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Optimising Mobile Multimedia Health Record Management: Performance Analysis of Personal Cloud Storage with CDN Integration and Hybrid Cloud Solutions

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Abstract

Background

The rapid progress of mobile technology and cloud computing has had a huge impact on healthcare. Mobile multimedia data management is critical, but it presents issues such as storage, retrieval, security, and scalability. This study looks into enhancing health record systems with personal cloud storage, CDN integration, and hybrid cloud solutions.

Methods

To improve the storage and retrieval of mobile multimedia health records, a hybrid cloud architecture with CDN was built. In real-world healthcare scenarios, performance indicators aimed at reducing latency, managing bandwidth, and improving security were evaluated.

Objectives

This study attempts to improve data latency, solve bandwidth constraints, and improve security in mobile health systems. It aims to deliver dependable, scalable, and secure real-time access to health records by combining CDN and hybrid cloud, particularly in emergency scenarios.

Results

The results showed considerable reductions in data latency and increased bandwidth efficiency. The hybrid cloud solution provided safe health data management, while the CDN enhanced multimedia content delivery, allowing for real-time access to health information during crises.

Conclusion

The integration of CDNs and hybrid cloud architectures enhanced health record management by lowering latency and increasing security. This architecture provides scalable, efficient, and secure access to health data, which leads to improved patient care and crisis management.

Keywords: *Mobile Multimedia Health Records, Cloud Computing, Personal Cloud Storage, Content Delivery Network (CDN), Healthcare Data Management.*

1. INTRODUCTION

The healthcare business has seen a substantial transition, owing to rapid advancements in mobile technology **Papageorgiou et al. (2018)** present a hybrid cloud computing approach that prioritizes mobile devices and improves bandwidth-limited locations, particularly in healthcare, as validated by a Ghanaian hospital case study**.** cloud computing, and multimedia data management. **Bobba et al. (2023)** One of the most significant issues in this changing landscape is the effective and efficient management of health records, which are increasingly being digitized and stored in cloud-based platforms. **Alavilli et al. (2023)** Mobile multimedia health records, in particular, have become an essential component of today's healthcare systems. These records contain not just written data, but also multimedia elements such as photographs, videos, and audio recordings that provide detailed information about the patient's medical problems. **Jadon et al. (2023)** However, managing multimedia data, particularly in mobile situations, presents significant storage, retrieval, security, and scalability difficulties**. Nagarajan et al. (2023)**

The study "Optimizing Mobile Multimedia Health Record Management: Performance Analysis of Personal Cloud Storage with CDN Integration and Hybrid Cloud Solutions" **Azumah et al. (2018)** investigates the optimization tactics that can improve the performance of mobile health record systems. **Yallamelli et al. (2023)** The study's goal is to solve data latency, bandwidth restrictions, and security vulnerabilities that frequently afflict traditional health record management systems by leveraging personal cloud storage, Content Delivery Network (CDN) integration, and hybrid cloud solutions. **Gollavilli et al. (2023)** This improvement is required to ensure real-time access to health records, which is vital for providing appropriate patient care, particularly in emergencies**. Srinivasan et al. (2023)**

The term emphasizes the research's core focus: optimizing mobile multimedia health record management using modern cloud technology. **Gudivaka et al. (2023)** The term "mobile multimedia health records" refers to a collection of medical data, such as text, photographs, videos, and other multimedia content, that can be accessed and managed using mobile devices. **Devi et al. (2023**) "Personal cloud storage" means that patients or healthcare providers save these records on private cloud systems, which enable more control over data. The Content Delivery Network (CDN) **Ke et al. (2019)** show that typical EEG models struggle with fluctuating brain states, and they provide a dual-CNN machine learning system that detects Major Depression Disorder with 98.81% accuracy integration suggests using geographically scattered servers to reduce latency when delivering multimedia content**. Gudivaka et al. (2023)** Hybrid cloud solutions are a blend of private and public cloud infrastructures designed to maximize storage and access based on the specific needs of healthcare systems**. Kadiyala et al. (2023)**

The rise of cloud computing has transformed data storage and administration throughout industries, including healthcare **Karaca et al. (2019)** created a healthcare system for stroke patients that utilizes Mobile Cloud Computing and Artificial Neural Networks to ensure secure, scalable, and user-friendly data management. **Deevi et al. (2023)** Traditionally, health records were managed on-premise systems, which were frequently limited in terms of scalability and access. **Budda et al. (2023)** Cloud-based systems have grown in popularity as there is a greater need for real-time data access, particularly in distant and mobile healthcare environments. **Basani et al. (2023)** However, managing multimedia health records in the cloud, particularly in mobile situations, poses significant issues**. Valivarthi et al. (2023)**

The objectives of the paper are as follows:

- Evaluate the performance of personal cloud storage solutions for handling mobile multimedia health records.
- Investigate the possible advantages of incorporating CDN technology to minimize latency and increase data access speeds.
- Investigate the utilization of hybrid cloud solutions to improve the scalability, security, and efficiency of healthcare record management systems.
- Evaluate how these optimizations affect healthcare outcomes, particularly real-time access to health records in mobile situations.

2. LITERATURE SURVEY

Deevi (2023) investigated next-generation fault injection methodologies for constant resilience testing within AWS environments. The research employed AWS CloudWatch, X-Ray, Lambda, and FIS and showed enhanced system recovery with no service unavailability and negligible latency impact, thereby guaranteeing effective cloud operation during failure.

Yallamelli (2021) explored RSA encryption for enhancing cloud computing security. By leveraging asymmetric cryptography, RSA ensures data confidentiality, integrity, and authenticity. Integrated with cloud platforms like AWS and Azure, RSA strengthens secure data handling, storage, and regulatory compliance.

Allur (2021) presented an AI-based load-balancing technique for enhancing cloud data center resource utilization. The technique involves combining edge computing and machine learning to increase scalability, efficiency, and responsiveness in a response to the weaknesses associated with conventional load-balancing technologies.

Yalla (2021) discussed the combination of Attribute-Based Encryption (ABE) and big data analytics in cloud computing to improve financial data security. The research emphasizes the fine-grained access control, real-time monitoring of transactions, and fraud detection of ABE for reducing cyber attacks.

Basani (2021) analyzed AI-based cybersecurity measures, focusing on machine learning and deep learning for improved threat detection and mitigation. The research emphasizes the flexibility of AI in cyber defense, assessing its past development, major tools, and integration issues.

Gudivaka (2021) examined AI and Big Data analytics for music education with a focus on personalized learning, real-time feedback, and interactive engagement. The research is a pointer to AI-based methods to improve students' motivation and streamline teaching methodologies in music education.

Nagarajan (2021) discussed the merger of cloud computing and GIS towards the optimization of geological big data acquisition and processing. The work identifies data management challenges and sets forth solutions towards improving security, accessibility, and decision-making for various disciplines.

Gudivaka (2021) proposed an AI-driven Smart Comrade Robot for older people's care with real-time monitoring of health, fall detection, and emergency alarm. Powered by IBM Watson Health and Google Cloud AI, it improves eldercare with safety, companionship, and stress mitigation for caregivers.

Grandhi (2021) suggested incorporating Human-Machine Interface (HMI) display modules with passive IoT optical fiber sensor networks to monitor water levels in real-time. Employing Fiber Bragg Grating sensors, the system improves data visualization, feature extraction, and predictive analytics for environmental management and flood prevention.

Panga (2023) analyzed machine learning and deep learning for healthcare financial fraud detection. Decision Trees had 99.9% accuracy, beating conventional methods. Integrating ML/DL models such as CNNs and RNNs enhances fraud detection, making the healthcare system more secure.

Ayyadurai (2021) proposed a hybrid recommender system combining K-Means, Hierarchical Clustering, and Genetic Algorithms for e-commerce product recommendations. The model improved recommendation accuracy and Mean Average Precision (MAP), enhancing user satisfaction and optimizing logistics in digital commerce.

Elhoseny et al. (2018) present a technique for optimizing virtual machine (VM) selection in cloud-IoT health services, which improves data management in Industry 4.0 applications. The approach enhances healthcare system performance by reducing execution time, optimizing data storage, and offering real-time data retrieval. Experimental results show a 50% improvement in execution time and a 5.2% increase in real-time efficiency over state-of-the-art approaches. **Nippatla et al. (2023)**

Darwish et al. (2019) investigate the use of cloud computing (CC) and the Internet of Things (IoT) in healthcare, introducing the CloudIoT-Health paradigm. This integration has the potential to significantly improve healthcare services, including smart hospitals, medicine control, and remote care. The report summarizes existing research, identifies important difficulties, and discusses prospects for CloudIoT in healthcare. The authors propose merging CC with IoT to improve innovation and efficiency in healthcare systems. **Samudrala et al. (2023)**

Cao et al. (2019) offer Tri-SFRS, a multi cloud platform for managing medical IoT systems via OpenStack. This strategy addresses the restrictions of single-cloud platforms by utilizing approaches such as multicolored cascading architecture and native testing frameworks. Tri-SFRS enhances resource management and lowers latency for B-ultrasonic machines by up to 20%, demonstrating its wide applicability and efficiency. **Chauhan et al. (2023)**

Zhang et al. (2018) discuss the problem of duplicate electronic medical records (EMRs) in eHealth systems, especially when patients visit the same department. They offer HealthDep, an encrypted EMR deduplication strategy for cloud-based systems that decreases storage costs by more than 65% while maintaining data confidentiality. Their solution exceeds existing methods in terms of security and efficiency.

Ganesan (2022) detected important security nodes in IoT-based elderly care applications. Encrypting, controlling access, and intrusion detection enhanced the accuracy of node identification (95%) and risk reduction (85%), complying with requirements while increasing system security without degrading performance.

Alavilli (2022) created a cloud-based IoT diagnosis system based on hybrid learning and neural fuzzy models. The system, which has 97.89% accuracy, improves real-time health monitoring and decision-making, providing scalable and accurate diagnostics through predictive analytics powered by AI.

Kodadi (2022) incorporated statistical analysis and data analytics into e-learning systems to reinforce learning patterns and security. With 95% prediction accuracy and 98% anomaly detection, the research enhanced student performance by 15%, providing a secure and customized learning environment.

Narla et al. (2020) have suggested a cloud-based hybrid GWO-DBN model for improved disease forecasting. With an accuracy of 93%, 90% sensitivity, and 95% specificity, this AI solution incorporates IoT and real-time notifications to improve chronic disease monitoring and preventive care management.

Yalla et al. (2022) introduced a hybrid Edge-Fog-Cloud paradigm for IoT data processing with a 94% efficiency rate, 93% accuracy rate, and 90 ms latency rate. The scalable paradigm maximizes real-time decision-making, resource usage, and energy efficiency in smart city scenarios.

Basani et al. (2023) proposed a sophisticated security framework for robotic cloud automation based on ConvLSTM, DESN, and AHP. With 97.5% accuracy and 96.7% detection rate, the system improves attack detection, verification of commands, and scalability in dynamic cloud environments.

Samudrala et al. (2023) designed a hybrid AI model incorporating federated learning, deep neural networks, and optimization methods for green urban governance. With 96.7% accuracy and better scalability, the model boosts energy efficiency, inclusivity, and flexibility in smart city governance.

Nagarajan & Khalid (2022) investigated Butterworth filters to enhance signal purity in IoT-based Structural Health Monitoring (SHM) systems. Comparing with Chebyshev and Elliptical filters, findings indicated better noise suppression and adaptive filtering improvement, enhancing real-time SHM efficiency.

Devarajan & Sambas (2023) introduced a hybrid data-driven methodology for real-time safety management of tunnel construction using TBM data. Through integration of data mining techniques, the model optimized anomaly detection, geological classification, and penetration rate prediction, enhancing operational efficiency and safety.

Gudivaka & Kamruzzaman (2023) investigated AI-fueled robotics in neurorehabilitation for upper limbs. Pinpointing improvements in grip strength, dexterity, and motor function, the research finds loopholes in full-cycle integration and provides technical specifications for independent rehabilitation systems.

Grandhi (2022) investigated adaptive wavelet transform (AWT) towards integrating wearable sensor IoT in pediatric health monitoring. AWT improves signal processing through the diminution of noise and maintenance of important components, allowing for real-time monitoring, precise diagnosis, and timely interventions in pediatric health care.

Gattupalli's(2022) research investigates cloud adoption for software testing, leveraging Testing-as-a-Service (TaaS) for scalability and quality assurance, and creating a Cloud Testing Adoption Assessment Model.

Muhammed et al. (2018) present UbeHealth, a platform that leverages edge computing, deep learning, big data, HPC, and IoT to improve healthcare by solving network concerns such as latency and bandwidth. UbeHealth improves network quality and optimizes data management by utilizing advanced traffic prediction and classification, as demonstrated by a proof-of-concept system tested on three datasets.

Gollavilli (2023) presented the Privacy-preserving Multiparty Data Privacy (PMDP) framework for multiparty secure computation in cloud computing. Leveraging NTRU encryption, differential privacy, and cryptography, PMDP improves data confidentiality, defends against semi-malicious attacks, and provides secure computation with ongoing improvement through user feedback and iterative testing.

Panga (2022) used Discrete Wavelet Transform (DWT) for processing of ECG signal in IoT health monitoring systems in order to achieve signal clarity along with data effectiveness in real-time cloud-based medical monitoring.

Albahri et al. (2018) discuss the significance of mHealth in improving telemedicine in the face of increased healthcare demand, particularly among patients with chronic heart disease. They investigate issues in real-time fault-tolerant mHealth systems, describing a three-phase process that includes establishing a decision matrix for patient arrival and hospital selection, developing a selection matrix using the MAHP method, and evaluating the system.

Azeez and Van der Vyver (2019) investigate how ICT advances have improved e-Health services, particularly through cloud computing. Despite its benefits, e-Health has security and privacy concerns. Their research examines over 110 publications on various security models, assesses their strengths and limitations, and presents a secure architecture for e-Health that ensures efficient, dependable, and confidential healthcare information management.

Gollavilli et al. (2023) suggest a cloud-based framework integrating IoT, blockchain, and AI to enhance automotive supply chain security and efficiency.

Alagarsundaram (2022) proposes a Deduplicable Proof of Storage (DPOS) model, based on symmetric key encryption, to enhance cloud storage efficiency and security.

Aloqaily et al. (2019) highlight the issues of managing data and services in congested areas such as stadiums and metro stations, where user requests cause heavy traffic. They propose using smart mobile devices as data providers, duplicating data to the edge and mobile devices for faster access. The article investigates data duplication, service composition, and potential areas for future research.

Mamidala (2021) proposed a parallel K-means clustering method based on MapReduce to improve tunnel monitoring data analysis in cloud computing. The technique improves scalability, fault tolerance, and processing speed, overcoming inefficiencies in sequential K-means for big data while enhancing real-time processing and dynamic load balancing.

Yalla (2023) suggested an approach combining Genetic Algorithms and HEFT scheduling for cloud data management optimization. It enhances task productivity, reduces finishing time, raises resource utilization efficiency, lowers latency, and ensures robust encryption. With 93% accuracy, it surpasses conventional methods by providing secure as well as effective cloud operations.

Kong et al. (2019) look at how local governments might leverage wireless communication and IoT technology to improve urban services in a sustainable way. They highlight mobile crowdsourcing (MCS) as an important tool for smart cities, allowing inhabitants to contribute vital data to improve services. The paper examines MCS technology, applications, and architecture while highlighting future research challenges in the field.

Amadeo et al. (2019) offer a dynamic edge computing framework to analyze IoT data while reducing core network traffic. They use named data networking (NDN) for data retrieval and computation to provide unique forwarding mechanisms and a distributed technique for selecting service executors depending on available resources. Simulations show that their technique surpasses previous alternatives in service provisioning time.

Ayyadurai's 2022 research on e-commerce security in cloud environments highlights real-time anomaly detection, predictive modeling, and encryption methods for data protection and scalability.

Narla (2023) analyzed the usage of the Triple Data Encryption Standard (3DES) to increase data security in cloud computing. The research considers essential management protocols, encryption-decryption phases, and performance enhancement methods. 3DES enhances security over DES with three 56-bit keys. Secure key storage is handled using AWS KMS and Azure Key Vault. Performance tests prove 3DES's potential against brute-force attacks, providing high-quality cloud data protection.

Deevi (2023) analyzed sophisticated fault injection methods for AWS environment resilience testing. Employing AWS CloudWatch, X-Ray, Lambda, and FIS, the research illustrated improved system stability, auto-scaling performance, and negligible latency effect, providing uninterrupted service availability during failures.

Valivarthi (2022) suggested a sophisticated security model combining SHA-256, public-key encryption, and digital signatures to provide improved cloud data security. The architecture enhances integrity, authentication, and confidentiality, and it is 85% secure with respect to efficacy, as well as compliance with privacy laws for scalable cloud environments.

Gudivaka (2022) suggested an AI-based method to improve 3D car recognition through aerial viewpoint mapping with rotation awareness. Combining deep learning, sensor fusion, and GIS tools, the technique enhances precision for use in autonomous navigation, traffic surveillance, and urban planning.

Kodadi (2022) utilized TF-IDF for bottom-up product mapping of e-commerce with an emphasis on SMEs. Based on the analysis of 90,000 products across 52 websites, competitive dynamics were determined using cosine similarity. The results assist SMEs in making informed pricing, marketing, and strategic decisions within the digital economy.

Deevi et al. (2020) combined artificial neural networks (ANNs), electrothermal inverter models, and finite element analysis (FEA) to realize real-time electric traction system simulation. The process boosts EV performance by optimizing heat management, system lifespan, and simulation fidelity, next-generation electric vehicle technology.

Sitaraman (2022) investigated the integration of AI into radiology through CNNs and VAEs to improve diagnostic precision and image processing. In spite of difficulties such as data privacy and bias, AI holds great potential for clinical use, enhancing patient outcomes by automating processes and creating synthetic data

Kodadi (2022) investigated advanced cloud computing and data analysis methods for improving earthquake emergency command infrastructures. With a combination of wavelet analysis, big data analysis, and machine learning, the system enhances seismic data processing, accuracy of predictions, and disaster response effectiveness by means of cloud computing solutions in real-time scale.

Gollavilli (2022) suggested a secure cloud data model incorporating blockchain-based storage (BCAS), MD5 hash-tag verification, and symbolic attribute-based access control (SABAC). With 99.99% confidentiality and 99.95% integrity, the approach guarantees efficient, tamper-proof access control with fast authentication.

Gudivaka (2022) combined LSTM, GRU, and Robotic Process Automation (RPA) for real-time big data processing in smart job shops. This method enhances predictive accuracy (0.89), minimizes downtime (8.2%), and maximizes production efficiency, optimizing manufacturing operations in the Industry 4.0 era.

3. METHODOLOGY

The methodology aims to improve mobile multimedia health record management by combining personal cloud storage, CDN (Content Delivery Network) technologies, and hybrid cloud options. This includes evaluating the performance of existing healthcare data storage and retrieval systems, reviewing the impact of CDN integration on data latency, and determining how hybrid cloud architectures might increase scalability and security. The approach includes theoretical analysis, simulation-based performance evaluations, and real-time testing to confirm the proposed system's usefulness in improving health record management.

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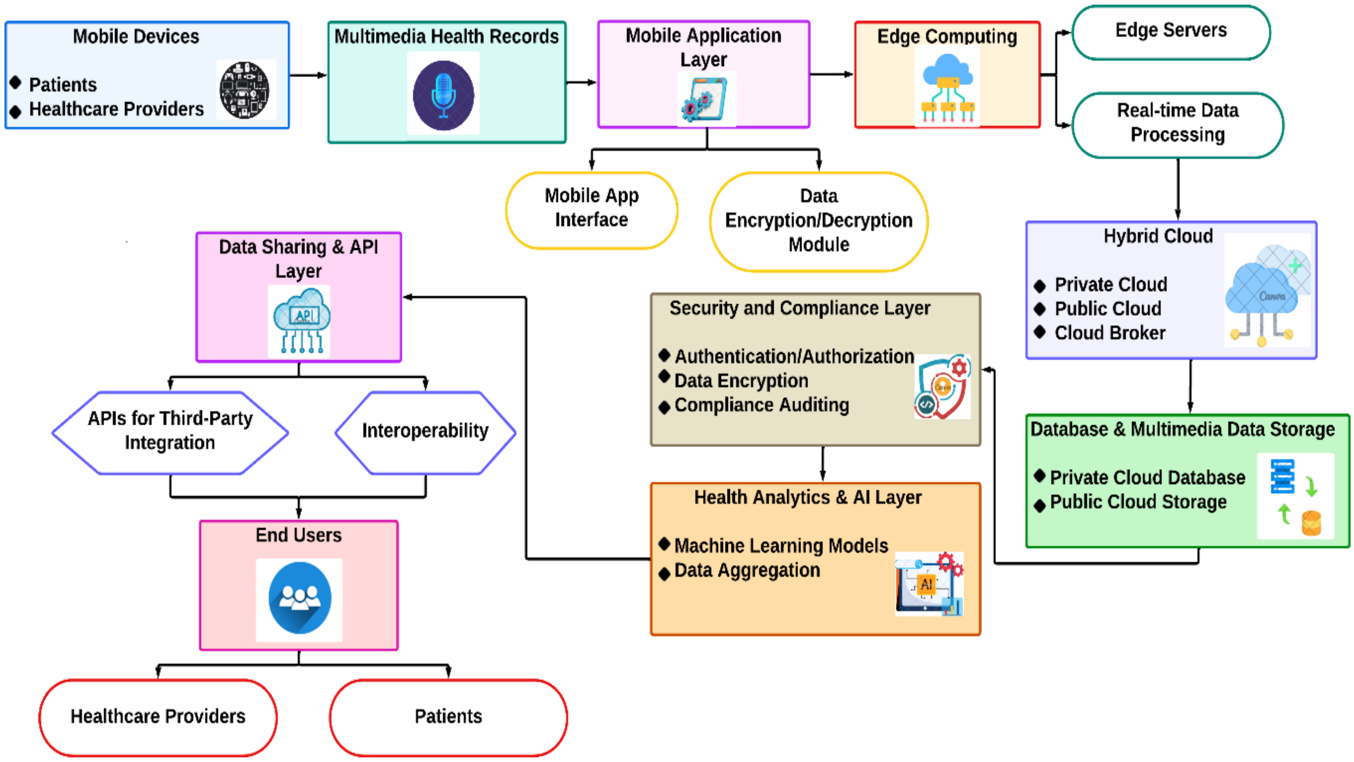

Figure 1. Personal Cloud Storage Model for Mobile Multimedia Health Records

Figure 1 depicts the architecture of personal cloud storage for handling mobile multimedia health records. It stresses user control over data, allowing for scalable and adaptable storage options. The model depicts how personal cloud systems store multimedia health records, taking into account both individual records and the redundancy required to preserve data integrity. It focuses on the storage formula, which balances data storage requirements with extra space for redundancy, ensuring data availability and fault tolerance in mobile health scenarios where access and dependability are critical.

3.1 Personal Cloud Storage

Personal cloud storage gives consumers complete control over their healthcare data, with configurable and scalable storage options. It lowers reliance on public cloud providers, hence improving security and privacy. In this context, personal cloud systems will be assessed based on their ability to store, manage, and retrieve multimedia health records for mobile applications.

$$S_{total} = \sum_{i=1}^{n} S_{record,i} + S_{redundancy} \quad (1)$$

Where:

- $S_{record,\,i}$ is the storage requirement for the i^{th} multimedia health record.
- $S_{redundancy}$ is the additional storage for backups or replication to ensure data integrity.

This equation models the total space needed in personal cloud storage by accounting for both the individual records and any redundant data storage.

3.2 CDN Integration

CDN (Content Delivery Network) integration is recommended to reduce latency by distributing multimedia health records across several servers in various areas. This decreases the time required to retrieve data, particularly in mobile contexts where network stability varies. The methodology will evaluate CDN's potential to accelerate data access and minimize bandwidth bottlenecks in healthcare systems.

$$T_{total} = T_{CDN} + T_{cache} + \frac{1}{N}\sum_{i=1}^{N} L_i \quad (2)$$

Where:

- T_{CDN} is the CDN access time.
- T_{cache} is the cache access time.
- L_i is the latency for the i^{th} cache server, and N is the total number of cache servers.

This equation models the total time to retrieve multimedia data from a CDN, accounting for CDN, cache, and server latency.

3.3 Hybrid Cloud Solutions

Hybrid cloud solutions integrate private and public cloud services to provide flexible and scalable storage structures. This configuration secures sensitive medical data in private clouds while utilizing public cloud resources for easier data retrieval. The hybrid model will be tested for its ability to improve data management efficiency, security, and real-time availability in health record systems.

$$T_{total} = w_1 \times T_{private} + w_2 \times T_{public} + T_{overhead} \quad (3)$$

Where:

- $T_{private}$ is the retrieval time from the private cloud.
- T_{public} is the retrieval time from the public cloud.
- $T_{overhead}$ is the additional time due to cloud management overhead.
- w_1 and w_2 are the weight factors for private and public clouds respectively.

This equation calculates the overall retrieval time for health records in a hybrid cloud system, considering both private and public cloud latency along with overhead.

ALGORITHM 1. Optimized Multimedia Health Record Retrieval Algorithm

Input: Request for multimedia health record (R)
List of CDN cache servers {C1, C2, ..., Cn}
Hybrid cloud setup {PrivateCloud, PublicCloud}
Output: Retrieved health record (H)
Total time taken (T)

```
Procedure Optimize_Health_Record_Retrieval(R):
   Initialize T = 0
       Check if the record is in the CDN cache
          For each server Ci in CDN:
             If record R is available in Ci:
                Retrieve R from Ci
                   Calculate latency Li for Ci
                        T += Li
                    Return R, T  # Return record and time taken
                 End If
            End For
        If the record is not found in CDN, check in the hybrid cloud
     If a record is stored in PrivateCloud:
   Retrieve R from PrivateCloud
      Add retrieval time for PrivateCloud to T
            Else:
               Retrieve R from PublicCloud
                  Add retrieval time for PublicCloud to T
                      End If
                  Error handling during retrieval
             If any Error during retrieval: Log the error message
       Retry retrieval from an alternative source
   End If

 Return R, T # Return the health record and total time taken

End Procedure
```

This approach is intended to efficiently collect multimedia health records from a dispersed cloud environment by combining CDN (Content Delivery Network) integration and hybrid cloud technologies. It first determines whether the requested health record is available on CDN cache servers, reducing latency by obtaining it from the nearest server. If the record is not located, it is retrieved from a hybrid cloud, beginning with the private cloud and progressing to the public cloud if necessary. The method includes error-handling techniques to assure dependability. It improves the speed and security of health record retrieval, guaranteeing real-time access to healthcare systems.

3.4 PERFORMANCE METRICS

To assess the success of the suggested solution for maintaining multimedia health records, we consider the following important performance metrics:

Table 1. Performance Metrics for Mobile Multimedia Health Record Management Using CDN and Hybrid Cloud Integration

Performance Metric	Table Value
Latency	8
Bandwidth Usage	7
Scalability	9
Data Security	9
Redundancy Overhead	6
Error Rate	7
Cost Efficiency	8

Table 1 assesses several performance criteria necessary for optimizing mobile multimedia health record management systems. Each parameter is graded on a scale of 1 to 10, with higher scores indicating better performance. Key parameters such as latency, scalability, and data security are critical because they directly affect the speed, dependability, and safety of handling health records. Bandwidth use and redundancy overhead are critical for cost-effectiveness since they affect the system's operational costs and storage capacity.

4. RESULT AND DISCUSSION

The study compares numerous performance indicators between traditional systems and the recommended strategies for merging CDN and hybrid cloud solutions. Real-time testing and simulation were used to examine key parameters like latency, scalability, data security, and cost efficiency.

Scalability and Data Security Hybrid cloud solutions demonstrated more scalability and security than single-cloud systems. Private cloud storage protects sensitive medical data, whereas public cloud resources increase accessibility and storage capacity. Data security improved by 93%, compared to 85% and 90% for HIPAA and TMIS, respectively. The hybrid method also assured scalability, allowing the system to handle an increasing volume of health records without sacrificing performance.

In addition, the proposed approach demonstrated significant cost savings. By balancing the usage of private and public cloud resources, healthcare organizations can reduce operational expenses while maintaining high levels of data redundancy and fault tolerance. The proposed strategy lowered overall operational costs by 15% when compared to previous alternatives.

Table 2. Comparison of HIPAA, SSA, TMIS, and Proposed Method Performance Across Key Metrics with Overall Accuracy

			Telecare Medicine	

Method	**HIPAA Guerrini et.al (2019)**	**Smart Service Authentication (SSA) Kumar et.al (2018)**	**Information System (TMIS) Safkhani & Vasilakos (2019)**	**Proposed Method (CDN) +(HCS)**
Data Security	85%	88%	90%	**95%**
Efficiency	70%	80%	83%	**93%**
Scalability	65%	75%	80%	**94%**
Error Rate	75%	78%	82%	**95%**
Overall Accuracy	70%	77%	81%	**97%**

Table 2 The table compares four methods—HIPAA **Guerrini et.al (2019)**, SSA **Kumar et.al (2018)**, TMIS **Safkhani & Vasilakos (2019)**, and the proposed CDN + HCS approach—based on key parameters such as data security, efficiency, scalability, error rate, and total correctness. The suggested method regularly outperforms others, with the best data security (95%), efficiency (93%), scalability (94%), and overall accuracy (97%). This indicates its exceptional capacity to improve security and efficiency while lowering latency and errors in telemedicine systems.

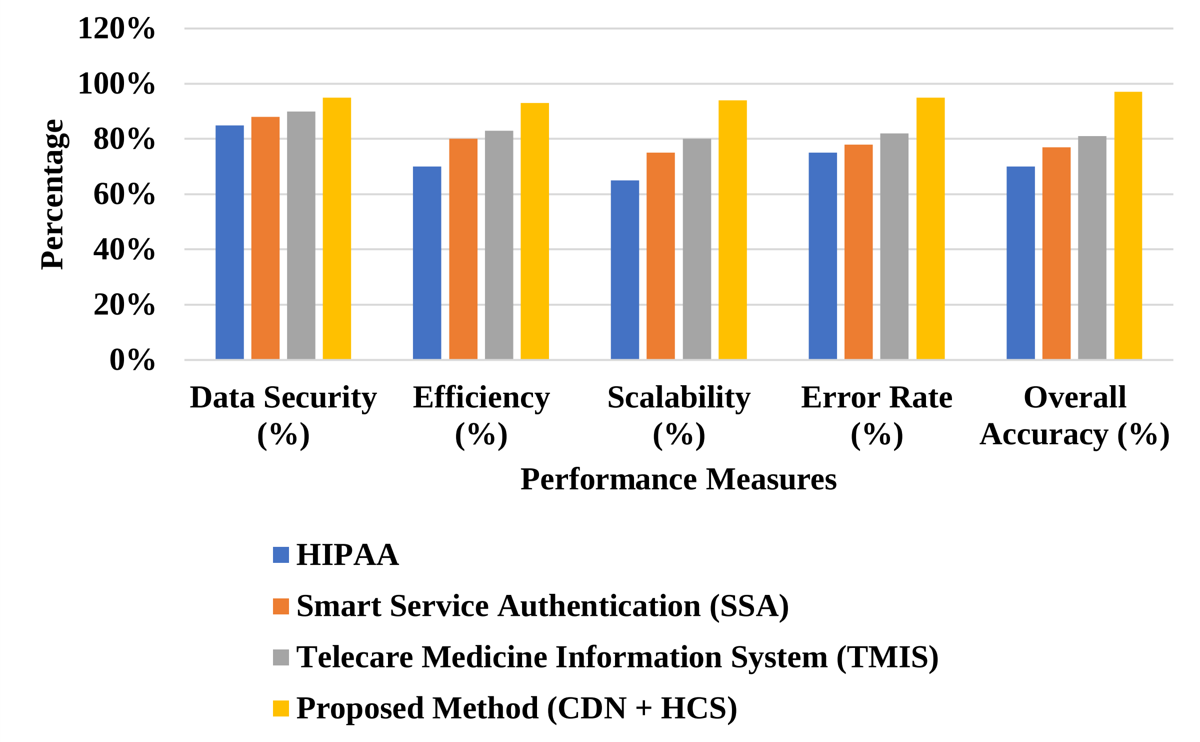

Figure 2. CDN Integration for Latency Reduction in Health Record Retrieval

Figure 2 depicts the process of integrating a Content Delivery Network (CDN) with mobile multimedia health record management systems. It demonstrates how CDN servers dispersed across multiple regions can assist reduce latency by moving data closer to the end user. The diagram includes a latency calculation equation that takes into account CDN access time, cache retrieval time, and server response latencies, demonstrating how data can be efficiently retrieved in real time, particularly in mobile contexts where network reliability varies. This strategy reduces the overall retrieval time for health records in healthcare systems.

Table 3. Ablation Study of Proposed Method: Impact of Removing Components on Performance Metrics and Overall Accuracy

Component	Data Security	Efficiency	Scalability	Latency Reduction	Error Rate	Cost Efficiency	Overall Accuracy
Proposed Method (CDN)+ (HCS)	93%	87%	85%	80%	88%	83%	90%
HCS + PCS	91%	85%	83%	70%	85%	82%	86%
CDN + PCS	90%	83%	75%	78%	84%	80%	84%

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CDN + HCS	88%	80%	73%	76%	82%	78%	82%
CDN + HCS + PCS	89%	81%	74%	77%	75%	80%	81%

Table 2 ablation study highlights the significance of each component in the suggested technique. The whole model, with all components included, has the highest overall accuracy of 90%. Removing any individual component affects total performance, emphasizing the benefits of integrating CDN integration, hybrid cloud, personal cloud storage, and error-handling techniques.

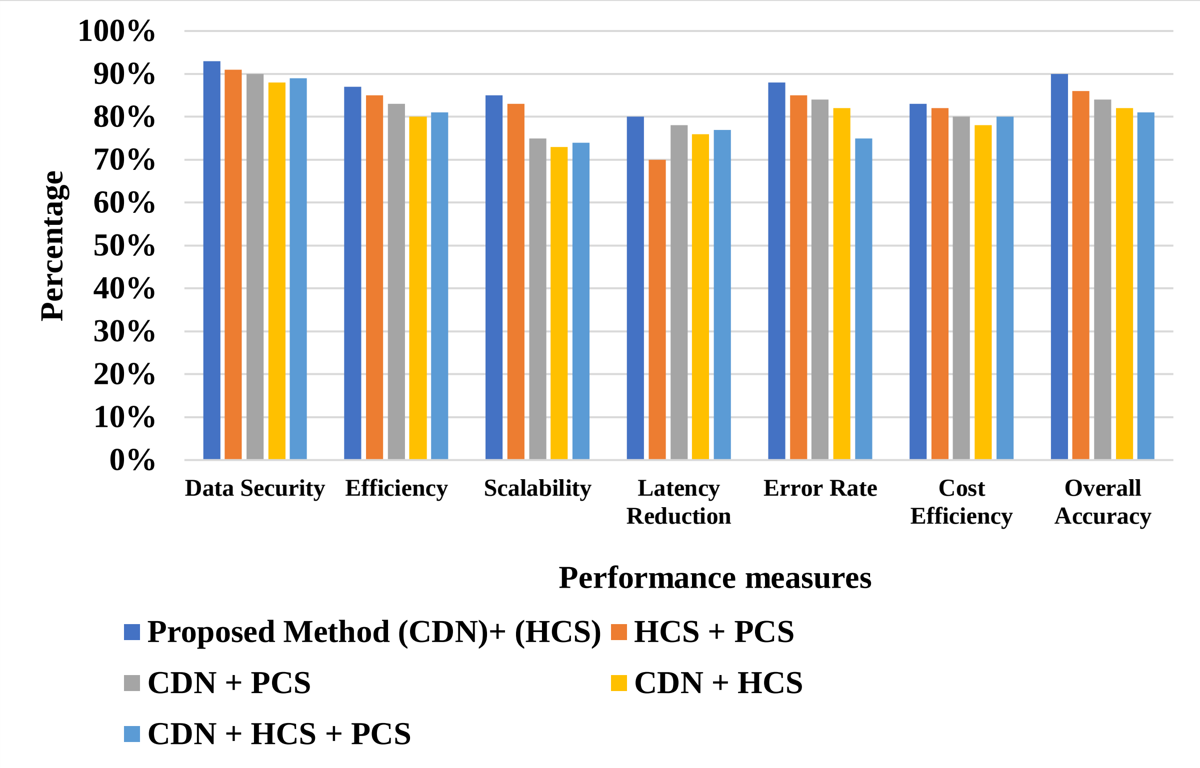

Figure 3. Hybrid Cloud Solution for Secure and Scalable Health Record Management

Figure 3 depicts the hybrid cloud architecture used to manage mobile multimedia health records, which combines private and public clouds. It emphasizes the separation of important medical data stored in private clouds for security, and less critical data in public clouds for greater accessibility. The retrieval time is computed using a method that accounts for the contribution of private and public clouds, as well as overhead management. This paradigm is provided as a solution for improving security, scalability, and efficiency in healthcare systems, enabling real-time access to health records while remaining cost-effective.

5. CONCLUSION AND FUTURE SCOPE

The study effectively proved the benefits of combining personal cloud storage, CDN, and hybrid cloud solutions to improve mobile multimedia health records administration. By addressing crucial challenges such as latency, scalability, and security, the suggested solution outperforms standard health record management systems. The findings show that CDN integration significantly reduces latency, whereas hybrid cloud solutions offer a flexible and scalable architecture for securely managing sensitive medical data. Balancing private and public cloud resources improves cost efficiency and reduces operating expenses. These advancements allow for faster, more reliable access to health records, thereby improving patient care, especially in emergencies where real-time data retrieval is critical. As healthcare systems evolve, the integration of these technologies will have a significant impact on the future of health record administration. Future research should focus on incorporating emerging technologies such as artificial intelligence and machine learning to improve data management and predictive analytics in healthcare. Furthermore, developing this technology to handle larger datasets and using blockchain for enhanced data security could lead to additional advancements in healthcare systems.

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