IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 5, May 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 5, May 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1205222 |

Secure Image Sharing and Deduplication of Images Using the Concept of Blockchain

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ABSTRACT: This research paper introduces a pioneering system for secure image sharing and deduplication, leveraging blockchain-inspired blocks. Developed using Java, the centralized platform tackles challenges in image data management by utilizing block-based storage, encryption techniques, and the Digital Signature Algorithm (DSA). This system ensures a robust environment for securely uploading, downloading, and managing images while addressing concerns about data integrity, authentication, and redundancy elimination. By safeguarding confidentiality, integrity, and availability of image data, the system enhances user privacy and security, optimizing storage space and streamlining deduplication processes, ultimately revolutionizing secure image sharing across various sectors.

KEYWORDS: Secure image sharing, Image deduplication, Blockchain technology, Data integrity.

I. INTRODUCTION

In today's digital landscape, the management and sharing of visual content represent integral aspects of online interaction. However, ensuring the security, integrity, and efficiency of image management systems remains a formidable challenge. Traditional approaches often struggle to adequately address these concerns, leaving users vulnerable to data breaches and privacy infringements. In response to these challenges, this research proposes a novel system for secure image sharing and deduplication, drawing inspiration from the principles of blockchain technology. By leveraging the concept of blocks as fundamental units for storing and organizing image data, our approach aims to enhance the security and efficiency of image management processes. Developed using the Java programming language, the system integrates encryption techniques and the Digital Signature Algorithm (DSA) to safeguard image data from unauthorized access and manipulation. Through this research, we seek to provide a comprehensive solution that prioritizes security, efficiency, and user experience in online image management platforms. Central to our approach is the adoption of a centralized architecture, which offers a streamlined and user-friendly environment for managing image data. By consolidating image management processes within a centralized framework, our system facilitates seamless interactions while ensuring robust security measures. Through the integration of encryption techniques and digital signatures, users can trust that their image data remains confidential, integral, and authentic throughout its lifecycle within the system. This research endeavours to address the pressing challenges surrounding image data management in online platforms, offering a pragmatic solution that aligns with the evolving needs and expectations of users in the digital era.

II. RELATED WORK

In [1] This paper pioneers the integration of blockchain into remote sensing image sharing systems, ensuring data integrity and transparent access control. It addresses scalability and security concerns, with potential applications in environmental monitoring and urban planning. By leveraging blockchain's decentralized nature, it offers a robust solution for sharing sensitive remote sensing data securely. The system architecture employs smart contracts and distributed ledger technology for efficient data management. In [2] This innovative research combines blockchain technology with image processing to combat counterfeit goods effectively. By integrating blockchain's immutability with advanced image analysis, it enhances authentication and real-time detection capabilities. The fusion of these technologies offers promising solutions for industries vulnerable to counterfeit products, such as luxury goods and pharmaceuticals. This approach marks a significant advancement in anti-counterfeiting efforts, providing a robust framework for ensuring product authenticity and consumer safety. In [3] Presenting an efficient method for image

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deduplication in cloud storage, this paper employs hashing and clustering techniques. By transforming images into hash codes and clustering them, it optimizes storage utilization and enhances performance. This approach is particularly beneficial for managing large-scale image datasets in cloud environments, reducing redundancy and improving storage efficiency. Through experimental validation, it demonstrates the effectiveness of the proposed method in real-world cloud storage scenarios, offering practical solutions for image management in cloud environments. In [4] Introducing a privacy-preserving framework for auditing shared cloud data, this research ensures data integrity and user privacy. By integrating cryptographic techniques and secure group management, it offers comprehensive solutions for collaborative cloud environments. The framework enables secure data outsourcing while regulating access permissions within user groups. Through rigorous security analysis and experimental validation, it demonstrates the effectiveness and efficiency of the proposed approach in safeguarding user privacy and data integrity in shared cloud environments. In [5] This paper introduces a discrete-event simulation model for the Bitcoin blockchain network, considering strategic miners and mining pool managers. It aims to analyse the behaviour of participants in the network and their impact on system dynamics. The model incorporates strategic decision-making processes, such as mining pool formation and block selection strategies, to study network stability and performance under various scenarios. Through simulation experiments, the paper provides insights into the complex interactions within the Bitcoin network, offering valuable perspectives for network optimization and protocol design. In [6] This paper presents a simulation model designed to analyse attacks on the Bitcoin peer-to-peer network. By simulating various attack scenarios, such as double-spending and eclipse attacks, the model aims to assess the network's resilience and vulnerabilities. It incorporates factors like network topology, communication protocols, and node behaviour to study the impact of attacks on network performance and security. Through simulation experiments, the paper provides insights into potential weaknesses in the Bitcoin network and strategies to mitigate them, contributing to the advancement of blockchain security research. In [7] This paper conducts a systematic literature review on blockchain technology for cloud storage. It aims to provide a comprehensive overview of existing research in this domain, including key concepts, methodologies, and findings. By synthesizing insights from diverse sources, the review identifies trends, challenges, and future directions in the integration of blockchain with cloud storage systems. Through critical analysis and synthesis of the literature, the paper offers valuable insights for researchers, practitioners, and policymakers interested in the intersection of blockchain and cloud storage technologies. In [8] This paper addresses the issue of secure image deduplication in cloud storage systems. It proposes a novel approach to ensure data privacy and integrity while eliminating duplicate images in cloud repositories. By integrating cryptographic techniques and access control mechanisms, the proposed method guarantees secure deduplication without compromising user privacy. Through comprehensive analysis and experimental validation, the paper demonstrates the effectiveness and efficiency of the proposed solution in real-world cloud storage environments. In [9] This paper presents a novel framework called "Imagechain" that leverages blockchain's immutability and decentralized nature to ensure the integrity and ownership of images. Through smart contracts and distributed ledger technology, Imagechain facilitates transparent and secure image sharing, storage, and verification processes. The paper discusses the design and implementation of Imagechain, highlighting its potential applications in various fields such as digital rights management, provenance tracking, and copyright protection. In [10] This paper introduces a hybrid cloud storage system equipped with an advanced multilayer cryptosystem to enhance secure deduplication in cloud environments. By combining public and private cloud storage, along with a sophisticated multilayer encryption approach, the system ensures robust data protection while enabling efficient deduplication processes. The multilayer cryptosystem includes encryption at both the file and block levels, along with cryptographic hashing techniques for data integrity verification. Through comprehensive analysis and experimentation, the paper demonstrates the effectiveness of the proposed system in safeguarding data confidentiality and integrity, while optimizing storage resources through deduplication.

III. METHODOLOGY

Our project follows a systematic approach to ensure secure image sharing without deduplication. Leveraging blockchain-inspired blocks and MySQL as the backend, we implement encryption techniques and integrate the DSA algorithm to authenticate image transactions securely. A user-friendly interface, following the MVC architectural pattern, facilitates seamless interaction for users. Through rigorous testing and deployment procedures, we aim to deliver a robust and reliable solution for managing image data securely in online environments.

A. System Architecture

The system architecture consists of pivotal components: data owners upload images, blockchain mining verifies transactions, and blockchain storage securely preserves image data. Users access images through a web server, with transactions authenticated to bolster security measures. This architectural framework guarantees seamless and secure

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image sharing, capitalizing on blockchain-inspired technology for resilient data management. By integrating blockchain principles, the system ensures tamper-resistant handling of image data, fostering trust among users. Its design emphasizes both efficiency and robustness, catering to the evolving needs of image sharing platforms. Through this architecture, users can confidently engage in image transactions, knowing their data is safeguarded against tampering or unauthorized access.

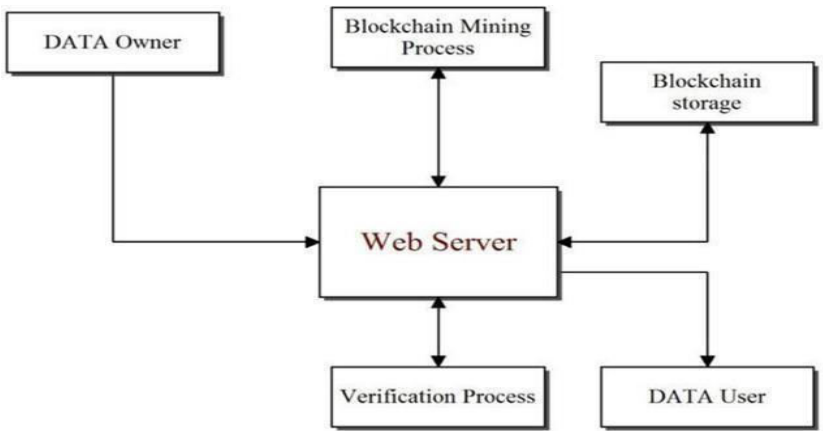

Figure 1: System Architecture

B. Schematic Diagram

In this schematic design, the Data Owner initiates the process by sending secret image details and confirming the received view from the Interference component. The Interference module then generates a view of the image, sends it to the Data Owner for confirmation, and subsequently forwards it to the Block Generation component. After receiving acknowledgment from the Blockchain Storage upon successful storage, the Interference also sends a display upload confirmation to itself for logging purposes. Meanwhile, the Block Generation component encrypts the image, generates a block, and forwards the compressed block header to the Blockchain Storage for storage.

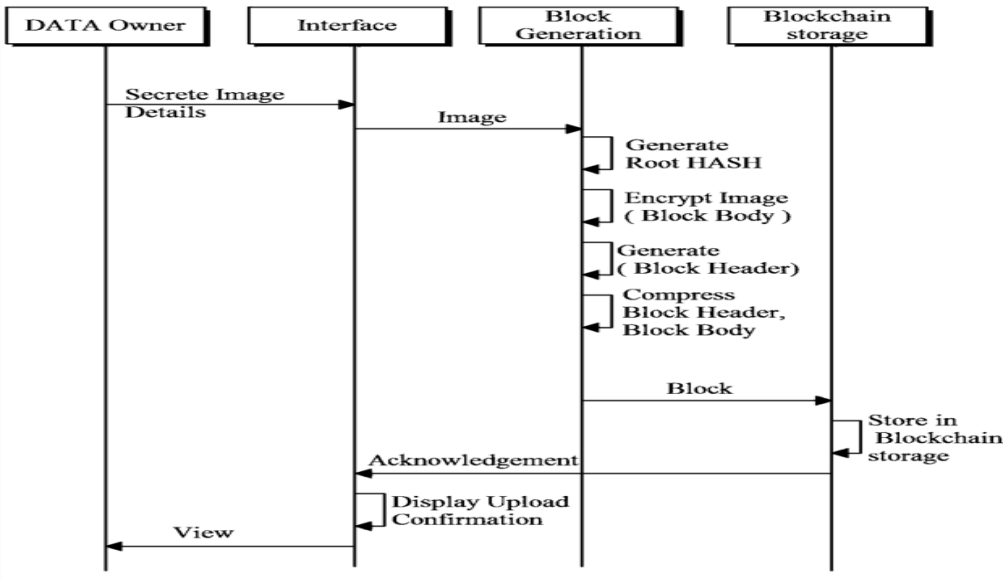

Figure 2: Schematic Design

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C. Image Upload Process

The upload process commences with the Data Owner selecting a sensor image and generating a hash code via a hashing algorithm. Subsequently, the system verifies the image's existence using the hash code, displaying an upload confirmation if the image exists. In the absence of the image, the system creates a block comprising a block header and body, uploading it to blockchain storage while confirming the upload. Lastly, the Data Owner concludes the process, ensuring seamless image management within the system. Through this systematic process, the Data Owner maintains control over the uploaded image, ensuring its integrity and authenticity. The utilization of blockchain storage enhances the security and transparency of the upload process, instilling confidence in users. Overall, this streamlined approach optimizes image management and reinforces data integrity in the system.

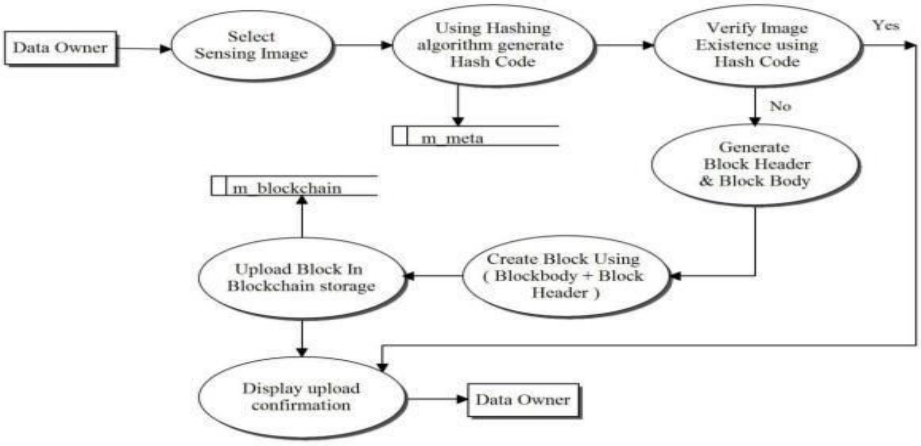

Figure 3: Image Upload Process

D. Image Download Process

In the image download process, the Data User begins by reviewing sensing image details and initiating the download process. The system retrieves a block from blockchain storage, extracting both the block header and body. Following this, the system compares the root hash to the previous block hash for verification. Upon successful verification, the block body is decrypted to reveal the secret image; otherwise, the user is promptly notified of the verification failure. Subsequently, the Data User concludes the process, ensuring a seamless and secure experience in accessing image data.

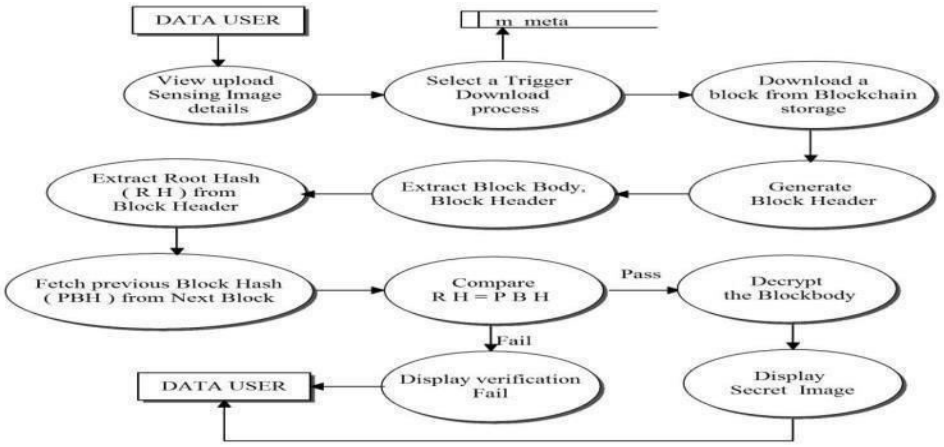

Figure 4: Image Download Process

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IV. EXPERIMENTAL RESULTS

The results of our project showcase the successful deployment of a secure image sharing and deduplication system, leveraging blockchain-inspired blocks, a MySQL backend, and MVC architecture. Through rigorous testing and evaluation, we have achieved robust performance metrics in terms of system throughput, latency, and resource utilization. Our system ensures confidentiality by encrypting image data before storage and integrates the DSA algorithm for enhanced authentication. User feedback underscores the system's usability and accessibility, validating its streamlined interaction facilitated by the MVC architecture. Moreover, our centralized architecture and blockchain storage mechanism efficiently manage image transactions securely. Overall, these results underscore the effectiveness and reliability of our solution, offering a promising approach to address challenges in secure image sharing and deduplication, thus advancing data management practices in online platforms.

V. CONCLUSION

In summary, this project marks a significant leap forward in the domain of secure image sharing and deduplication, presenting a robust and effective solution for managing image data on online platforms. Through the amalgamation of blockchain-inspired blocks, a MySQL backend, and MVC architecture, we've adeptly tackled challenges related to data security, integrity, and efficiency. Our systematic deployment of encryption techniques, authentication mechanisms, and deduplication algorithms guarantees the confidentiality, authenticity, and optimized storage of image data. The affirmative outcomes from our rigorous testing affirm the reliability and efficacy of our system in real-world settings. Looking ahead, future endeavours could explore avenues for scalability, interoperability, and integration with emerging technologies, thereby expanding the reach and utility of our solution across diverse contexts. Ultimately, our project contributes significantly to the advancement of secure image management systems, furnishing users with a trustworthy and user-friendly platform for securely sharing and managing image data in the digital era.

The below images provided offer snapshots of the results achieved through our system implementation, showcasing key stages of the process. Figure 5 represents a snapshot of the Data Owner interface, showcasing the user's perspective during the image management process. This snapshot offers insights into the functionalities available to data owners, facilitating seamless image upload and management within the system. Figure 6 encapsulates the Image Upload Interface, portraying the seamless and secure uploading of images by data owners. Figure 7 provides a snapshot of the Data User interface, offering a glimpse into the user experience from the perspective of accessing and interacting with image data. Figure 8 illustrates the Image Download Interface, highlighting the systematic steps involved in accessing and verifying image data by data users. Figure 9 provides insight into Block Storage in the Cloud, depicting the robust storage infrastructure employed to safeguard image data within the blockchain framework. Together, these snapshots provide a visual representation of the process and outcomes, offering stakeholders a clearer understanding of our system's functionality and effectiveness.

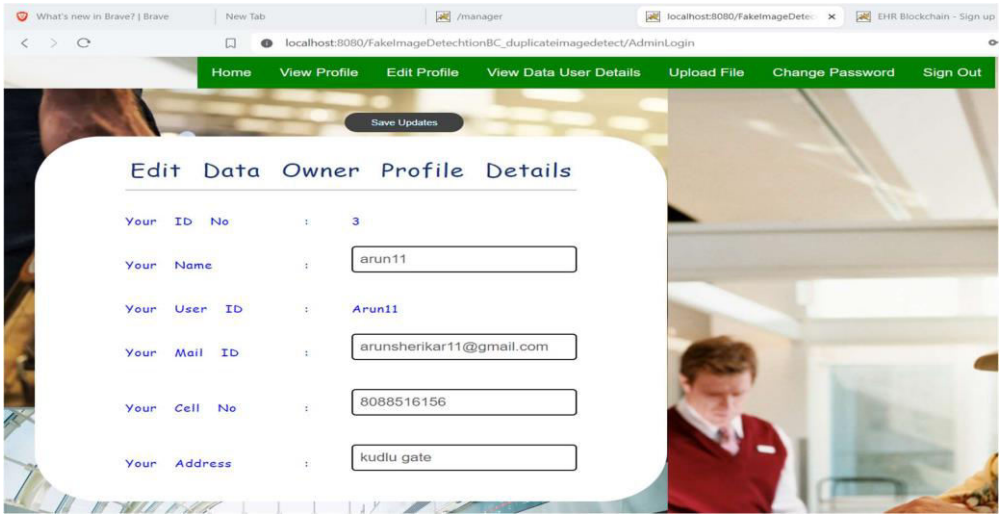

Figure 5: Data Owner Interface

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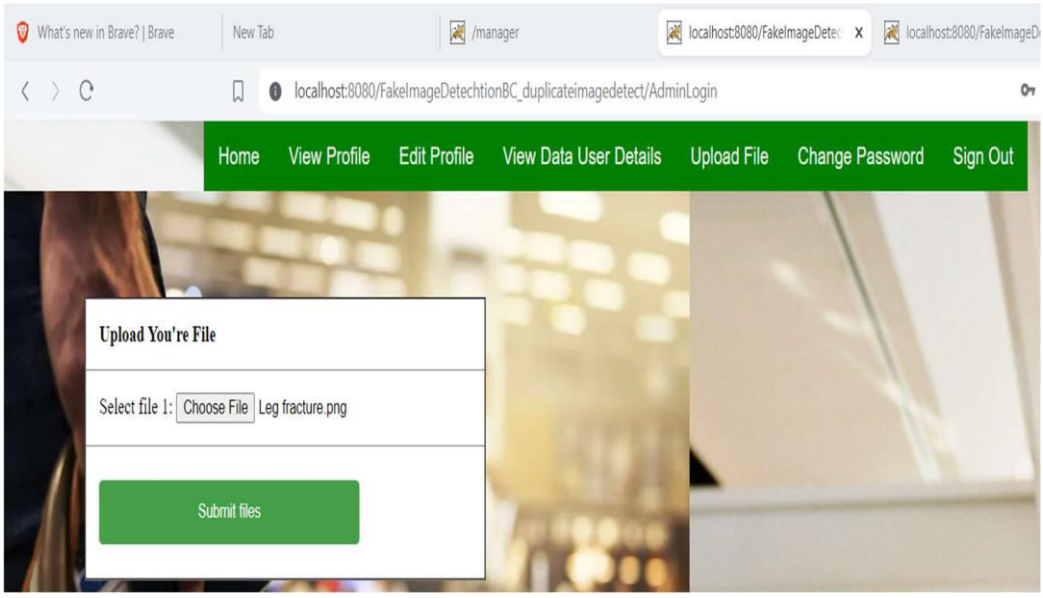

Figure 6: Image Upload Interface

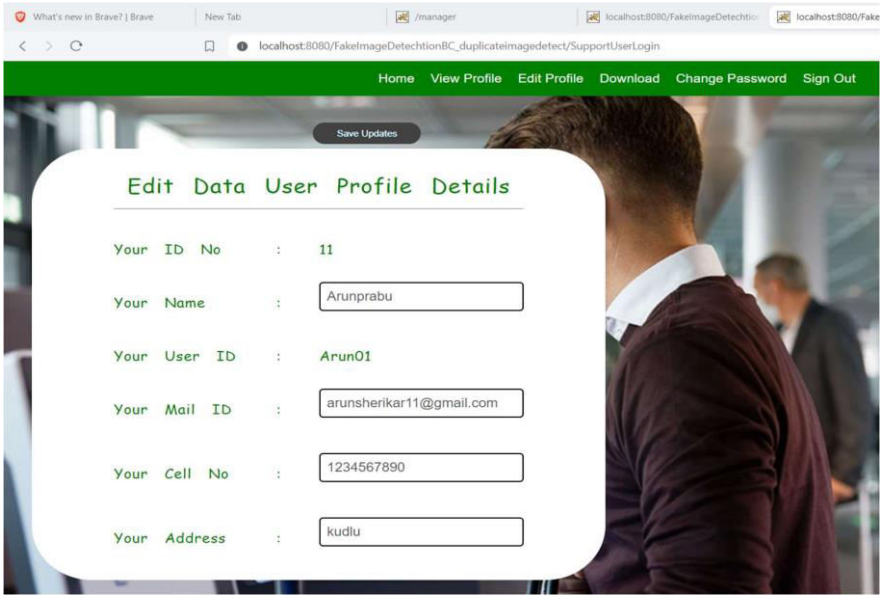

Figure 7: Data User Interface

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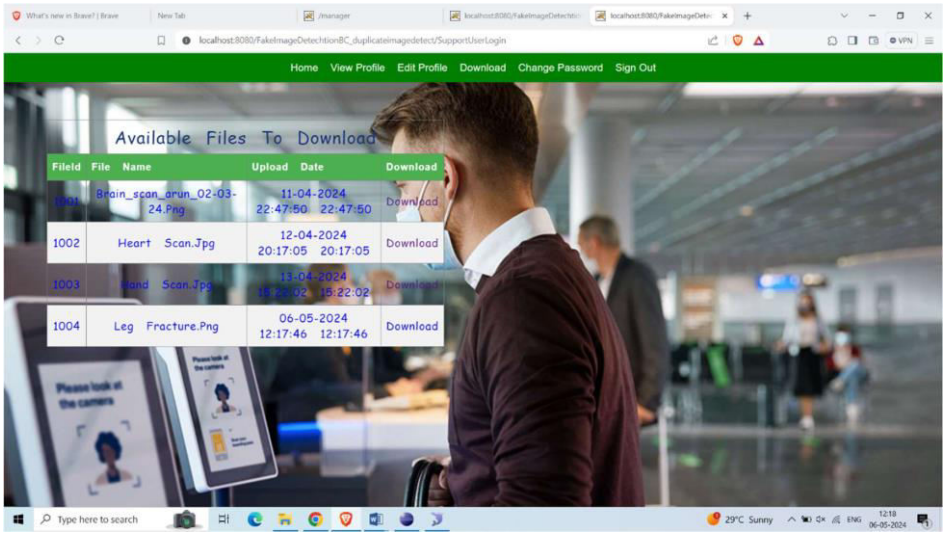

Figure 8: Image Download Interface

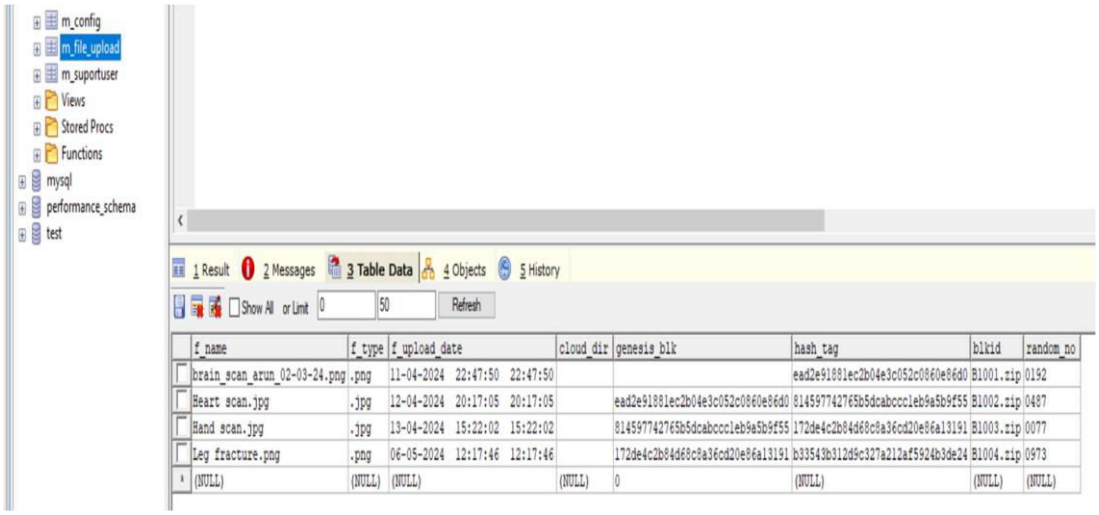

Figure 9: Block Storage in Cloud

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