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Topic: Design of Medical Big Data Systems: A Review of Non-functional Requirements

Abstract: The rise of big data has unlocked a world of possibilities, particularly in healthcare, where it promises to revolutionize therapies and personalize medicine. This study delves into the critical non-functional requirements for designing medical big data systems, emphasizing efficient management, robust architecture, and stringent security measures. It is through the exploration of these essential elements that valuable insights are provided that can be used to optimize healthcare data systems and ultimately, the outcomes of patients.

Keywords: *big data, healthcare, medical data systems, non-functional requirements, management, architecture, security, personalized medicine, data optimization.*

Introduction: The explosion of big data, characterized by its immense volumes of information, has captured the interest of various industries as they seek to harness its immense potential. Both public and private sectors are generating, storing, and analyzing vast quantities of data to enhance their services and drive innovation. In the realm of healthcare, big data sources encompass a diverse range of elements, from hospital records and patient medical histories to examination results and Internet of Things (IoT) devices. Furthermore, biomedical research plays a pivotal role in contributing substantial amounts of data to public healthcare (Dash et al., 2019). In the following sections, we will delve into each non-functional requirement, shedding light on their significance in designing robust and efficient medical big data systems.

Management and Analysis

The management and analysis of big data pose a unique set of challenges, necessitating the use of cutting-edge computing solutions to effectively harness its potential. According to (Dash et al., 2019) the proficient management, analysis, and interpretation of big data can pave the way for groundbreaking advancements in healthcare.

To tackle the complexity and volume of big data, it is essential to implement artificial intelligence (AI) algorithms and innovative fusion algorithms, which can help process, analyze, and extract valuable insights from vast amounts of information. These insights can significantly contribute to the improvement of healthcare services by enabling more accurate diagnoses, personalized treatments, and better patient outcomes.

Developing proper storage and analytical tools is equally crucial in managing big data. Efficient storage solutions can ensure data integrity and accessibility, while sophisticated analytical tools can facilitate data-driven decision-making, leading to more responsive, interactive, and efficient healthcare services. (Shafqat et al., 2020)

When designing medical big data systems, it is imperative to address these management and analysis challenges by incorporating advanced computing technologies and methodologies. A well-designed system should not only provide efficient storage and processing capabilities but also facilitate the seamless integration of AI algorithms and other analytical tools.

Efficient Architecture

Regarding Efficient Architecture, (Sebaa et al., 2018) highlight the challenges associated with processing vast quantities of medical data from diverse sources, as well as the limitations of traditional data warehousing frameworks. To address these challenges, the researchers propose a

Hadoop-based Medical Big Data Warehouse (MBDW), which not only presents an innovative data warehouse architecture but also explores research issues in conventional data warehouses.

The MBDW proposed by (Sebaa et al., 2018) employs partitioning and bucketing techniques to manage fact table growth and tackle the lack of primary and foreign keys in Apache Hive. By utilizing nested partitioning based on dimension table keys, the researchers offer a groundbreaking architecture for managing large-scale medical data. Their study demonstrates that nested partitioning in a Hadoop-based data warehouse can effectively resolve the issue of primary and foreign keys in Apache Hive.

Ultimately, the design and implementation of this new data warehouse architecture aim to ensure the fair distribution of health resources, demonstrating the potential of innovative solutions to revolutionize the handling of medical big data.

Security

In the realm of Medical Big Data Systems, non-functional requirements such as security are of paramount importance. (Sharma et al., 2021) introduce a smart contract-based architecture designed to enhance security by facilitating the storage, sharing, and access of healthcare data through a blend of distributed applications, smart contracts, and an Interplanetary File System (IPFS). Their investigation reveals that the proposed scheme encodes and processes healthcare data within IPFS, effectively reducing processing overhead while maintaining robust data protection. Moreover, this innovative approach enables the Medical Big Data System to verify the integrity of requested files, further bolstering the security of healthcare data. The study demonstrates that their smart contract-based architecture outperforms existing schemes,

showcasing its potential for improving both the security and efficiency of Medical Big Data Systems.

Furthermore, (EL Azzaoui et al., 2022) adopt a more futuristic perspective, delving into the challenges associated with large-scale medical data processing and exploring the potential of Quantum Information Science to enhance usability. They suggest employing scalable complex computation and search algorithms to efficiently process unstructured data, ultimately improving the Quality of Service (QoS) offered by intelligent healthcare systems.

The authors also propose a novel Blockchain-based delegated Quantum cloud architecture for medical big data processing and security, consisting of three distinct phases: Blockchain-cluster generation, Quantum Terminal Machine, and Quantum cloud-as-a-service. To assess the effectiveness of this solution, the authors compare it with related works in terms of scalability, efficiency, and security, finding that their proposed architecture boasts significant advantages over existing approaches, particularly in scalability and efficiency.

Conclusion

To realize the full potential of Medical Big Data Systems in revolutionizing healthcare, it's crucial to address non-functional requirements such as management, analysis, and security. Innovative approaches, including smart contract-based architectures, Hadoop-based data warehouses, and Quantum Information Science, offer promising advancements in tackling the challenges associated with large-scale medical data. By carefully considering these non-functional requirements when designing Medical Big Data Systems, we can ensure the efficient and secure handling of medical data. This attention to detail will enhance the Quality of Service (QoS) provided by intelligent healthcare systems, ultimately driving improvements in patient care and outcomes.

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