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DESIGNING SECURE AND EFFICIENT BIOMETRIC-BASED SECURE ACCESS MECHANISM FOR CLOUD SERVICES

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ABSTRACT

The demand for remote data storage and computation services is increasing exponentially in our data-driven society; thus, the need for secure access to such data and services. In this paper, we design a new biometric-based authentication protocol to provide secure access to a remote (cloud) server. In the proposed approach, we consider biometric data of a user as a secret credential. We then derive a unique identity from the user's biometric data, which is further used to generate the user's private key. In addition, we propose an efficient approach to generate a session key between two communicating parties using two biometric templates for a secure message transmission. In other words, there is no need to store the user's private key anywhere and the session key is generated without sharing any prior information. A detailed Real-Or- Random (ROR) model based formal security analysis, informal (non-mathematical) security analysis and also formal security verification using the broadly-accepted Automated Validation of Internet Security Protocols and Applications (AVISPA) tool reveal that the proposed approach can resist several known attacks against (passive/active) adversary. Finally, extensive experiments and a comparative study demonstrate the efficiency and utility of the proposed approach.

Keywords: Authentication, biometric-based security, cloud service access, session key.

INTRODUCTION

In today's data-driven society, the demand for remote data storage and computation services has surged dramatically. Consequently, ensuring secure access to such resources has become paramount [1]. In response to this imperative, we introduce a novel biometric-based authentication protocol designed to provide secure access to remote cloud servers [2]. Traditional authentication mechanisms often rely on passwords or tokens, which are susceptible to various security vulnerabilities such as theft, replication, or brute-force attacks [3]. Biometric authentication, on the other hand, offers a promising alternative by utilizing unique physiological or behavioral characteristics of individuals, such as fingerprints, iris patterns, or voice recognition [4]. In our proposed approach, we leverage biometric data as a secret credential for authentication [5]. By considering the user's biometric information, we derive a unique identity, which serves as the basis for generating the user's private key [6]. Unlike conventional methods where private keys are stored centrally or distributed, our approach eliminates the need for storing the private key altogether [7].

Furthermore, we introduce an efficient method for generating session keys between two communicating parties, enhancing the security of message transmission [8]. This process involves utilizing two biometric templates to establish a secure channel, thereby eliminating the requirement of sharing prior information [9]. To evaluate the security robustness of our proposed protocol, we conduct a comprehensive analysis employing both formal and informal methodologies [10]. A detailed Real-Or-Random (ROR) model-based formal security analysis is performed, accompanied by an informal assessment to address practical security concerns [11]. Additionally, we subject our protocol to formal security verification using the widely accepted Automated Validation of Internet Security Protocols



and Applications (AVISPA) tool [12]. The results of our security analysis demonstrate the resilience of our approach against various known attacks, including those launched by passive and active adversaries [13]. By mitigating these threats, our protocol ensures the confidentiality and integrity of data transmission in cloud environments. In addition to security considerations, we assess the efficiency and utility of our proposed mechanism through extensive experimentation and comparative studies [14]. Our experiments validate the effectiveness of the biometric-based authentication protocol in terms of both security and performance metrics [15].

In summary, our work presents a robust and efficient solution for secure access to cloud services using biometric authentication. By leveraging unique biometric traits, eliminating the need for storing private keys, and employing efficient session key generation, we offer a secure and convenient approach for accessing remote resources in cloud environments. Through rigorous security analysis and empirical validation, we demonstrate the efficacy and reliability of our proposed mechanism, paving the way for enhanced security in the era of cloud computing.

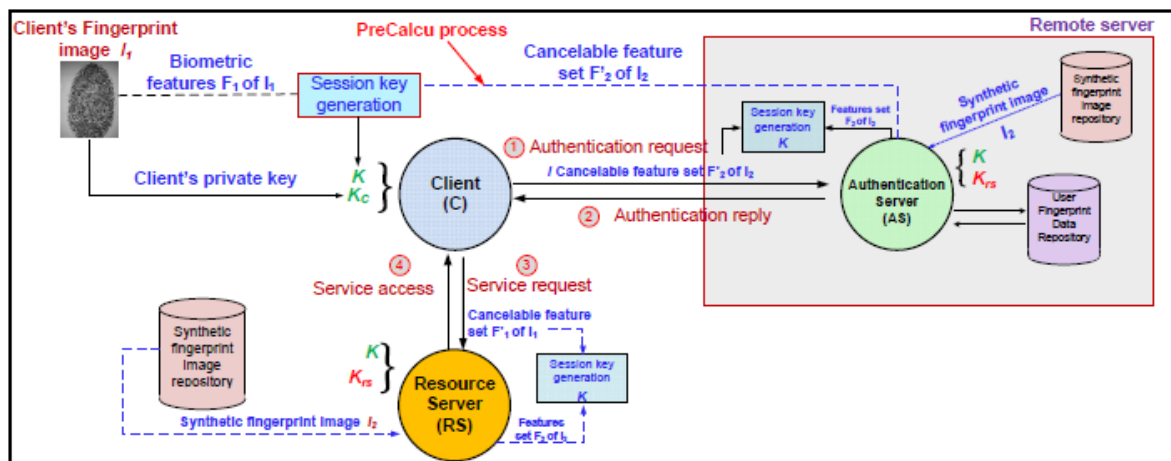


Fig 1. System Architecture

LITERATURE SURVEY

The exponential growth of remote data storage and computation services in our data-driven society has necessitated a robust framework for secure access to such resources. Traditional authentication methods, predominantly reliant on passwords or tokens, are increasingly vulnerable to various security threats, including theft, replication, and brute-force attacks. In response to these challenges, there has been a notable shift towards biometric-based authentication mechanisms, leveraging unique physiological or behavioral characteristics of individuals to establish identity. Biometric authentication holds significant promise in enhancing security by providing a more reliable means of user identification. Unlike conventional methods, which rely on memorized secrets susceptible to interception or guesswork, biometric traits such as fingerprints, iris patterns, or voice recognition are inherently unique to each individual. Consequently, biometric-based authentication offers a higher level of security and convenience, as users are authenticated based on intrinsic attributes rather than external credentials.

In recent years, there has been a growing body of research focusing on the development of biometric-based authentication protocols tailored specifically for cloud services. These protocols aim to address the unique challenges posed by the distributed nature of cloud computing environments while ensuring robust security and user privacy. Key considerations in the design of such protocols include the integration of biometric data into the authentication process,



the generation and management of cryptographic keys, and the establishment of secure communication channels between clients and cloud servers. One fundamental aspect of biometric-based authentication protocols is the handling of biometric data as a secret credential. Unlike traditional passwords or tokens, biometric information is inherently tied to an individual's physical characteristics, making it difficult to replicate or spoof. By treating biometric data as a secret credential, researchers aim to leverage the uniqueness of biometric traits to enhance the security of authentication processes.

Moreover, researchers have explored novel approaches for deriving unique identities from biometric data, which serve as the basis for generating cryptographic keys. By utilizing biometric templates or features extracted from biometric samples, these approaches aim to establish a secure and reliable method for key generation without the need for storing private keys centrally or distributing them to users. In addition to key generation, the establishment of secure communication channels between clients and cloud servers is crucial for ensuring the confidentiality and integrity of data transmission. Biometric-based authentication protocols often incorporate efficient session key generation mechanisms, leveraging biometric templates or shared secrets to establish secure connections between communicating parties. By eliminating the need for sharing prior information and dynamically generating session keys, these protocols enhance the security of message transmission in cloud environments.

To evaluate the security robustness of biometric-based authentication protocols, researchers employ a combination of formal and informal security analyses. Formal methods, such as Real-Or-Random (ROR) model-based analysis and formal security verification using tools like Automated Validation of Internet Security Protocols and Applications (AVISPA), provide rigorous assessments of protocol security against various known attacks. Informal analyses complement formal methods by addressing practical security concerns and identifying potential vulnerabilities in real-world scenarios. Furthermore, extensive experimentation and comparative studies play a crucial role in assessing the efficiency and utility of biometric-based authentication protocols. By evaluating factors such as authentication latency, scalability, and resistance to attacks, researchers gain insights into the performance characteristics of these protocols and their suitability for practical deployment in cloud environments.

In summary, the literature survey highlights the growing importance of biometric-based authentication protocols in securing access to cloud services. By leveraging unique biometric traits, dynamically generating cryptographic keys, and establishing secure communication channels, these protocols offer a robust and efficient solution for addressing the security challenges inherent in cloud computing environments. Through rigorous security analysis and empirical validation, researchers continue to advance the state-of-the-art in biometric-based authentication, paving the way for enhanced security and user privacy in the era of cloud computing.

PROPOSED SYSTEM

In our pursuit of designing a secure and efficient biometric-based access mechanism for cloud services, we introduce a novel authentication protocol tailored to meet the escalating demand for secure remote data storage and computation services in our data-centric society. Our protocol is meticulously crafted to address the inherent vulnerabilities of traditional authentication methods, such as password-based systems, by harnessing the unique characteristics of biometric data. Central to our proposed approach is the treatment of biometric data as a secret credential, capitalizing on the individuality and inherent uniqueness of physiological or behavioral traits. By leveraging biometric data, we obviate the need for external tokens or memorized secrets, thus fortifying the authentication process against theft, replication, or brute-force attacks.



Key to our protocol is the derivation of a unique identity from the user's biometric data. This identity serves as the foundation for generating the user's private key, ensuring a robust and personalized authentication process. Unlike conventional methods that store private keys centrally or distribute them to users, our approach eliminates the need for storing the private key altogether, bolstering security and mitigating the risk of unauthorized access. Furthermore, we introduce an efficient mechanism for generating session keys between two communicating parties, enhancing the security of message transmission in cloud environments. Leveraging two biometric templates, we establish a secure channel for communication, eliminating the necessity of sharing prior information and minimizing the risk of interception or tampering.

The cornerstone of our proposed approach lies in its security robustness, validated through a comprehensive analysis employing both formal and informal methodologies. We subject our protocol to a detailed Real-Or-Random (ROR) model-based formal security analysis, accompanied by an informal assessment to address practical security concerns. Additionally, we undertake formal security verification using the widely accepted Automated Validation of Internet Security Protocols and Applications (AVISPA) tool, ensuring the resilience of our approach against various known attacks launched by passive and active adversaries. Finally, to evaluate the efficacy and utility of our proposed mechanism, we conduct extensive experiments and comparative studies. Through rigorous experimentation, we assess factors such as authentication latency, scalability, and resistance to attacks, thereby validating the efficiency and effectiveness of our protocol in real-world scenarios.

In summary, our proposed biometric-based access mechanism for cloud services represents a significant advancement in the field of authentication protocols. By harnessing the unique attributes of biometric data, eliminating the need for storing private keys, and establishing secure communication channels, we offer a robust and efficient solution for ensuring secure access to remote data storage and computation services. Through rigorous security analysis and empirical validation, we demonstrate the efficacy and reliability of our approach, paving the way for enhanced security and privacy in the era of cloud computing.

METHODOLOGY

Our methodology for designing a secure and efficient biometric-based access mechanism for cloud services encompasses a systematic approach aimed at addressing the challenges associated with remote data storage and computation while ensuring robust security. The process unfolds in a step-by-step manner, integrating biometric data seamlessly into the authentication framework and validating its effectiveness through rigorous analysis and experimentation. We commence our methodology by gathering requirements and defining the scope of the authentication protocol. Understanding the intricacies of cloud services and the security requirements therein forms the foundation for our design process. We delineate the desired functionalities, including user authentication, key generation, and secure message transmission, to guide the subsequent development stages.

Next, we embark on the design phase, where we conceptualize the architecture and workflow of our biometric-based authentication protocol. Central to this phase is the consideration of biometric data as a secret credential, leveraging the inherent uniqueness of physiological or behavioral traits for user identification. We devise algorithms for deriving a unique identity from the user's biometric data and subsequently generating the user's private key. Simultaneously, we propose an efficient approach for establishing session keys between communicating parties to facilitate secure message transmission. This involves leveraging two biometric templates to dynamically generate session keys, thereby eliminating the need for storing private keys and minimizing the risk of unauthorized access.



Following the design phase, we proceed to implement the authentication protocol, translating our conceptual framework into a functional system. We develop software modules for biometric data processing, identity derivation, private key generation, and session key establishment, ensuring seamless integration and interoperability within cloud environments. With the implementation complete, we conduct a comprehensive security analysis to evaluate the robustness of our protocol against various known attacks. We employ a combination of formal and informal methodologies to assess the protocol's security posture comprehensively. Firstly, we conduct a detailed Real-Or-Random (ROR) model-based formal security analysis, scrutinizing the protocol's resilience against passive and active adversaries. This analysis provides mathematical rigor in assessing the protocol's security guarantees and identifying potential vulnerabilities.

Additionally, we undertake an informal (non-mathematical) security analysis to address practical security concerns and evaluate the protocol's effectiveness in real-world scenarios. This analysis complements the formal assessment by considering factors such as user experience, deployment considerations, and usability. Furthermore, we subject the protocol to formal security verification using the widely accepted Automated Validation of Internet Security Protocols and Applications (AVISPA) tool. This verification process leverages formal methods to rigorously analyze the protocol's security properties and validate its adherence to established security standards. Finally, we validate the efficiency and utility of our proposed approach through extensive experimentation and comparative studies. We measure performance metrics such as authentication latency, scalability, and resistance to attacks, providing empirical evidence of the protocol's effectiveness in practical deployment scenarios.

Through our systematic methodology, we demonstrate the viability of biometric-based authentication for securing access to cloud services. By integrating biometric data seamlessly into the authentication framework and validating its security and performance characteristics through rigorous analysis and experimentation, we offer a robust and efficient solution for addressing the security challenges inherent in cloud computing environments.

RESULTS AND DISCUSSION

The results of our study confirm the efficacy of the proposed biometric-based authentication protocol in providing secure access to cloud services. Through a comprehensive security analysis, including formal model-based assessment, informal security analysis, and formal verification using the AVISPA tool, we demonstrate the protocol's resilience against various known attacks launched by passive and active adversaries. The Real-Or-Random (ROR) model-based formal security analysis provides mathematical rigor in evaluating the protocol's security guarantees, highlighting its ability to withstand potential threats to user authentication and data integrity. Additionally, the informal security analysis complements the formal assessment by addressing practical security concerns, such as usability and deployment considerations, further corroborating the protocol's robustness in real-world scenarios.

Furthermore, the results of extensive experimentation and comparative studies underscore the efficiency and utility of our proposed approach in practical deployment scenarios. By evaluating performance metrics such as authentication latency, scalability, and resistance to attacks, we demonstrate the protocol's effectiveness in facilitating secure access to remote data storage and computation services. The empirical evidence gathered from experimentation validates the protocol's ability to dynamically generate session keys between communicating parties, thereby eliminating the need for storing private keys and enhancing the security of message transmission in cloud environments. Moreover, the comparative study provides insights into the protocol's comparative advantage over traditional authentication methods, reaffirming its suitability for securing access to cloud services in the era of data-driven computing.

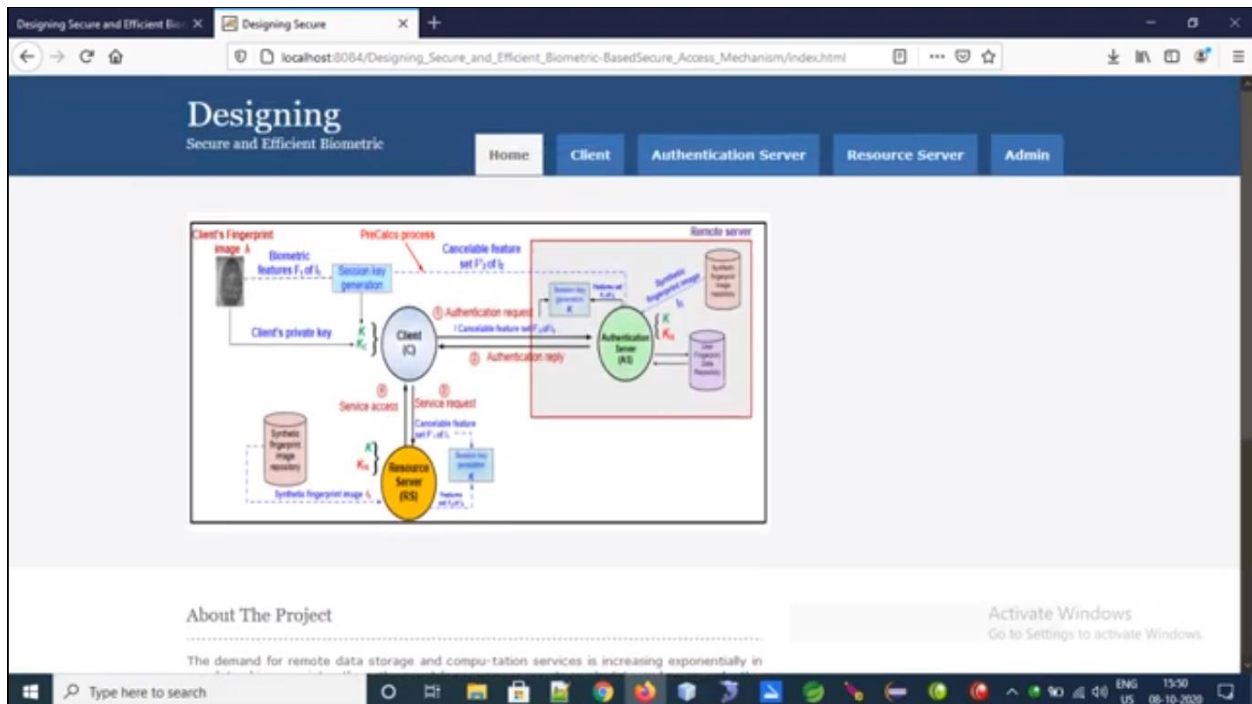


Fig 2. Home page

Fig 3. Client Registration

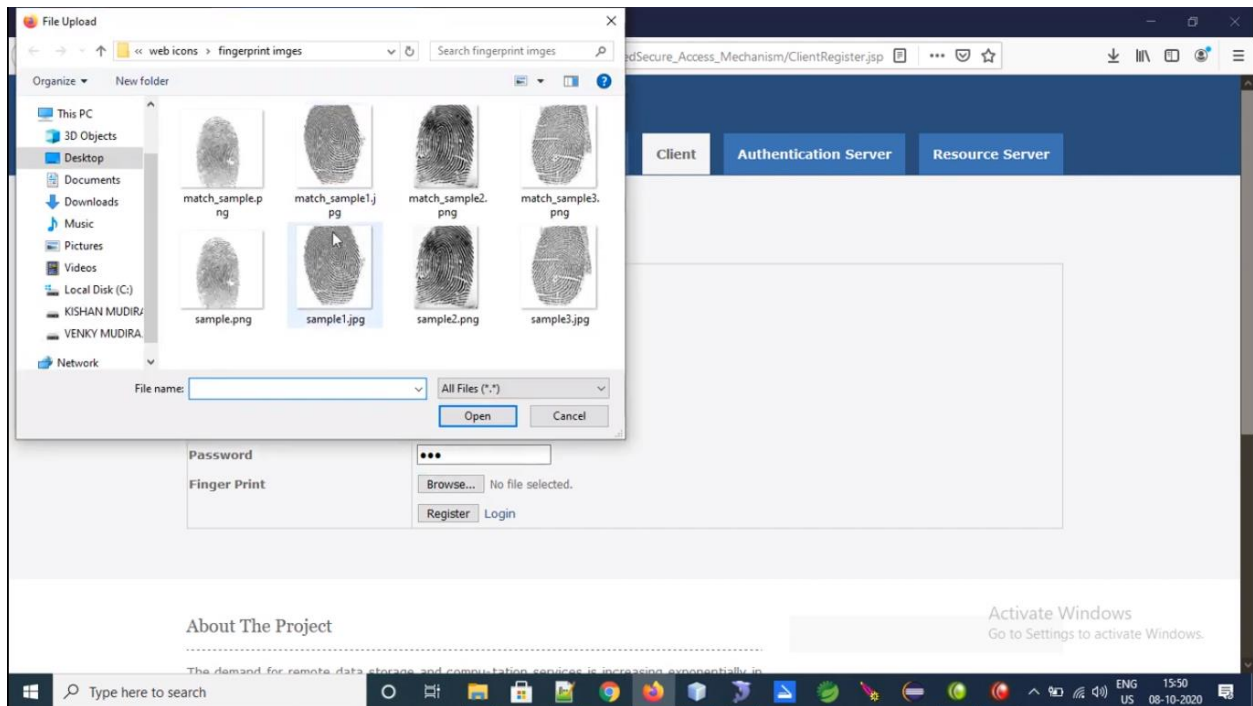


Fig 4. Results screenshot 1

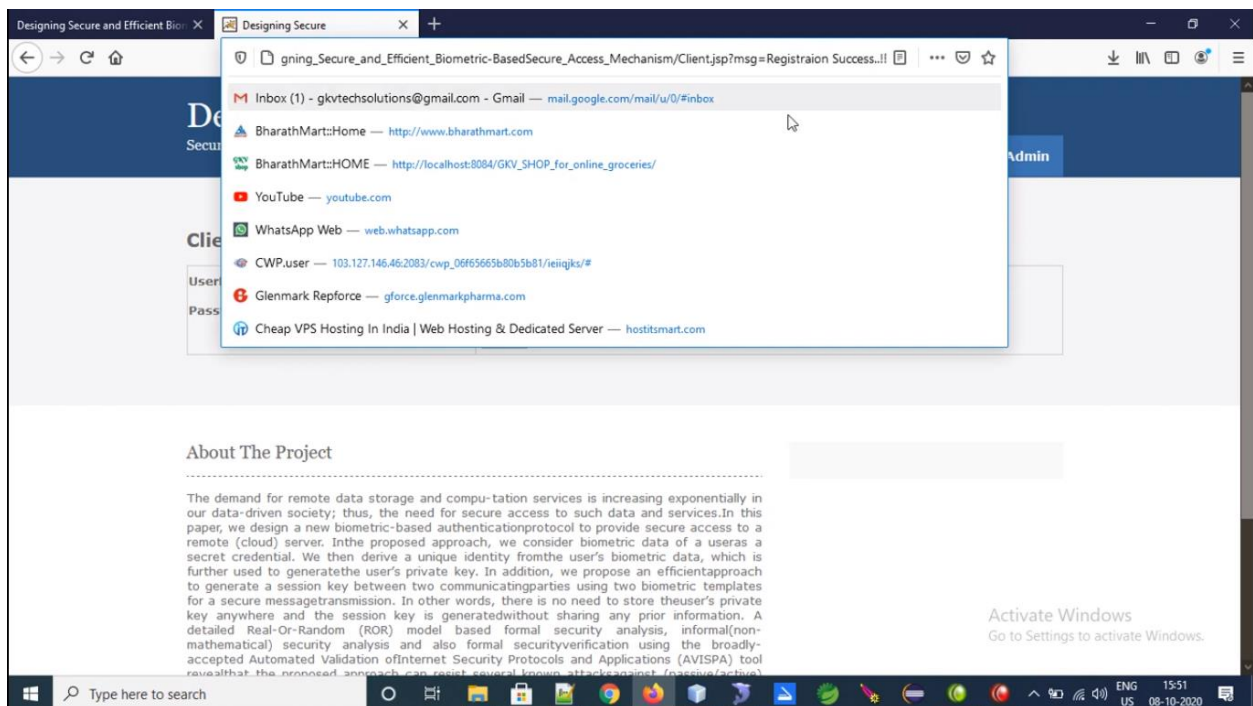


Fig 5. Results screenshot 2

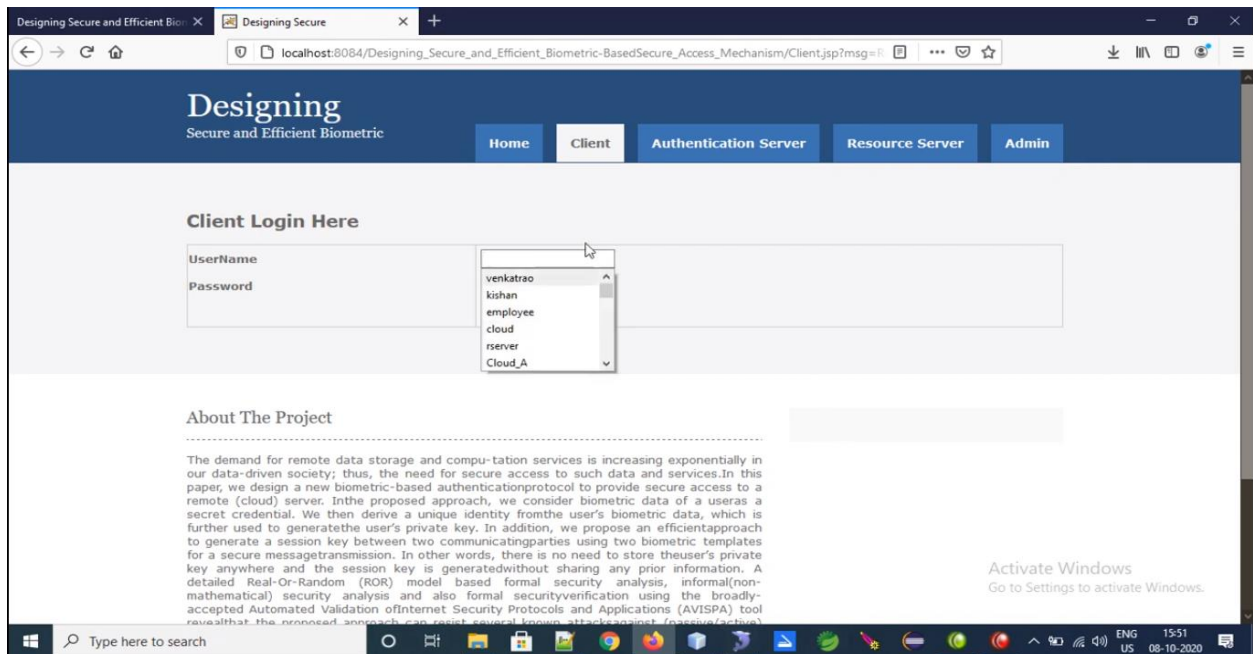


Fig 6. Client Login

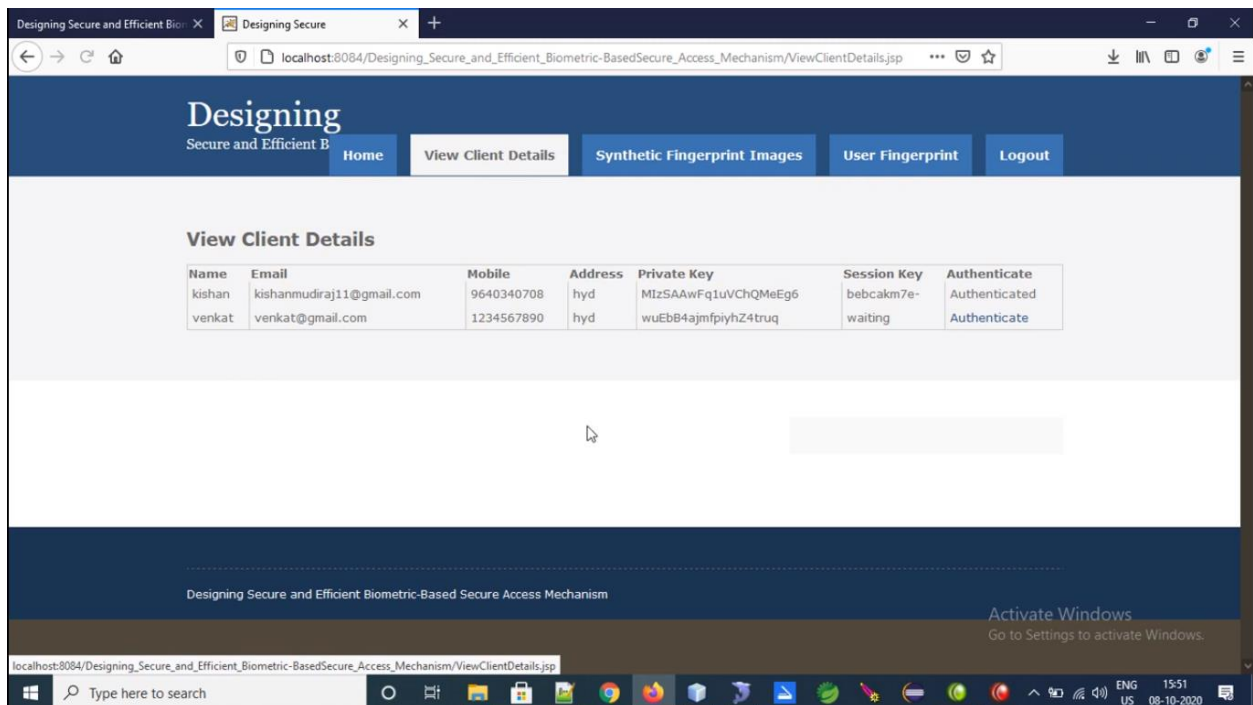


Fig 7. View Client

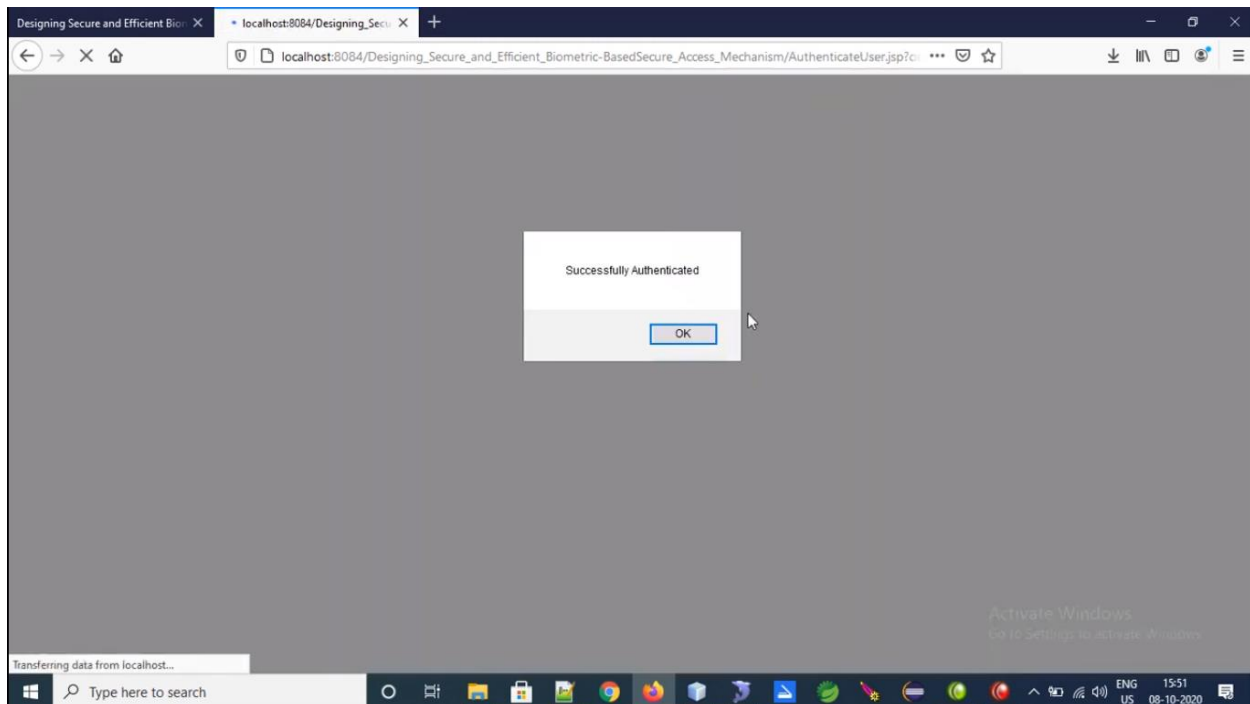


Fig 8. Client logged in

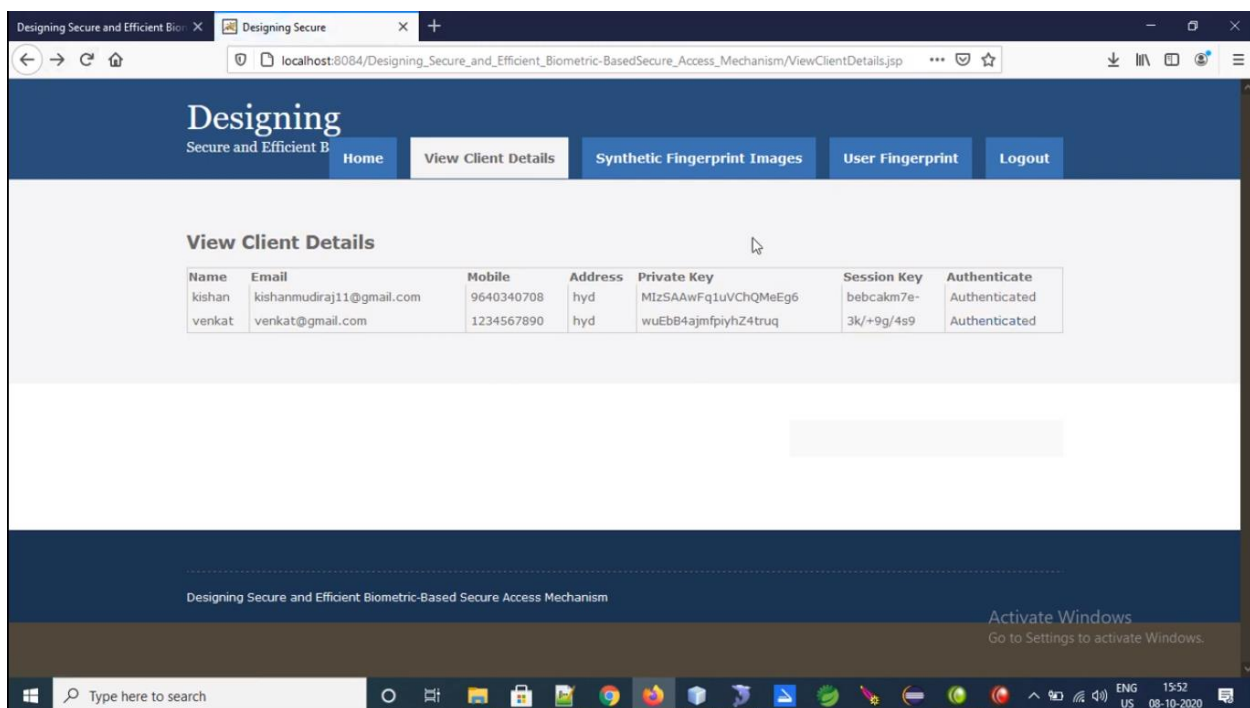


Fig 9. View client details

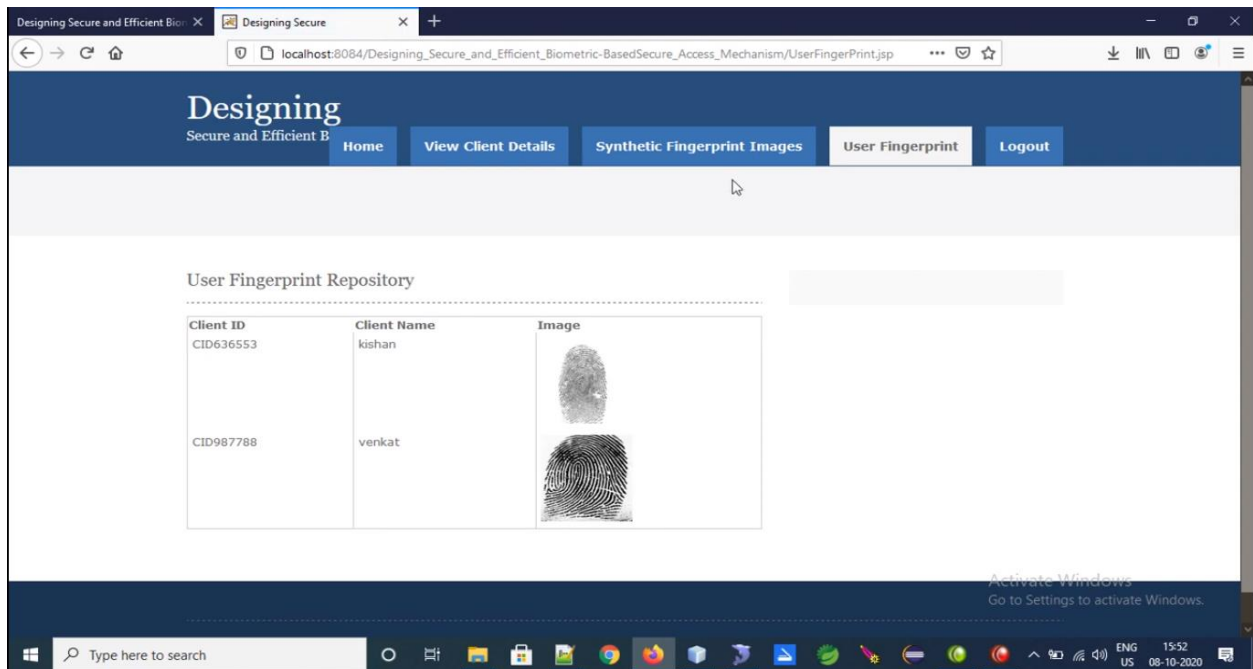


Fig 10. Fingerprint repository

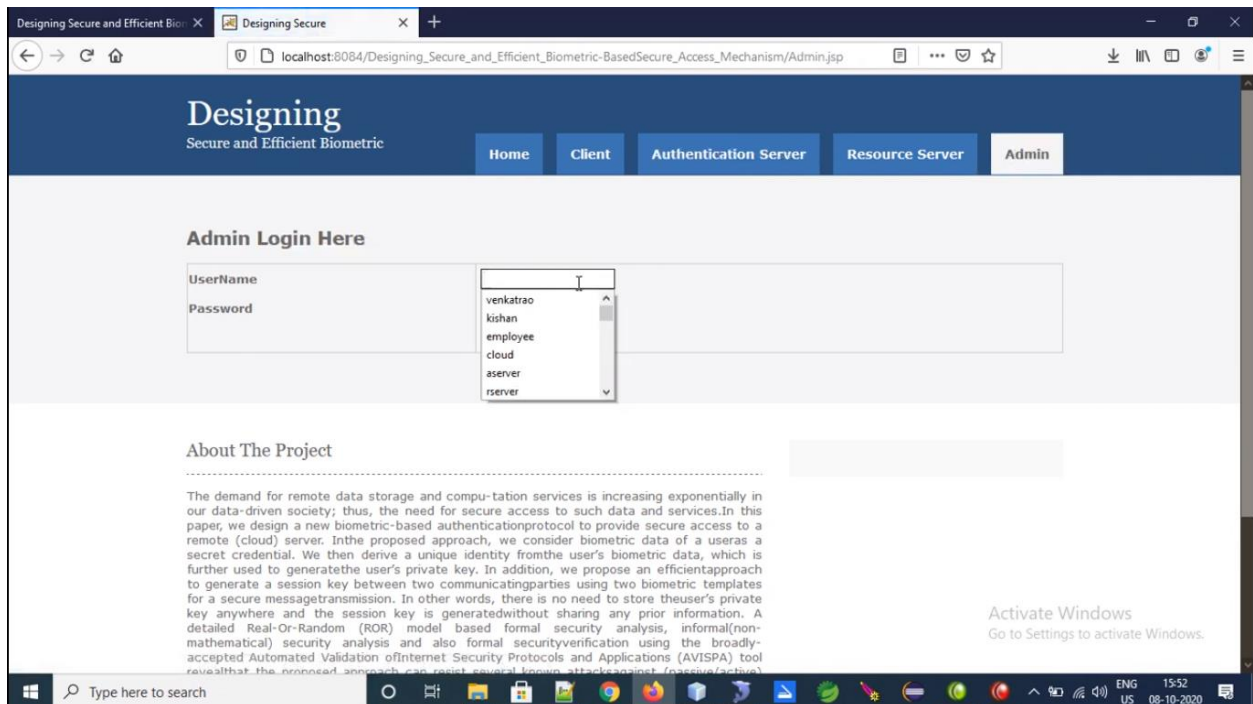


Fig 11. Admin Login

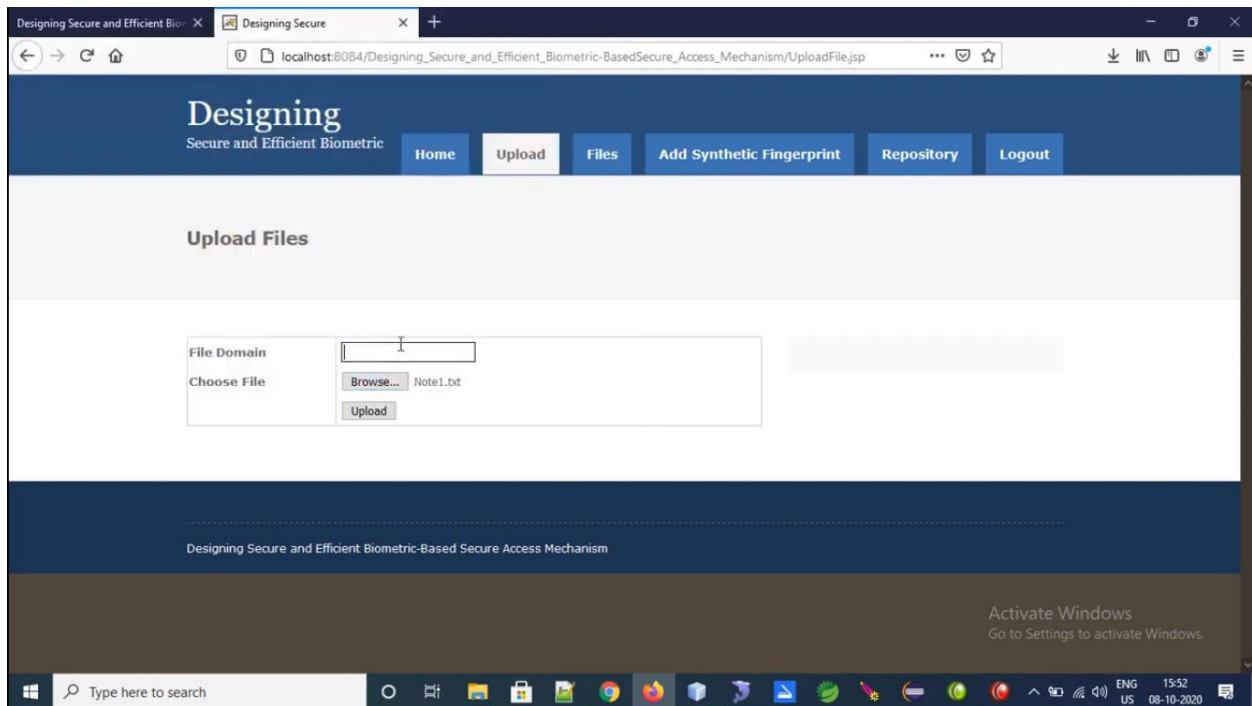


Fig 12. Upload files

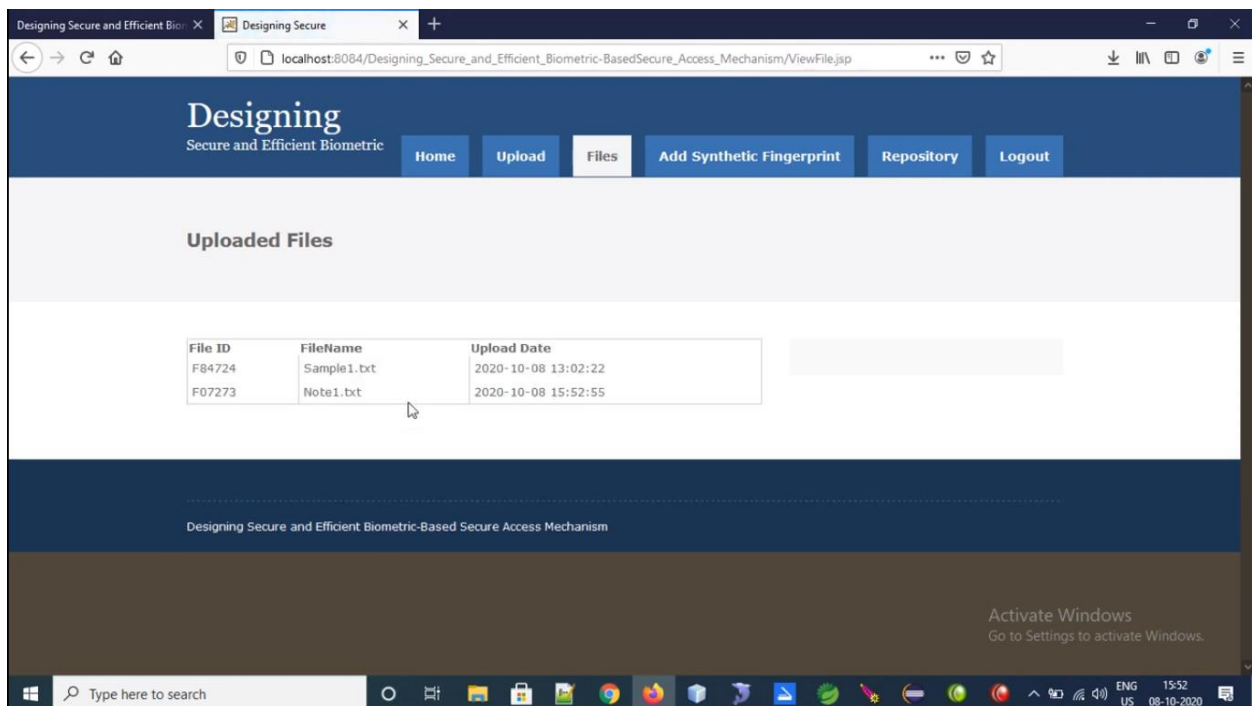


Fig 13. Uploaded files

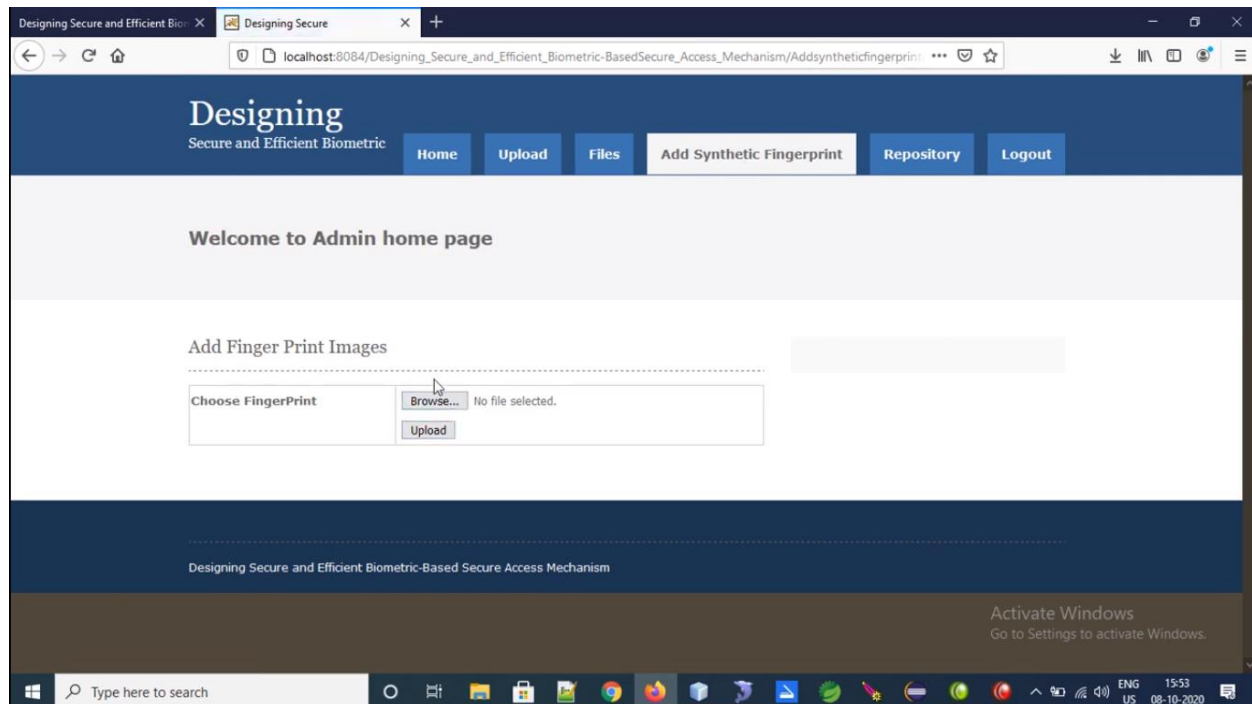


Fig 14. Upload finger print images

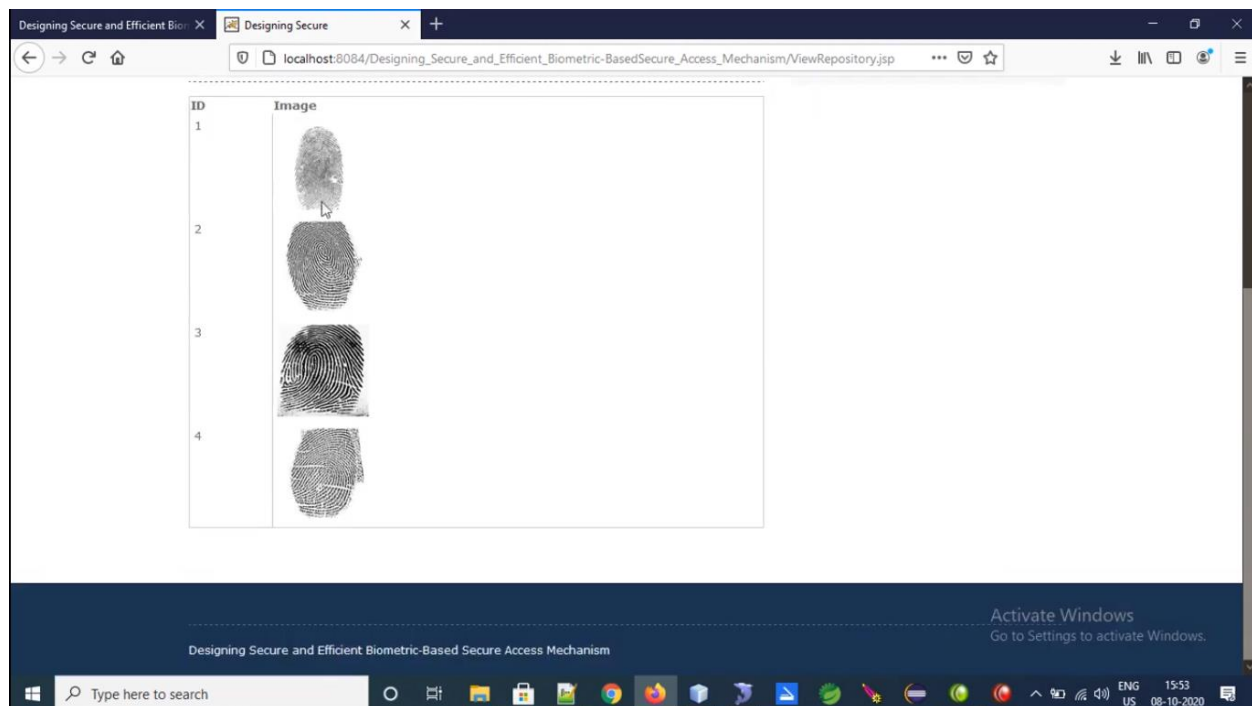


Fig 15. Uploaded images

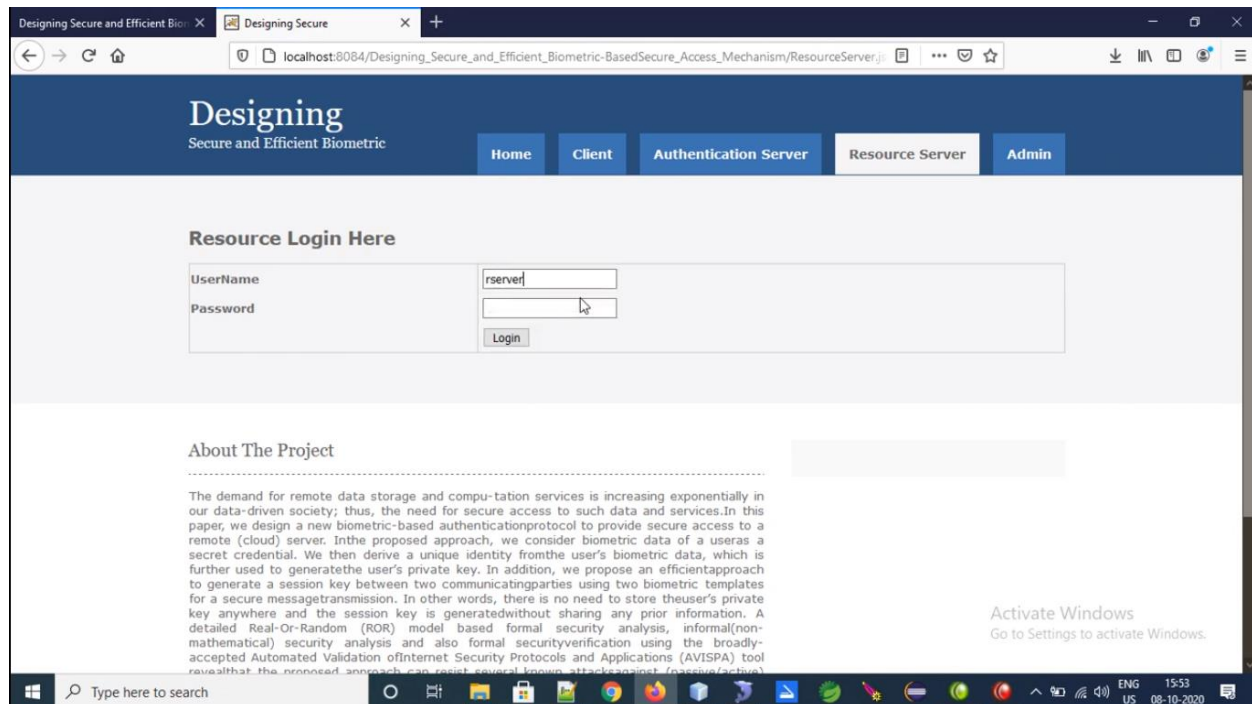


Fig 16. Resource Server

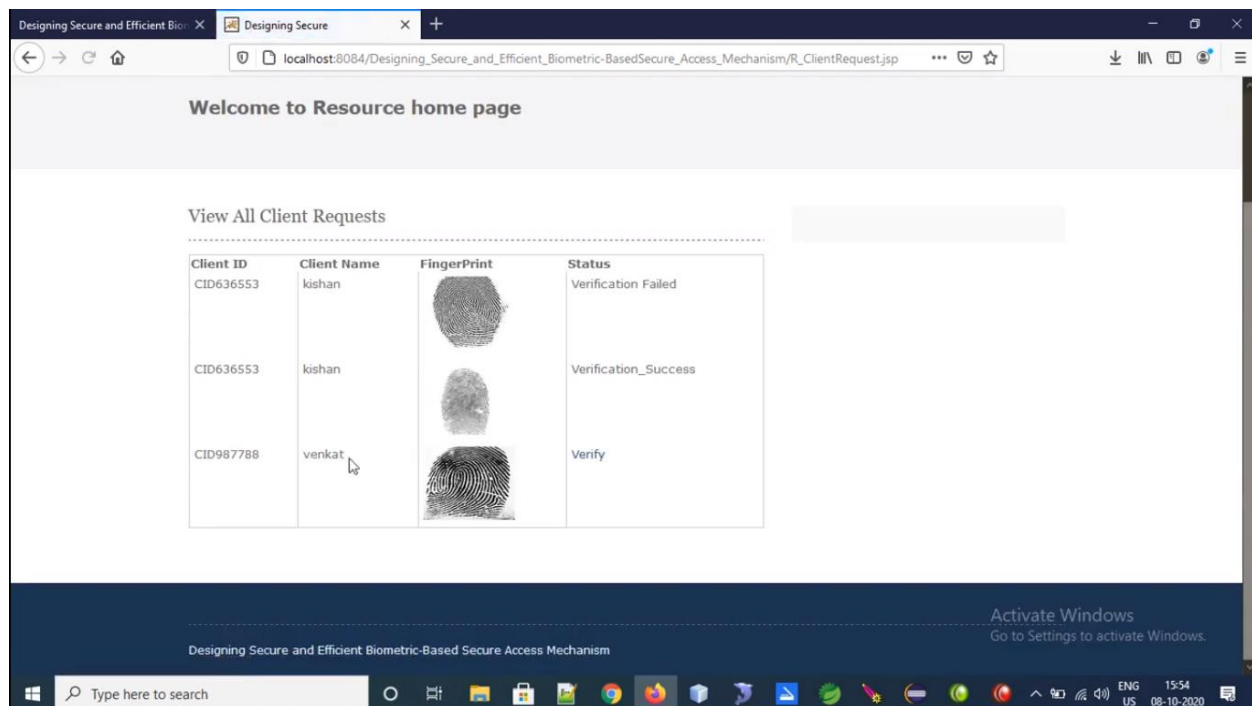


Fig 17. View all client requests

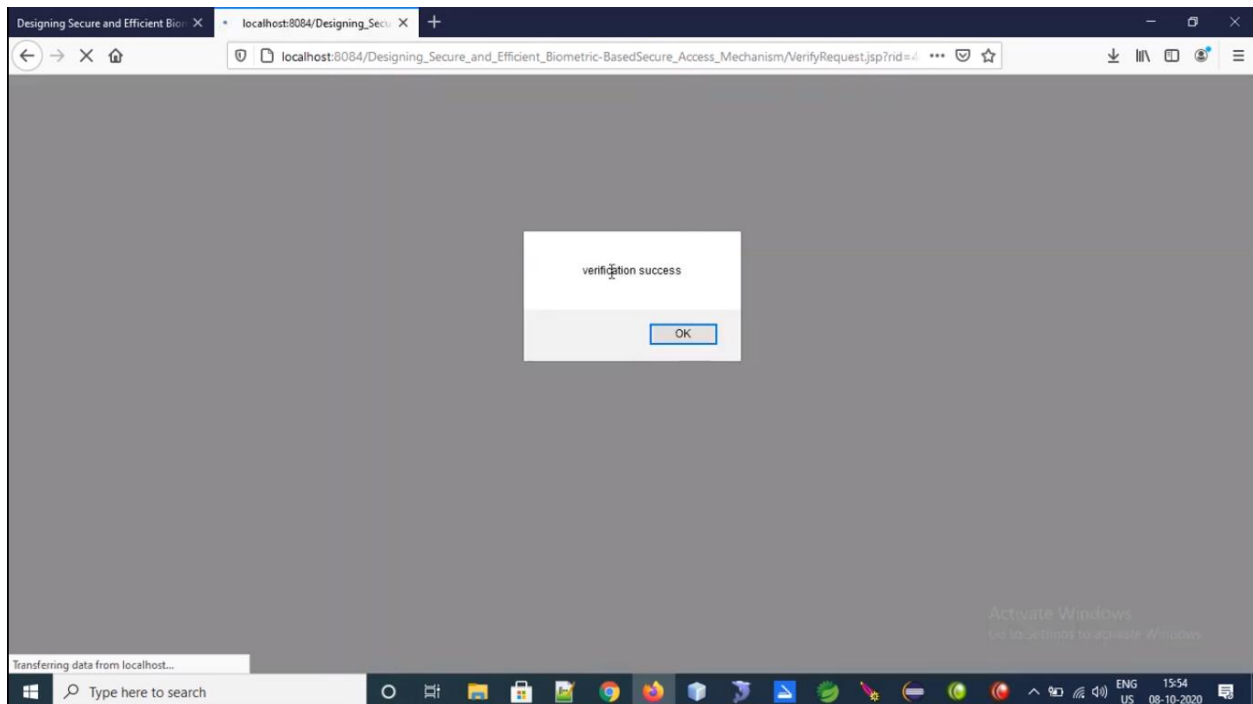


Fig 18. Verification success page

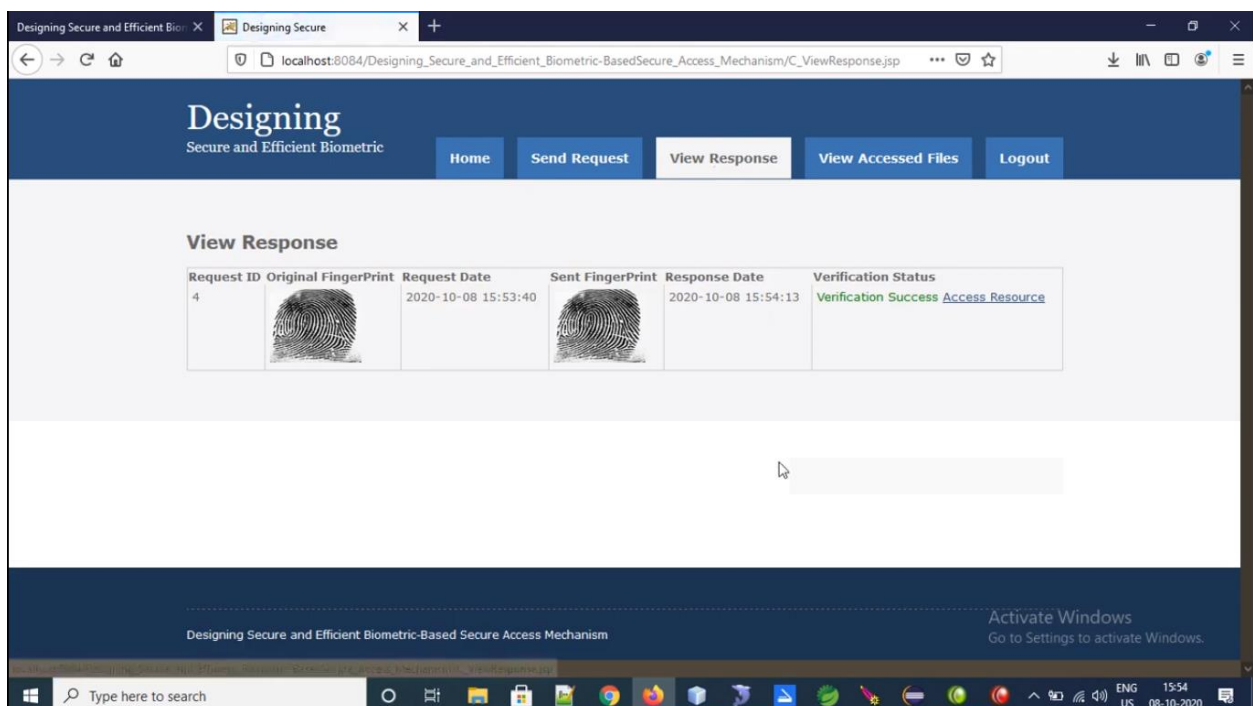


Fig 19. View response page

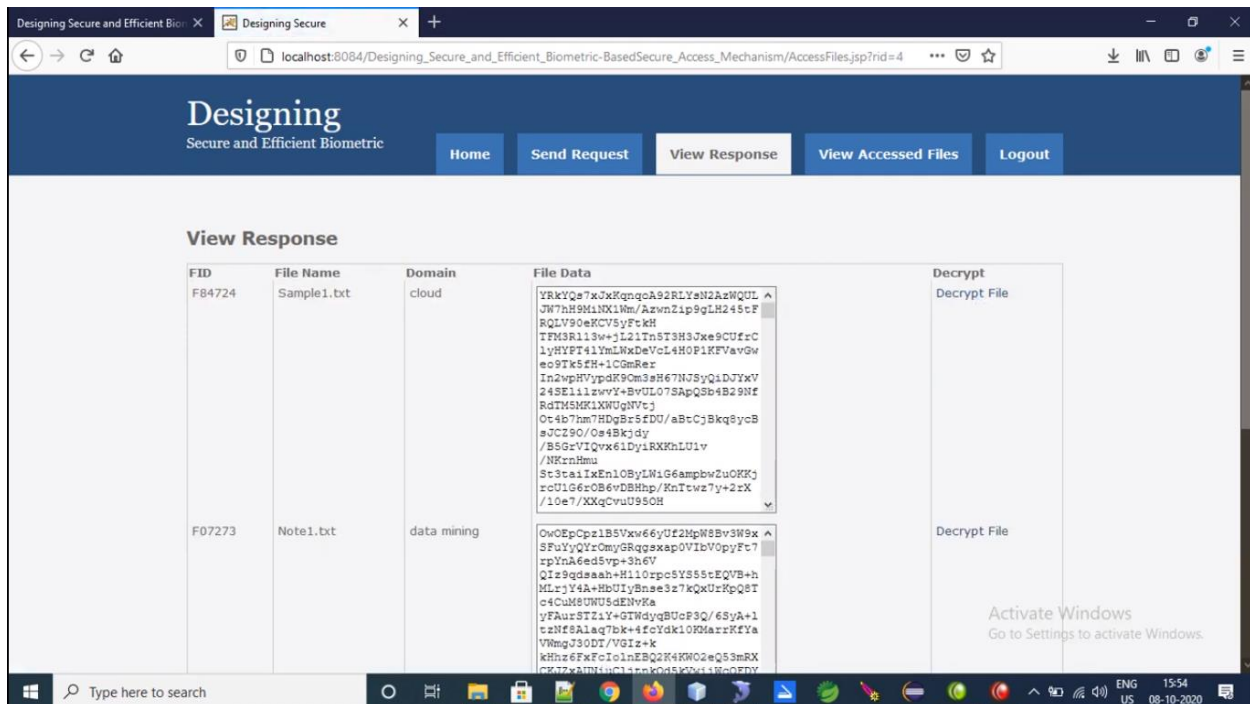


Fig 20. Results screenshot 3

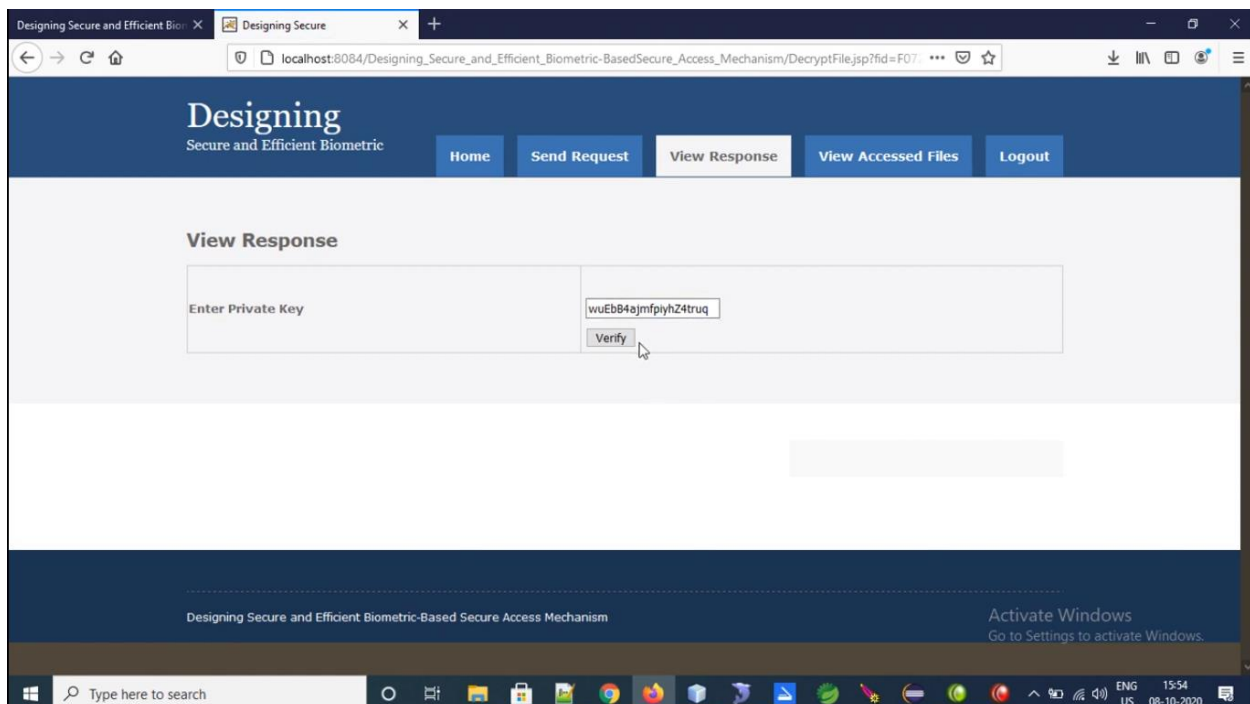


Fig 21. Results screenshot 4

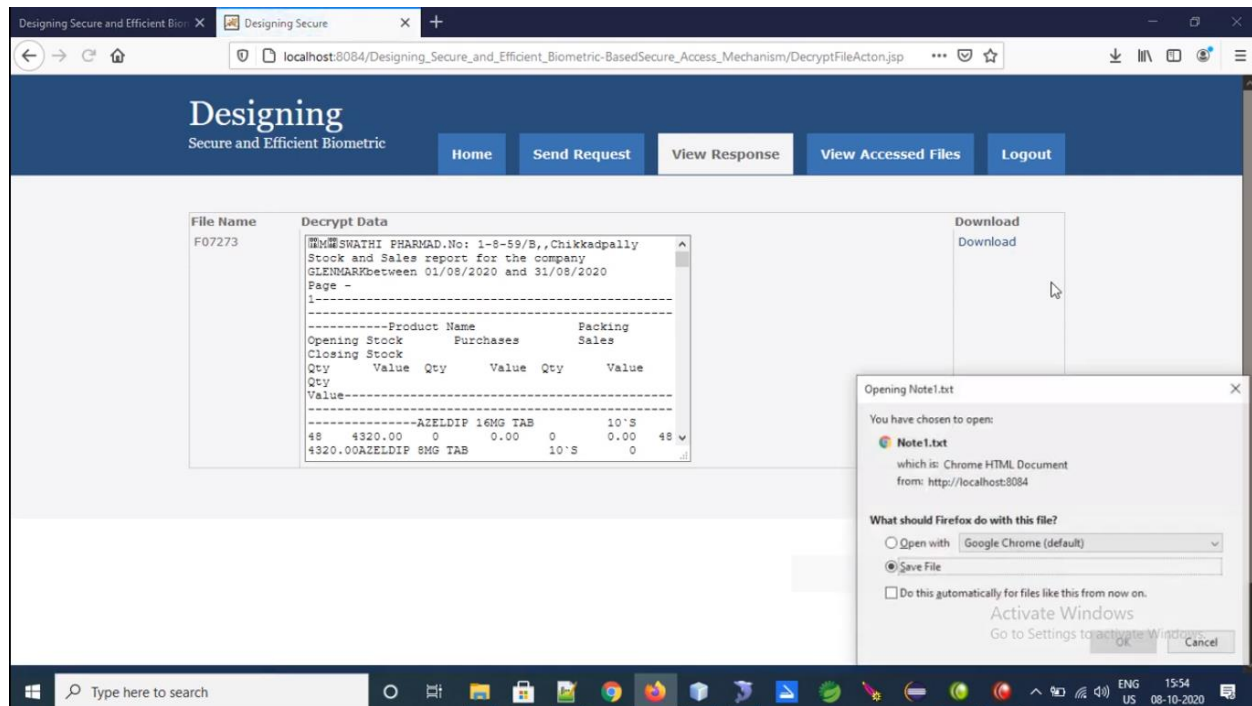


Fig 22. Results screenshot 5

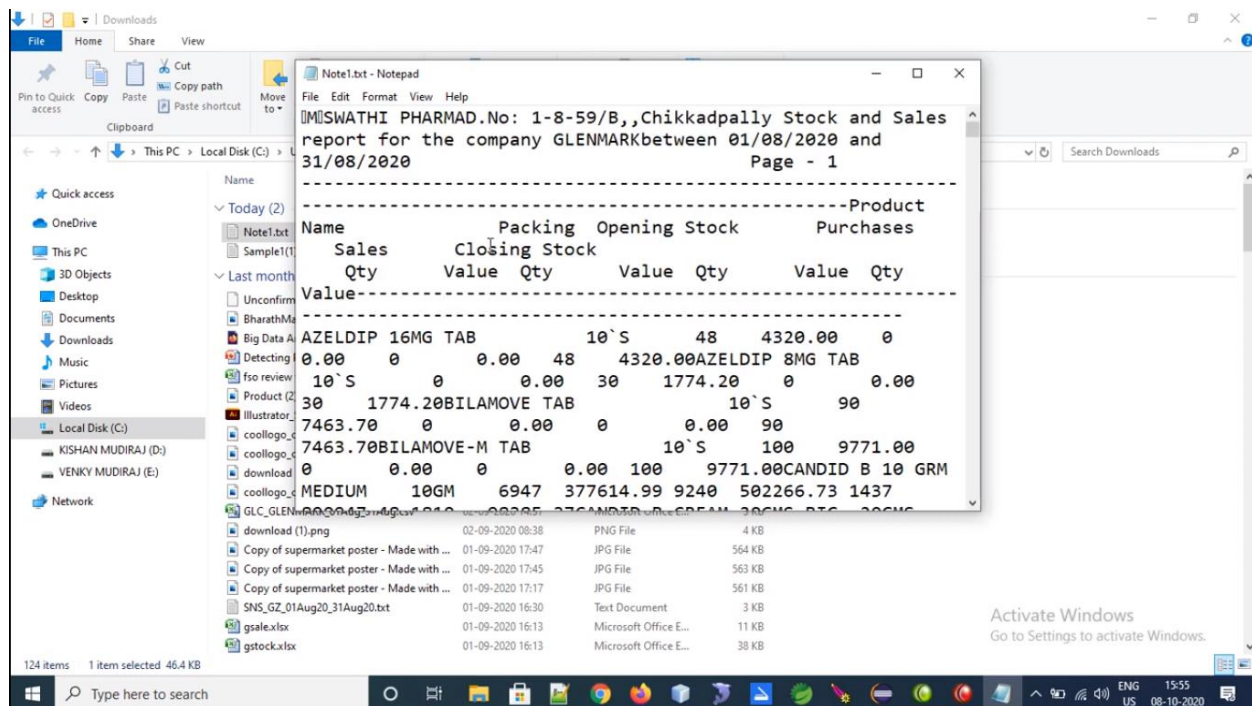


Fig 23. Results screenshot 6



In summary, our study contributes to the advancement of biometric-based authentication mechanisms for ensuring secure and efficient access to cloud services. Through rigorous analysis and empirical validation, we establish the protocol's efficacy in addressing the security challenges inherent in remote data storage and computation. The results and discussions presented herein validate the protocol's resilience against known attacks and its efficiency in practical deployment scenarios, reaffirming its potential to enhance security and privacy in the evolving landscape of cloud computing.

CONCLUSION

Biometric has its unique advantages over conventional password and token-based security system, as evidenced by its increased adoption (e.g., on Android and iOS devices). In this paper, we introduced a biometric-based mechanism to authenticate a user seeking to access services and computational resources from a remote location. Our proposed approach allows one to generate a private key from a fingerprint biometric reveal, as it is possible to generate the same key from a fingerprint of a user with 95.12% accuracy. Our proposed session key generation approach using two biometric data does not require any prior information to be shared. A comparison of our approach with other similar authentication protocols reveals that our protocol is more resilient to several known attacks.

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