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Purshottam Hoovayya, R. Sorna Keerthi, S. Krishnakumar

ALL INDIA INSTITUTE OF MEDICAL SCIENCE, BATHINDA, UNIVERSITY COLLEGE OF ENGINEERING PULLANGUDI, ACADEMY OF MARITIME EDUCATION AND TRAINING, DEEMED TO BE UNIVERSITY

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[1]Purshottam Hoovayya, Dy. Medical Superintendent & Assistant Professor, Department of Hospital Administration, All India Institute of Medical Science, Bathinda, Punjab -151001. pursh2002@gmail.com

[2]R. Sorna Keerthi, Assistant Professor (Selection Grade), Department of Electronics and Communication Engineering, University College of Engineering Pullangudi, Ramanathapuram-623513. sornakeerthi.ucer@gmail.com

[3]S. Krishnakumar, Post Doctoral Fellow, Department of Mechanical Engineering, Academy of Maritime, Education and Training, Deemed to be University, 135 East Coast Road, Kanathur – 603112. krishnakumarmech@ametuniv.ac.in

Abstract

The convergence of Blockchain and Artificial Intelligence (AI) has the potential to revolutionize the management and sharing of Electronic Health Records (EHRs) and the authentication of medical devices, particularly in the context of global healthcare systems. Blockchain's decentralized and immutable nature ensures enhanced data security, transparency, and patient-centric control, addressing significant challenges such as data breaches, interoperability, and unauthorized access. Simultaneously, AI optimizes EHR sharing by providing real-time predictive analytics, improving decision-making, and detecting anomalies in data access. This chapter explores the integration of Blockchain and AI technologies for securing and optimizing Electronic Health Record sharing, device authentication, and patient consent management. Key issues such as scalability, privacy concerns, cross-border interoperability, and regulatory compliance are discussed, alongside solutions like smart contracts and hybrid blockchain models. The fusion of these technologies offers a new paradigm in ensuring seamless, secure, and efficient healthcare collaboration, which is increasingly critical in a globalized world. As healthcare systems evolve towards digitalization, this chapter provides insights into the challenges and opportunities of adopting Blockchain and AI-driven solutions for enhancing the security and efficiency of healthcare data management.

Keywords: Blockchain, Artificial Intelligence, Electronic Health Records (EHR), Data Security, Interoperability, Smart Contracts.

Introduction

The integration of Blockchain technology and Artificial Intelligence (AI) is rapidly emerging as a transformative force in healthcare, particularly in the management of Electronic Health Records (EHRs) and the authentication of medical devices [1]. As healthcare systems worldwide continue to embrace digital transformation, the need for secure, efficient, and interoperable

methods for sharing patient data has become more critical [2]. Traditional healthcare systems, reliant on centralized databases and paper-based records, have long struggled with data fragmentation, privacy breaches, and difficulties in cross-institutional data sharing [3]. These challenges have resulted in inefficiencies in patient care, delays in decision-making, and gaps in the continuity of treatment, particularly in emergency situations or when patients seek care across borders. Blockchain, with its inherent qualities of decentralization, transparency, and immutability, offers a powerful solution for overcoming these barriers by ensuring secure, transparent, and tamper-proof EHR management [4]. In conjunction with AI, which can analyze vast amounts of data in real-time and improve decision-making, these technologies present a promising future for more effective and personalized healthcare delivery [5].

Blockchain technology's primary advantage in healthcare is its ability to provide a decentralized, transparent ledger that records every interaction with medical records in a secure and immutable way [6]. This means that any modification or access to patient data is permanently logged and verifiable, reducing the risks of unauthorized data access, tampering, or fraud [7]. The decentralized nature of Blockchain eliminates the need for a central authority to manage and store sensitive patient data, which is a significant departure from traditional healthcare information systems [8]. In a Blockchain-based system, each healthcare provider participating in the network can access patient records securely, but only with patient consent. Blockchain ensures that only authorized individuals or institutions can modify or access the records, with each action being auditable in real-time [9]. This feature addresses long-standing concerns about data breaches in centralized systems, making Blockchain an ideal solution for enhancing the security and transparency of Electronic Health Records [10].

The integration of AI with Blockchain can further enhance the management and sharing of EHRs by optimizing the process of decision-making and automating various tasks [11]. AI technologies, particularly machine learning and natural language processing, can be used to analyze vast amounts of medical data stored on Blockchain, identifying patterns, trends, and anomalies that might be overlooked by human practitioners [12]. AI can also predict patient health outcomes, recommend personalized treatment plans, and improve diagnosis accuracy by processing real-time data inputs from various sources, including wearable devices and IoT-enabled medical devices [13]. In this way, AI can support healthcare providers by offering data-driven insights that streamline workflows, reduce errors, and improve patient care [14]. AI can enhance the efficiency of Blockchain-based EHR systems by managing data access, predicting data usage patterns, and providing advanced algorithms that assist in detecting fraudulent activities or unusual access requests [15].