research and General Science, 6(5), 24-27.
131. Sharma, A., Sarishma; Tomar, R., Chilamkurti, N & Kim, B.-G. (2020).

Blockchainbased smart contracts for internet of medical things in E-Healthcare. Electronics, 9(10), 1609-1621.

132. Sheik, A.A., Selvakumar, S & Ramya, C. (2017). Decriptive Analytics. In R. D. Sahu, Applying Predictive Analytics Within the Service Sector (pp. 88-112). IGI Global.

133. Shi, J. (2019). The Application of Blockchain-as-a-Service (BaaS) and its Providers in China. Fourth International Conference on Economic and Business Management (FEBM 2019) (pp. 127-130). Atlantis Press.

134. Shinde, S.M., Awatade, S.R., Bhosale, P.G., Deshmane, S.V & Todkari, A.D. (2022). Hospital Management System Using PHP with MySQL. International Journal of Advanced Research in Science, Communication and Technology (IJARSCT), 2(8), 12-15.

135. Shrestha, S & Panta, S. (2023). Blockchain-based Electronic Health Record Management System. Journal of Artificial Intelligence and Capsule Networks, 5(3), 298-313.

136. Siang, L.C., Edmund, S., Ramaiah, C.K & Prakash, S. (2009). Electronic Medical Records Management Systems: An Overview. DESIDOC Journal of Library & Information Technology, 29(6), 3-12.

137. Sikder, M. K. A., Chy, A. N & Seddiqui, M. H. (2018). Electronic health record system for human diseaseprediction and healthcare improvement in Bangladesh. Informatics, Electronics & Vision (ICIEV), 2018 International Conference (pp. 1-5). CIEV.

138. Sinha, R. (2010). Impact of health information technology in public health. Sri Lanka Journal of Bio-Medical Informatics, 1(4), 223-236.

139. Sony, M., Antony, J & Tortorella, GL. (2023). Critical Success Factors for Successful Implementation of Healthcare 4.0: A Literature Review and Future Research Agenda. Intertional Journal of Environmental Research and Public Health, 20(5), 134-154.

140. Tamplin, T. (2023). Blockchain Architecture. Retrieved from Finance Strategist: https://www.financestrategists.com/wealth-management/blockchain/blockchain-architecture/

141. Tiao, S. (2024). What Is Big Data? Retrieved from Oracle: https://www.oracle.com/big-data/what- is-big-data/

142. Torre-Diaz, I., García-Zapirain, B & López-Coronado, M. (2017). Analysis of Security in Big Data Related to Healthcare. Journal of Digital Forensics, Security and Law, 12(3), 39-46.

143. Tyagi, N. (2021). 7 Types Of Agile Methodologies. Retrieved from Analytic Steps: https://www.analyticssteps.com/blogs/7-types-agile-methodologies

144. Ulusoy, H., Colombo, P., Ferrari, E., Kantarcioglu, M., Pattuk, E & Guard, M.R. (2015). Fine- grained Security Policy Enforcement for MapReduce Systems. 10th ACM Symposium on Information, Computer and Communications Security (pp. 285-296). Elsevier.

145. Véliz, C. (2019). Medical privacy and big data: A further reason in favour of public universal healthcare coverage. In H. J. de Campos TC, Philosophical Foundations of Medical Law. Oxford University Press.

146. Verma, J.P., Agrawal, S., Patel, B & Patel, A. (2016). Big Data Abalytics: Challenges and Applications for text, Audio, Video and Social Media Data. International Journal on Soft Computing, Artificial Intelligence and Applications (IJSCAI), 5(1), 41-51.

147. Wang, Y., Kung, L & Byrd, T.A. (2018). Big data analytics: understanding its capabilities and potential benefits for healthcare organizations. Technological Forecasting and Social Change, 126(1), 3-13.

148. Watson, H. (2019). Update Tutorial: Big Data Analytics: Concepts, Technology, and Applications. Communications of the Association for Information Systems, 44(2), 21.

149. Yanamadala, S., Morrison, D., Curtin, C., McDonald,. K & Hernandez-Boussard, T. (2016). Electronic Health Records and Quality of Care: An Observational Study Modeling Impact on Mortality, Readmissions, and Complications. Medicine, 19(95), 1-6.

150. Yang, X.M., Li, X., Wu, H.Q & Zhao, K.Y. (2017). The application model and challenges of

blockchaintechnology in education. Modern Distance Education Research, 2(1), 34-45.
151. Yavad, G., Lad, P., Pandey, P & Kolla, T. (2016). Advanced Hospital Database Management System. International Journal of Advanced Research in Computer and Communication Engineering, 5(4), 221-223.
152. Yen, PY., McAlearney, AS., Sieck, CJ., Hefner, JL & Huerta, TR. (2017). Health Information Technology (HIT) Adaptation: Refocusing on the Journey to Successful HIT Implementation. JMIR Medical Informatics, 5(3), 28-37.
153. Zaied, A.N.H., Elmogy, M & Abd Elkader, S. (2015). Electronic Health Records: Applications, Techniques and Challenges. International Journal of Computer Applications, 119(14), 38-49.