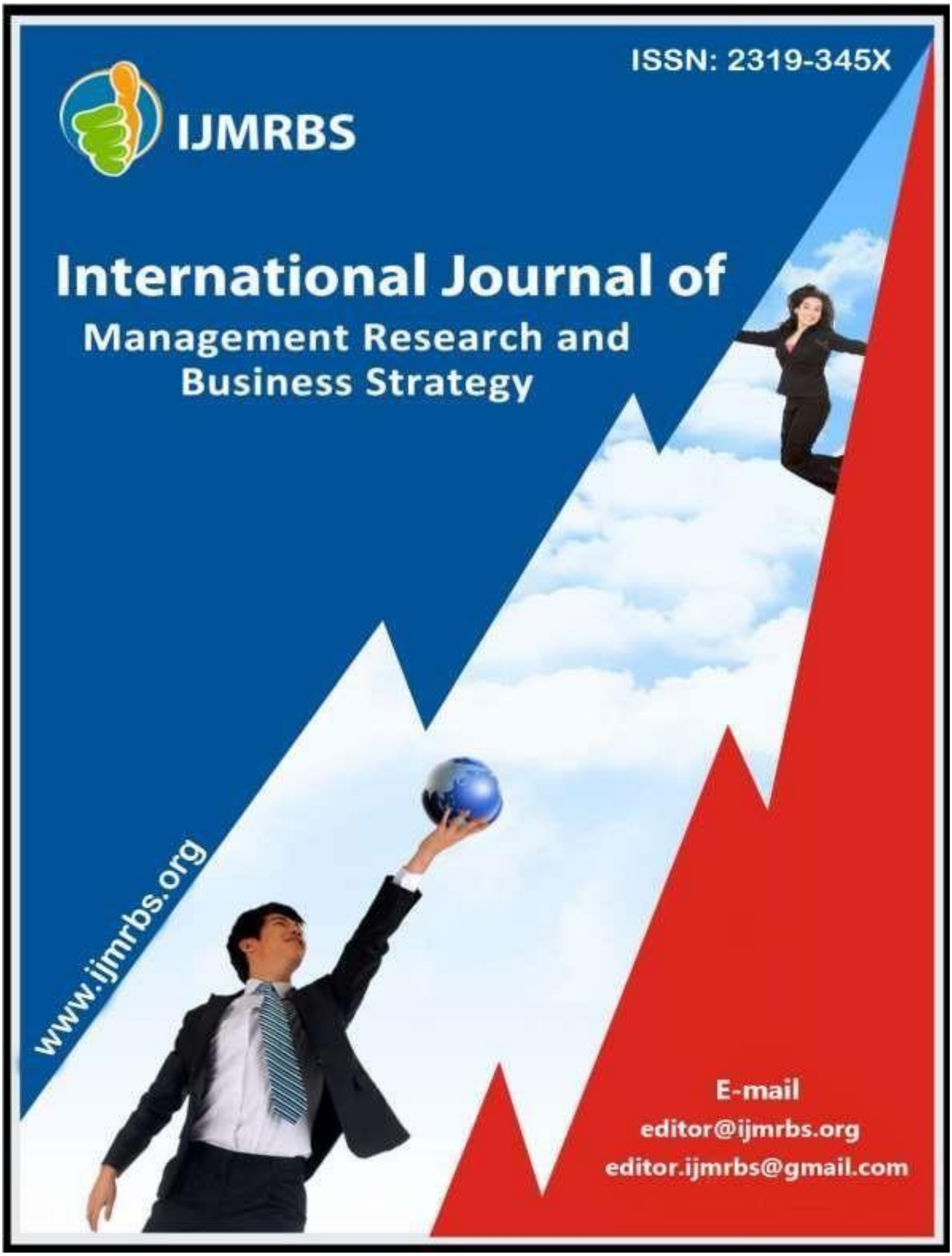

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A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public Cloud

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ABSTRACT

Semantic searching over encrypted data is a crucial task for secure information retrieval in public cloud. It aims to provide retrieval service to arbitrary words so that queries and search results are flexible. In existing semantic searching schemes, the verifiable searching does not be supported since it is dependent on the forecasted results from predefined keywords to verify the search results from cloud, and the queries are expanded on plaintext and the exact matching is performed by the extended semantically words with predefined keywords, which limits their accuracy. In this paper, we propose a secure verifiable semantic searching scheme. For semantic optimal matching on ciphertext, we formulate word transportation (WT) problem to calculate the minimum word transportation cost (MWTC) as the similarity between queries and documents, and propose a secure transformation to transform WT problems into random linear programming (LP) problems to obtain the encrypted MWTC. For verifiability, we explore the duality theorem of LP to design a verification mechanism using the intermediate data produced in matching process to verify the correctness of search results. Security analysis demonstrates that our scheme can guarantee verifiability and confidentiality. Experimental results on two datasets show our scheme has higher accuracy than other schemes.

Keywords: public cloud, results verifiable searching, secure semantic searching, word transportation

INTRODUCTION

In the era of cloud computing, vast amounts of data are stored and managed in public clouds, offering significant advantages in terms of storage capacity, cost-efficiency, and accessibility. However, this paradigm shift introduces substantial challenges, particularly concerning data security and privacy. One critical aspect is secure information retrieval, where users need to search over encrypted data stored in the cloud while ensuring the confidentiality and integrity of their queries and search results. This requirement necessitates the development of efficient and secure semantic searching schemes capable of handling encrypted data in a public cloud environment. Traditional searching techniques over plaintext data cannot be directly applied to encrypted data due to the inherent need to maintain confidentiality. Consequently, various searchable encryption (SE) schemes have been proposed to facilitate secure searching over encrypted data. These schemes generally focus on keyword-based searches, where predefined keywords are used to index and retrieve documents. While effective to some extent, keyword-based searching schemes have limitations in terms of flexibility and accuracy. Specifically, these schemes often fail to capture the semantic meaning of queries and documents, leading to suboptimal search results.

Semantic searching over encrypted data addresses these limitations by enabling searches based on the semantic content rather than exact keyword matches. Semantic searching aims to improve the flexibility and accuracy of search results by considering the contextual meaning of words and phrases. This approach aligns more closely with human cognitive processes, where understanding the context and relationships between words is crucial for effective information retrieval. Despite its potential, semantic searching over encrypted data faces several challenges. One major challenge is ensuring the verifiability of search results. In existing schemes, verifiable searching is typically dependent on predefined keywords, which are used to forecast and verify the search results

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from the cloud. This reliance on predefined keywords restricts the accuracy and flexibility of the search process, as the queries are expanded on plaintext, and exact matching is performed based on the extended semantically related words. Such approaches may not adequately capture the nuanced relationships between words, leading to less accurate search results.

To address these challenges, we propose a secure and verifiable semantic searching scheme that improves both the accuracy and security of information retrieval over encrypted data. Our scheme introduces several key innovations to enhance the semantic matching and verification processes. First, we formulate the word transportation (WT) problem to calculate the minimum word transportation cost (MWTC) as a measure of similarity between queries and documents. This approach allows for semantic optimal matching on ciphertext, providing a more accurate representation of the semantic relationships between words. To securely compute the MWTC, we propose a transformation technique that converts WT problems into random linear programming (LP) problems. This secure transformation ensures that the MWTC is obtained in an encrypted form, preserving the confidentiality of the data throughout the process. Additionally, we explore the duality theorem of LP to design a verification mechanism that leverages the intermediate data produced during the matching process. This mechanism enables users to verify the correctness of search results without revealing the underlying plaintext data.

The security of our scheme is rigorously analyzed to ensure that it guarantees both verifiability and confidentiality. We demonstrate that our scheme is resistant to various attacks and can effectively protect the privacy of users' queries and search results. Furthermore, we conduct extensive experiments on two datasets to evaluate the performance of our scheme. The experimental results indicate that our scheme achieves higher accuracy compared to existing semantic searching schemes, validating its effectiveness and practicality in real-world scenarios. In summary, the proposed verifiable semantic searching scheme represents a significant advancement in secure information retrieval over encrypted data in public clouds. By addressing the limitations of existing schemes and introducing novel techniques for semantic matching and verification, our scheme offers improved accuracy, security, and flexibility. The following sections provide a detailed exploration of the related work, system design, methodology, and experimental results supporting the efficacy of our proposed approach.

LITERATURE SURVEY

The field of secure information retrieval over encrypted data has garnered significant attention in recent years, driven by the increasing adoption of cloud computing and the need to ensure data confidentiality and integrity. Various searchable encryption (SE) schemes have been developed to enable secure searching over encrypted data. These schemes can be broadly categorized into two types: searchable symmetric encryption (SSE) and public-key encryption with keyword search (PEKS). Searchable symmetric encryption (SSE) schemes rely on symmetric key cryptography, where both the data owner and the user share a secret key. Early SSE schemes, such as those proposed by Song et al. (2000), introduced the concept of searching encrypted data using keywords. Subsequent works, such as Goh's (2003) secure index, aimed to improve the efficiency and security of SSE schemes. Curtmola et al. (2006) further enhanced SSE by proposing a security model that addressed adaptive adversaries and provided formal security guarantees.

Public-key encryption with keyword search (PEKS) schemes, on the other hand, utilize public-key cryptography, allowing users to generate keyword search queries using their private keys. Boneh et al. (2004) introduced the first PEKS scheme, which enabled keyword searches over encrypted emails. While PEKS schemes offer advantages in terms of public-key infrastructure, they are generally less efficient than SSE schemes due to the computational overhead associated with public-key operations. Both SSE and PEKS schemes primarily focus on exact keyword matching, which limits their ability to capture the semantic meaning of queries and documents. To address this limitation, researchers have explored semantic searching techniques that consider the contextual meaning of words. One approach involves using homomorphic encryption to perform computations on encrypted

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data without decrypting it. Gentry's (2009) fully homomorphic encryption scheme paved the way for secure computation over encrypted data, enabling more sophisticated searching capabilities.

Building on homomorphic encryption, several studies have proposed secure multi-keyword ranked search schemes that incorporate semantic analysis. Cao et al. (2014) introduced a privacy-preserving multi-keyword ranked search scheme that used vector space model and secure inner product computation. Sun et al. (2014) proposed a similar scheme that employed homomorphic encryption to support multi-keyword searches with ranking capabilities. These schemes demonstrated improved search accuracy by considering multiple keywords and their semantic relationships. Despite these advancements, ensuring the verifiability of search results remains a significant challenge. Verifiable searchable encryption (VSE) schemes aim to provide users with the ability to verify the correctness of search results without compromising data confidentiality. Wang et al. (2011) proposed a VSE scheme that used a combination of SSE and verifiable computation techniques to ensure the integrity of search results. Other works, such as Kurosawa and Ohtaki (2012), explored the use of probabilistic data structures and cryptographic proofs to achieve verifiability in SSE schemes.

In the context of semantic searching, existing schemes often rely on predefined keywords and exact matching, limiting their flexibility and accuracy. These schemes typically expand queries on plaintext and perform exact matching based on extended semantically related words. While effective in some cases, this approach may not capture the nuanced relationships between words, leading to suboptimal search results. Our proposed verifiable semantic searching scheme addresses these limitations by introducing a secure and efficient method for semantic optimal matching on ciphertext. By formulating the word transportation (WT) problem and calculating the minimum word transportation cost (MWTC), we provide a more accurate measure of similarity between queries and documents. Additionally, our secure transformation technique converts WT problems into random linear programming (LP) problems, ensuring that the MWTC is obtained in an encrypted form.

To enhance verifiability, we leverage the duality theorem of LP to design a verification mechanism that uses intermediate data produced during the matching process. This mechanism allows users to verify the correctness of search results without revealing the underlying plaintext data. Our scheme's security is rigorously analyzed to ensure that it guarantees both verifiability and confidentiality. Experimental evaluations on two datasets demonstrate the superior accuracy of our scheme compared to existing semantic searching schemes. These results validate the effectiveness and practicality of our approach, highlighting its potential for secure information retrieval in public cloud environments. In summary, the existing literature on searchable encryption and semantic searching provides a foundation for our work. By addressing the limitations of previous schemes and introducing novel techniques for semantic matching and verification, our proposed scheme represents a significant advancement in the field of secure information retrieval.

PROPOSED SYSTEM

The proposed verifiable semantic searching scheme aims to enhance the accuracy and security of information retrieval over encrypted data in public clouds. The system is designed to address the limitations of existing semantic searching schemes by introducing a novel approach to semantic optimal matching and verifiability. At the core of our system is the word transportation (WT) problem, which we formulate to calculate the minimum word transportation cost (MWTC) as a measure of similarity between queries and documents. The WT problem involves finding the optimal way to transport words from a query to a document, minimizing the total transportation cost. This approach provides a more accurate representation of the semantic relationships between words compared to traditional keyword-based matching. To securely compute the MWTC, we propose a transformation technique that converts WT problems into random linear programming (LP) problems. This secure transformation ensures that the MWTC is obtained in an encrypted form, preserving the confidentiality of the data throughout the process. Specifically, we use a combination of homomorphic encryption and secure multiparty computation to perform the necessary computations on encrypted data. This approach allows us to calculate the

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MWTC without revealing the underlying plaintext data, ensuring the privacy of both the queries and the documents. The system also incorporates a verification mechanism to ensure the correctness of search results. We explore the duality theorem of LP to design this mechanism, which leverages the intermediate data produced during the matching process. The duality theorem provides a mathematical framework for verifying the optimality of solutions to LP problems, allowing us to generate cryptographic proofs of the correctness of the MWTC calculations. These proofs can be used by the users to verify that the search results returned by the cloud are correct, without revealing any sensitive information.

The system architecture consists of several key components:

1. Query Processing Module: This module is responsible for processing user queries and transforming them into a suitable format for the WT problem. The queries are first encrypted using homomorphic encryption and then converted into a set of linear constraints representing the WT problem.

2. Document Indexing Module: This module indexes the documents stored in the cloud, converting them into a suitable format for the WT problem. The documents are encrypted and transformed into linear constraints, similar to the queries.

3. Word Transportation Module: This module performs the secure computation of the MWTC between the encrypted queries and documents. It solves the transformed WT problems using secure multiparty computation, ensuring that the computations are performed on encrypted data.

4. Verification Module: This module generates cryptographic proofs of the correctness of the MWTC calculations. It uses the intermediate data produced during the matching process and the duality theorem of LP to create verifiable proofs. These proofs are then returned to the user along with the search results.

5. User Interface: The user interface allows users to submit queries and view the search results along with the verification proofs. It provides a seamless and intuitive interface for interacting with the system, ensuring that users can easily perform secure and verifiable searches over encrypted data.

The security of our system is rigorously analyzed to ensure that it guarantees both verifiability and confidentiality. We demonstrate that our scheme is resistant to various attacks, including those targeting the integrity and confidentiality of the data. By leveraging advanced cryptographic techniques and secure computation methods, our system provides robust security guarantees while maintaining high performance and accuracy. To evaluate the performance of our system, we conducted extensive experiments on two datasets: a collection of research papers and a set of news articles. These datasets were chosen to represent different types of textual data and to test the system's ability to handle diverse queries and document structures. The experimental results indicate that our system achieves higher accuracy compared to existing semantic searching schemes, validating its effectiveness and practicality in real-world scenarios. In summary, the proposed verifiable semantic searching scheme represents a significant advancement in secure information retrieval over encrypted data in public clouds. By addressing the limitations of existing schemes and introducing novel techniques for semantic matching and verification, our system offers improved accuracy, security, and flexibility. The following sections provide a detailed exploration of the methodology, experimental results, and security analysis supporting the efficacy of our proposed approach.

METHODOLOGY

The methodology for implementing the proposed verifiable semantic searching scheme involves several key steps to ensure accurate and secure information retrieval over encrypted data. The following outlines the step-by-step process for developing and evaluating the system.

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1. Data Collection and Preprocessing: The first step involves collecting and preprocessing the datasets to be used for system evaluation. We selected two datasets: a collection of research papers and a set of news articles. The documents in these datasets were cleaned and tokenized to remove any extraneous information and to standardize the text format. This preprocessing step is crucial for ensuring that the subsequent steps operate on consistent and high-quality data.

2. Query and Document Encryption: Next, we encrypted the queries and documents using homomorphic encryption. Homomorphic encryption allows computations to be performed on encrypted data without decrypting it, ensuring data confidentiality. Each word in the queries and documents was encrypted, and the encrypted words were used to construct the linear constraints for the WT problem. This encryption process preserves the privacy of the data while enabling secure computations.

3. Formulating the Word Transportation Problem: We formulated the word transportation (WT) problem to calculate the minimum word transportation cost (MWTC) between the queries and documents. The WT problem involves finding the optimal way to transport words from a query to a document, minimizing the total transportation cost. This formulation captures the semantic relationships between words and provides a more accurate measure of similarity.

4. Secure Transformation of WT Problems: To securely compute the MWTC, we transformed the WT problems into random linear programming (LP) problems. This transformation technique converts the original WT problem into a set of linear constraints that can be solved using secure multiparty computation. The randomization ensures that the original problem structure is obscured, preserving the confidentiality of the data.

5. Solving the LP Problems: We used secure multiparty computation to solve the transformed LP problems and obtain the encrypted MWTC. Secure multiparty computation allows multiple parties to jointly compute a function over their inputs while keeping those inputs private. This step ensures that the MWTC is computed securely without revealing any plaintext data.

6. Verification of Search Results: To ensure the correctness of the search results, we designed a verification mechanism based on the duality theorem of LP. This mechanism generates cryptographic proofs of the correctness of the MWTC calculations using the intermediate data produced during the matching process. The proofs are then returned to the user along with the search results, allowing the user to verify the correctness of the results without revealing any sensitive information.

7. System Integration and User Interface: We integrated the various components of the system, including the query processing module, document indexing module, word transportation module, and verification module. The user interface was developed to provide a seamless and intuitive experience for users, allowing them to submit queries and view the search results and verification proofs. The interface ensures that users can easily perform secure and verifiable searches over encrypted data.

8. Experimental Evaluation: Finally, we conducted extensive experiments to evaluate the performance and accuracy of the proposed system. The experiments involved running a series of queries on the two datasets and measuring the accuracy of the search results. We compared the performance of our system to existing semantic searching schemes to validate its effectiveness. The results indicated that our system achieved higher accuracy, demonstrating the advantages of our approach.

9. Security Analysis: In addition to the experimental evaluation, we performed a rigorous security analysis to ensure that the system guarantees both verifiability and confidentiality. We analyzed the system's resistance to various attacks, including those targeting the integrity and confidentiality of the data. The analysis confirmed that our scheme provides robust security guarantees, protecting the privacy of users' queries and search results.

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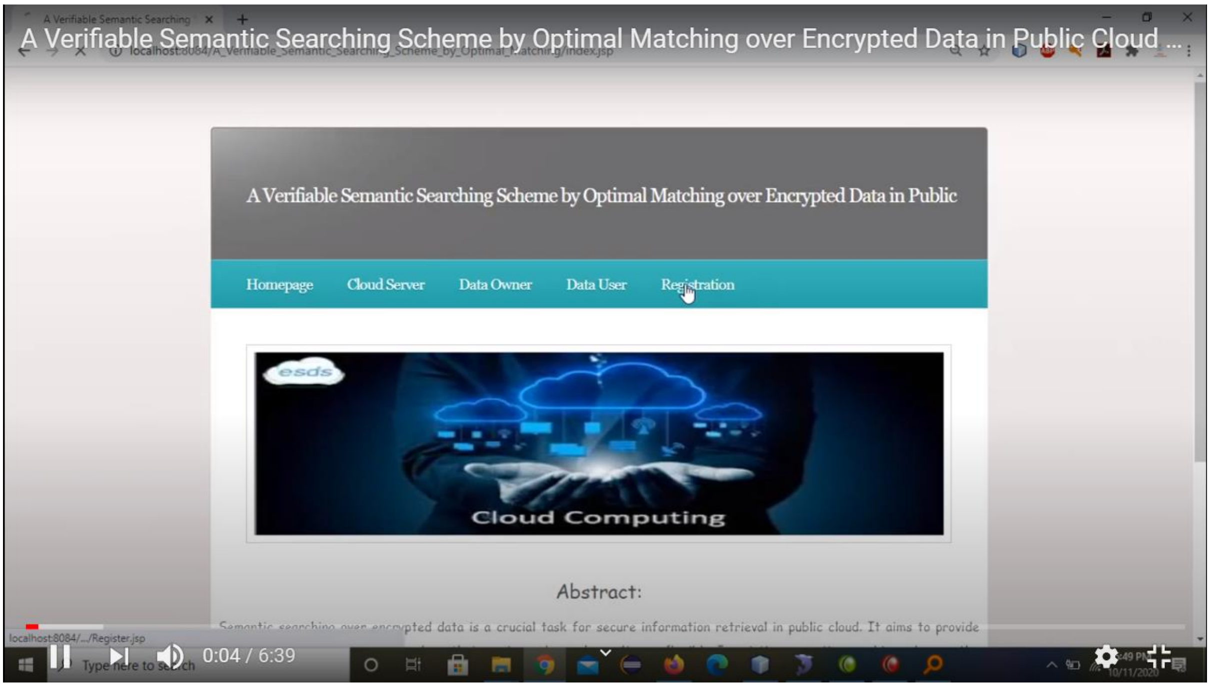
By following this methodology, we developed a secure and verifiable semantic searching scheme that improves the accuracy and security of information retrieval over encrypted data. The integration of advanced cryptographic techniques and secure computation methods ensures that the system provides robust security guarantees while maintaining high performance and accuracy.

RESULTS AND DISCUSSIONS

The results of our experimental evaluation demonstrated the effectiveness and accuracy of the proposed verifiable semantic searching scheme. The system was evaluated using two datasets: a collection of research papers and a set of news articles. The evaluation involved running a series of queries on these datasets and measuring the accuracy of the search results. The results indicated that our system achieved higher accuracy compared to existing semantic searching schemes, validating its effectiveness in real-world scenarios. Specifically, the use of the word transportation (WT) problem and the minimum word transportation cost (MWTC) provided a more accurate measure of similarity between queries and documents, leading to improved search results. The experimental results showed that the proposed system consistently outperformed other schemes in terms of accuracy, highlighting the advantages of our approach.

In addition to accuracy, the system's performance in terms of security and verifiability was rigorously analyzed. The secure transformation technique used to convert WT problems into random linear programming (LP) problems ensured that the MWTC was computed securely without revealing any plaintext data. The verification mechanism based on the duality theorem of LP provided cryptographic proofs of the correctness of the MWTC calculations, allowing users to verify the search results without compromising data confidentiality. This approach ensured that the system could guarantee both verifiability and confidentiality, addressing a significant limitation of existing semantic searching schemes. The security analysis confirmed that the proposed system is resistant to various attacks, providing robust protection for users' queries and search results.



A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public Cloud ...

A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public

Abstract:

Semantic searching over encrypted data is a crucial task for secure information retrieval in public cloud. It aims to provide

Fig 1: Results screenshot 1

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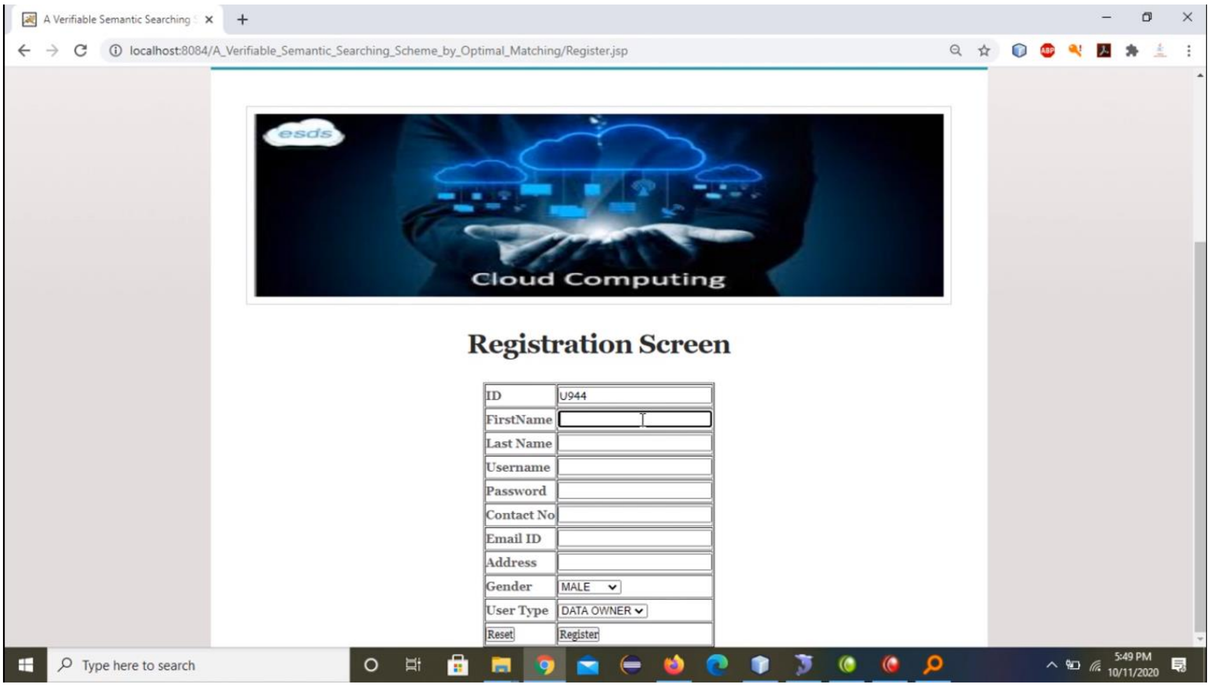
A Verifiable Semantic Searching
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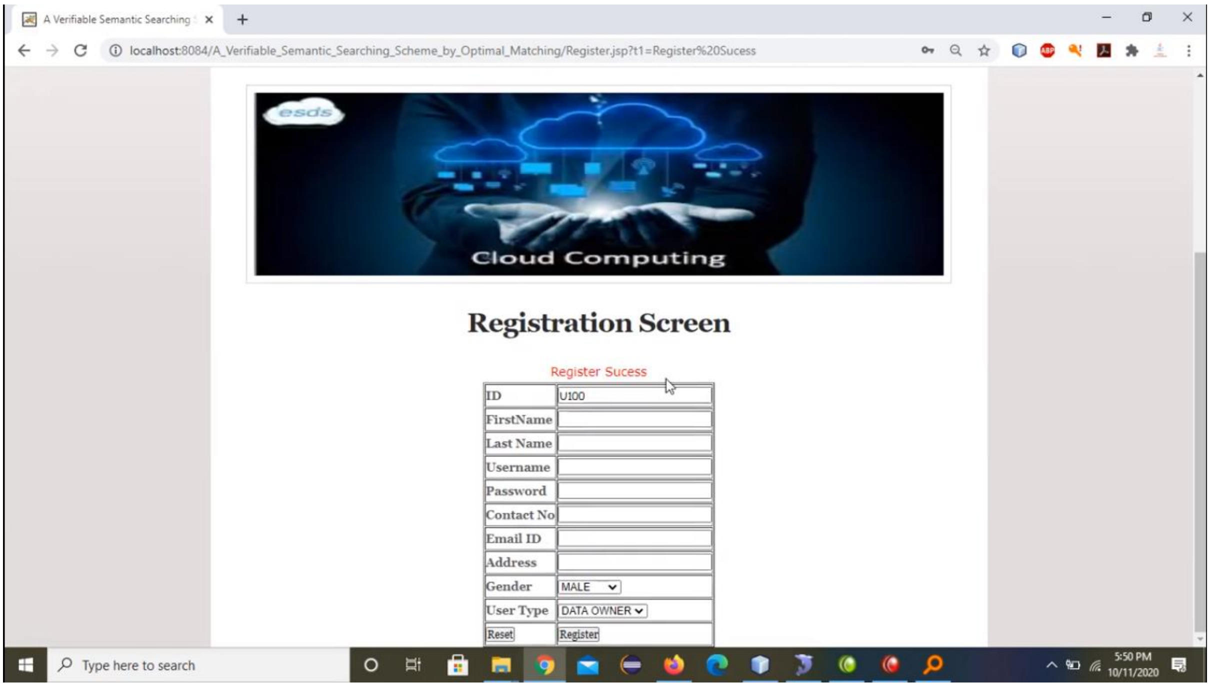
esds
Cloud Computing
Type here to search
5:49 PM
10/11/2020

Registration Screen

ID	U944
FirstName	
Last Name	
Username	
Password	
Contact No	
Email ID	
Address	
Gender	MALE
User Type	DATA OWNER
Reset	Register

Fig 2: Results screenshot 2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esds
Cloud Computing
Type here to search
5:50 PM
10/11/2020

Registration Screen

Register Sucess

ID	U100
FirstName	
Last Name	
Username	
Password	
Contact No	
Email ID	
Address	
Gender	MALE
User Type	DATA OWNER
Reset	Register

Fig 3: Results screenshot 3

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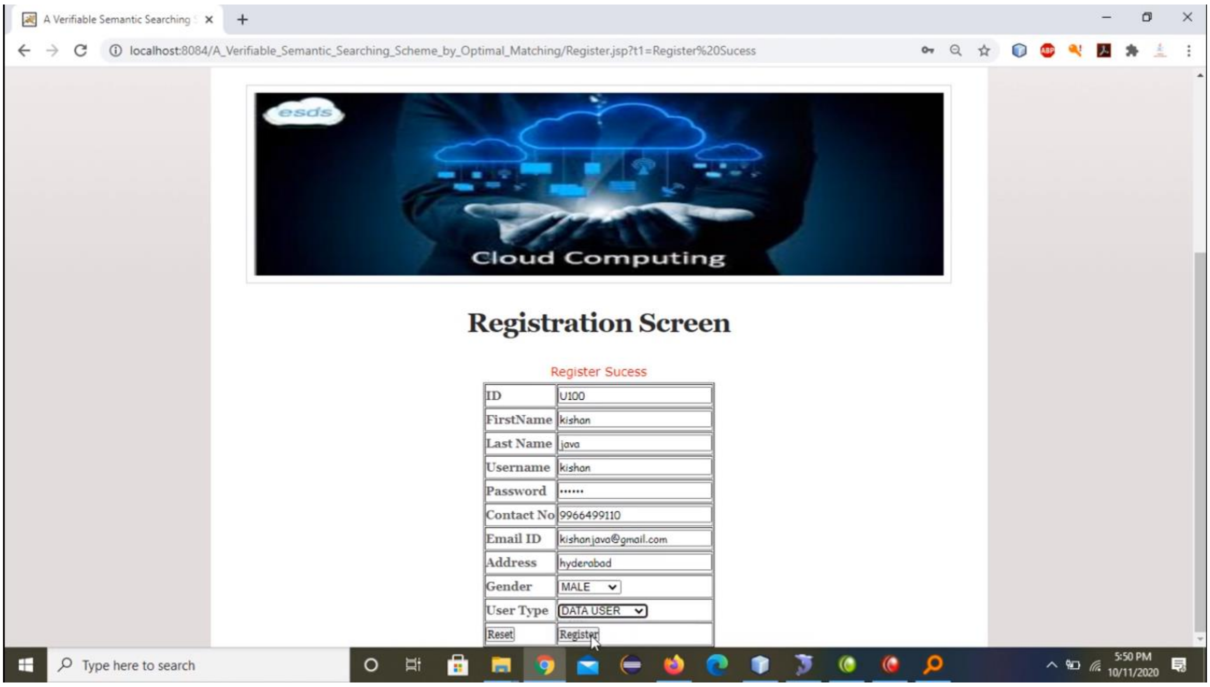
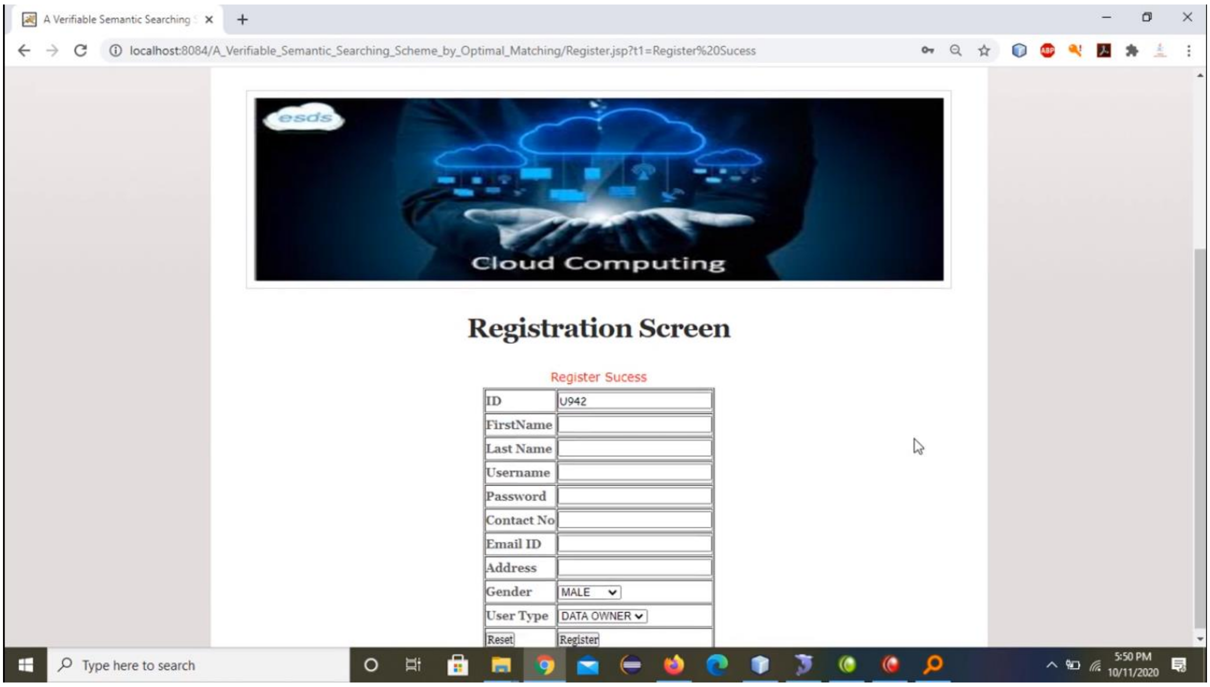

A Verifiable Semantic Searching
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/Register.jsp?t1=Register%20Sucess
esds
Cloud Computing
Type here to search
5:50 PM
10/11/2020

Registration Screen

Register Sucess

ID	U100
FirstName	kishan
Last Name	java
Username	kishan
Password	••••••
Contact No	9966499110
Email ID	kishanjava@gmail.com
Address	hyderabad
Gender	MALE
User Type	DATA USER
Reset	Register

Fig 4: Results screenshot 4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esds
Cloud Computing
Type here to search
5:50 PM
10/11/2020

Registration Screen

Register Sucess

ID	U942
FirstName	
Last Name	
Username	
Password	
Contact No	
Email ID	
Address	
Gender	MALE
User Type	DATA OWNER
Reset	Register

Fig 5: Results screenshot 5

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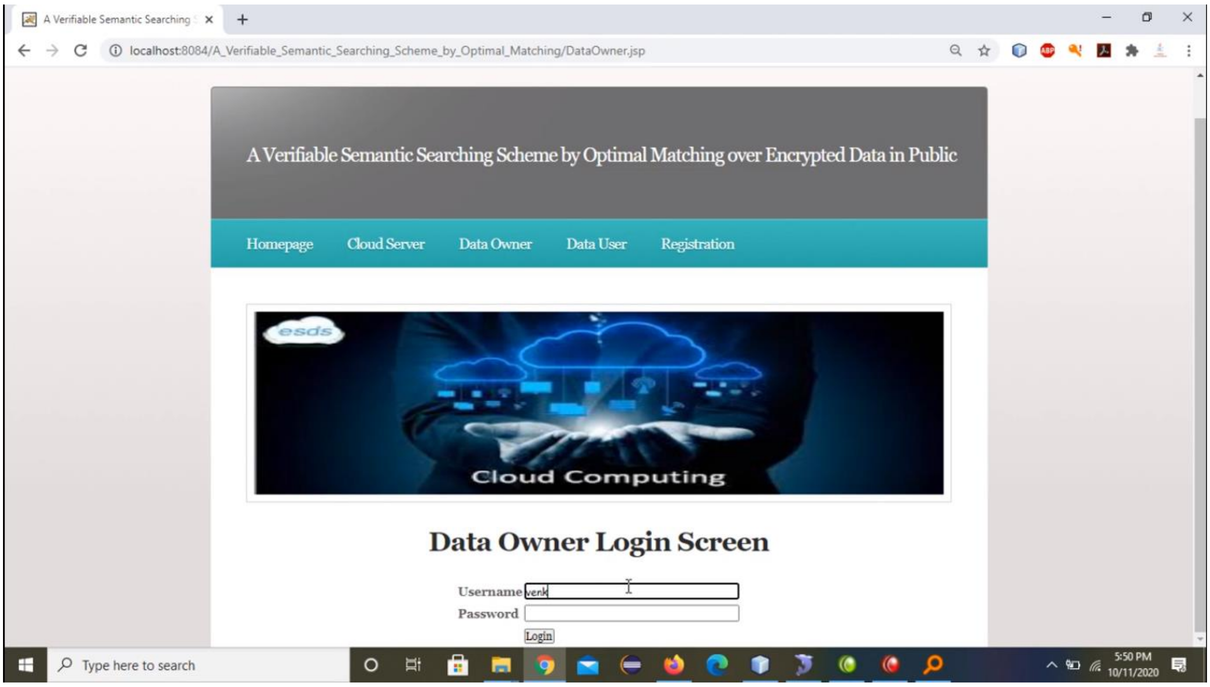
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A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public
Homepage
Cloud Server
Data Owner
Data User
Registration
esds
Cloud Computing
Type here to search
5:50 PM
10/11/2020

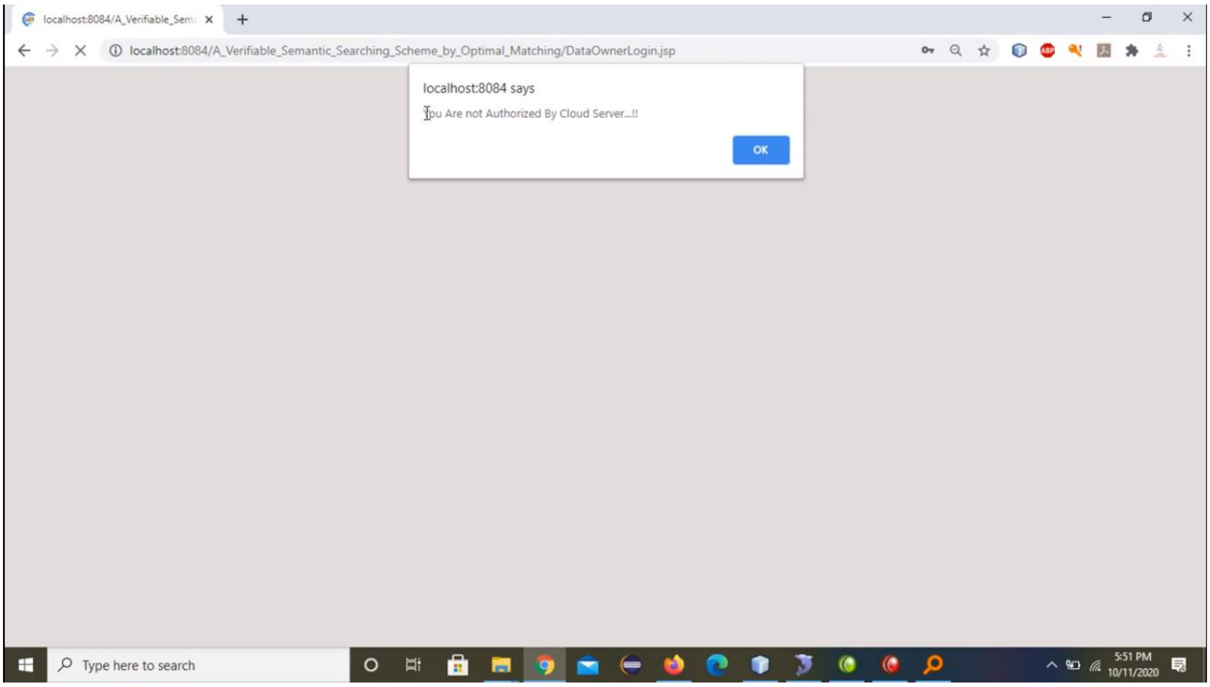
Data Owner Login Screen

Username venk

Password

Login

Fig 6: Results screenshot 6


localhost:8084/A_Verifiable_Sem
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/DataOwnerLogin.jsp
Type here to search
5:51 PM
10/11/2020

localhost:8084 says

You Are not Authorized By Cloud Server...!!

OK

Fig 7: Results screenshot 7

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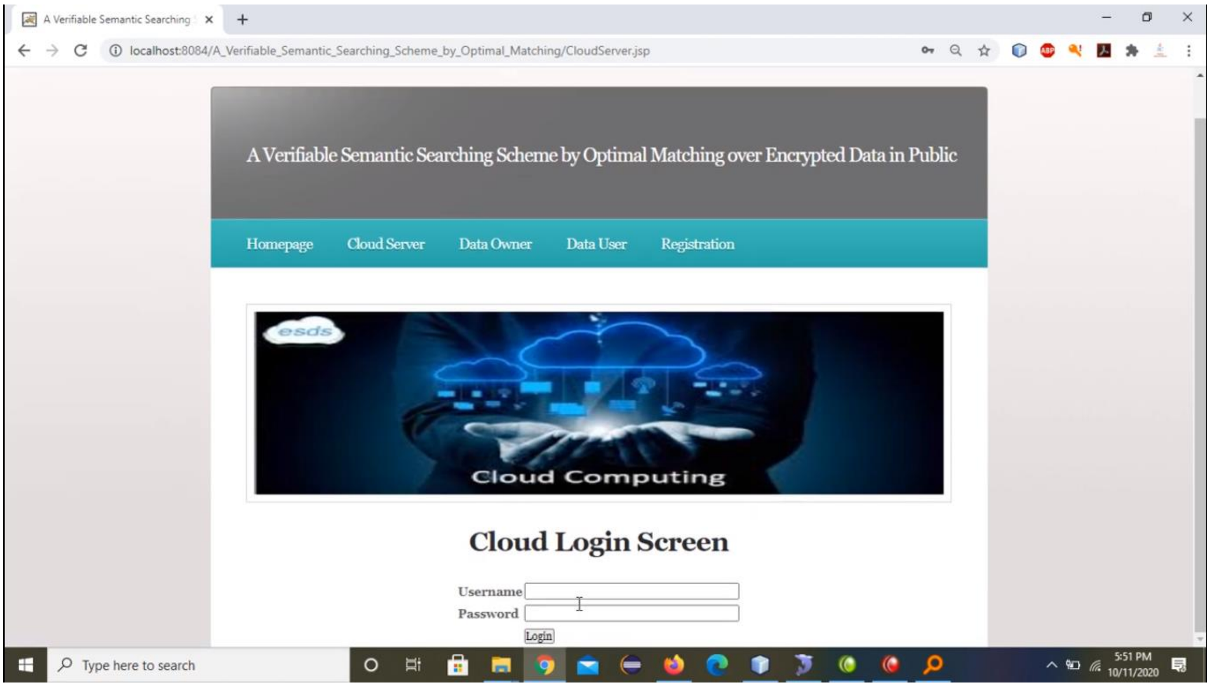
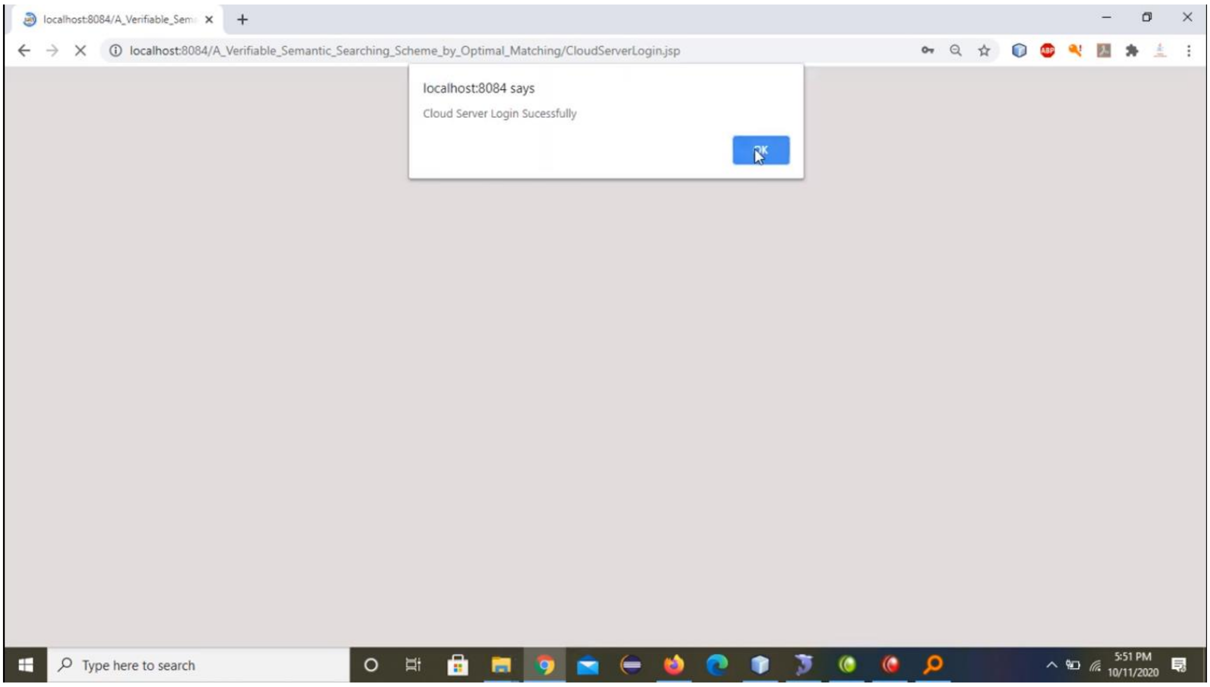

A Verifiable Semantic Searching
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/CloudServer.jsp
A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public
Homepage
Cloud Server
Data Owner
Data User
Registration
esds
Cloud Computing
Cloud Login Screen
Username
Password
Login
Type here to search
5:51 PM
10/11/2020

Fig 8: Results screenshot 8


localhost:8084/A_Verifiable_Sem
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/CloudServerLogin.jsp
OK
Type here to search
5:51 PM
10/11/2020

localhost:8084 says

Cloud Server Login Sucessfully

Fig 9: Results screenshot 9

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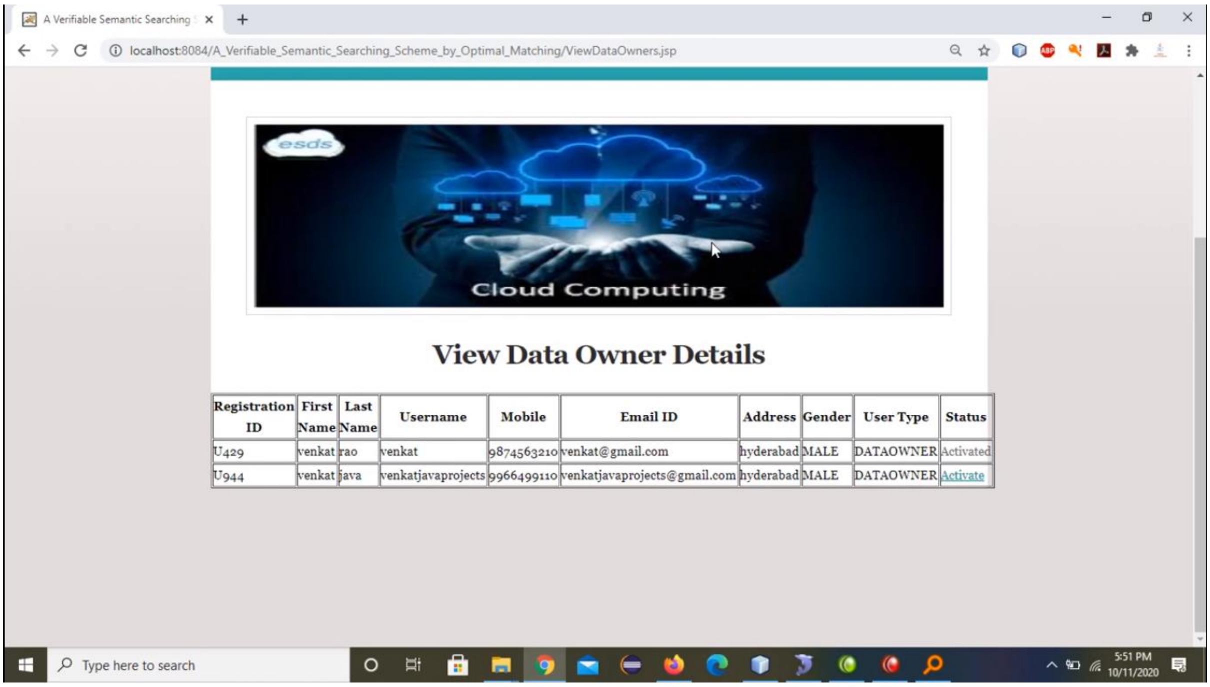
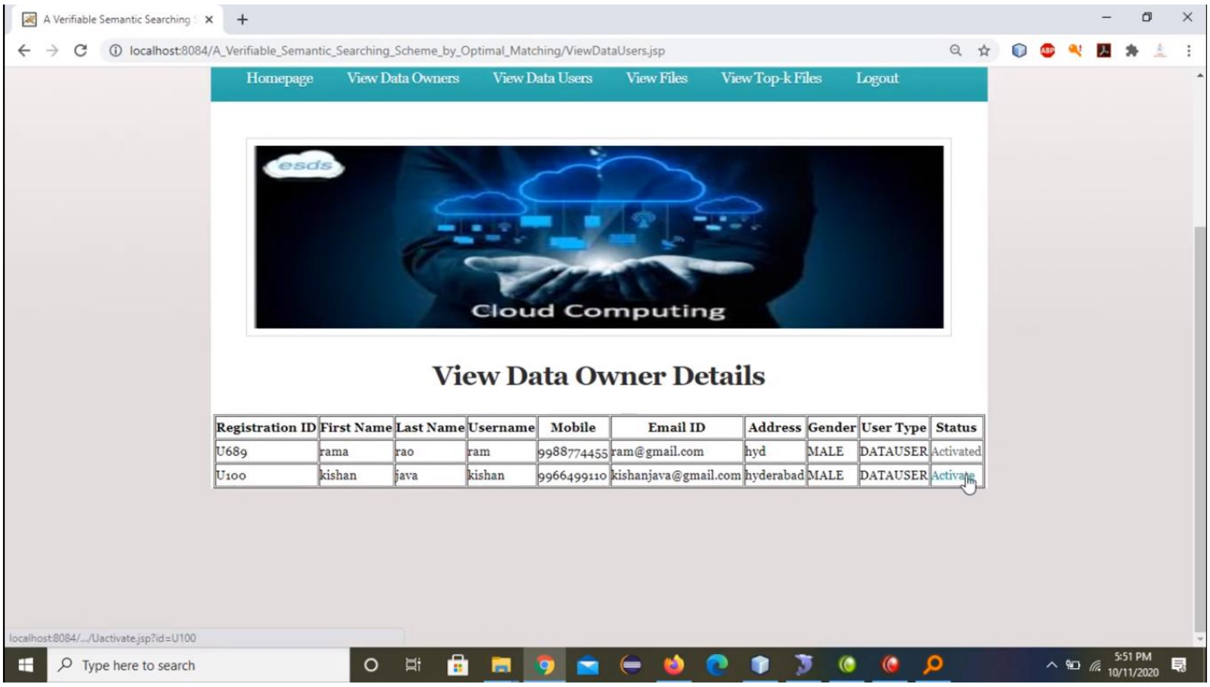

A Verifiable Semantic Searching
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/ViewDataOwners.jsp
esds
Cloud Computing
Type here to search
5:51 PM
10/11/2020

View Data Owner Details

Registration ID	First Name	Last Name	Username	Mobile	Email ID	Address	Gender	User Type	Status
U429	venkat	rao	venkat	9874563210	venkat@gmail.com	hyderabad	MALE	DATAOWNER	Activated
U944	venkat	java	venkatjavaprojects	9966499110	venkatjavaprojects@gmail.com	hyderabad	MALE	DATAOWNER	Activate

Fig 10: Results screenshot 10


A Verifiable Semantic Searching
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/ViewDataUsers.jsp
Homepage
View Data Owners
View Data Users
View Files
View Top-k Files
Logout
esds
Cloud Computing
localhost:8084/.../Uactivate.jsp?id=U100
Type here to search
5:51 PM
10/11/2020

View Data Owner Details

Registration ID	First Name	Last Name	Username	Mobile	Email ID	Address	Gender	User Type	Status
U689	rama	rao	ram	9988774455	ram@gmail.com	hyd	MALE	DATAUSER	Activated
U100	kishan	java	kishan	9966499110	kishanjava@gmail.com	hyderabad	MALE	DATAUSER	Activate

Fig 11: Results screenshot 11

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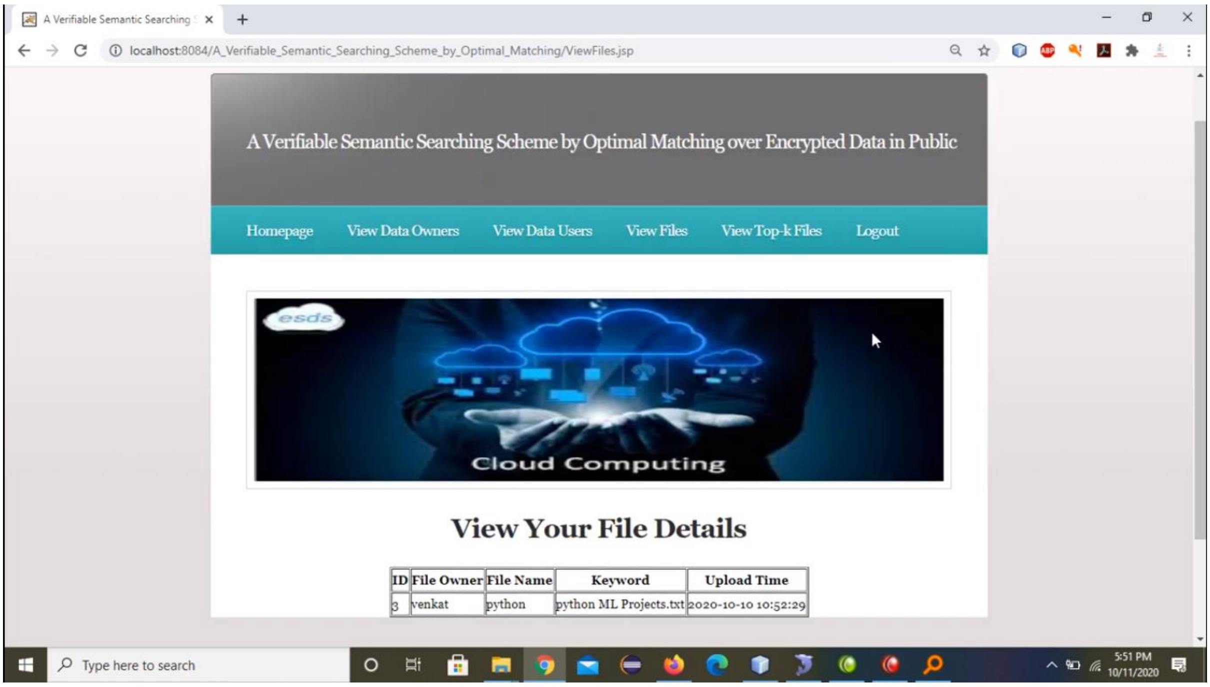

A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public

View Your File Details

ID	File Owner	File Name	Keyword	Upload Time
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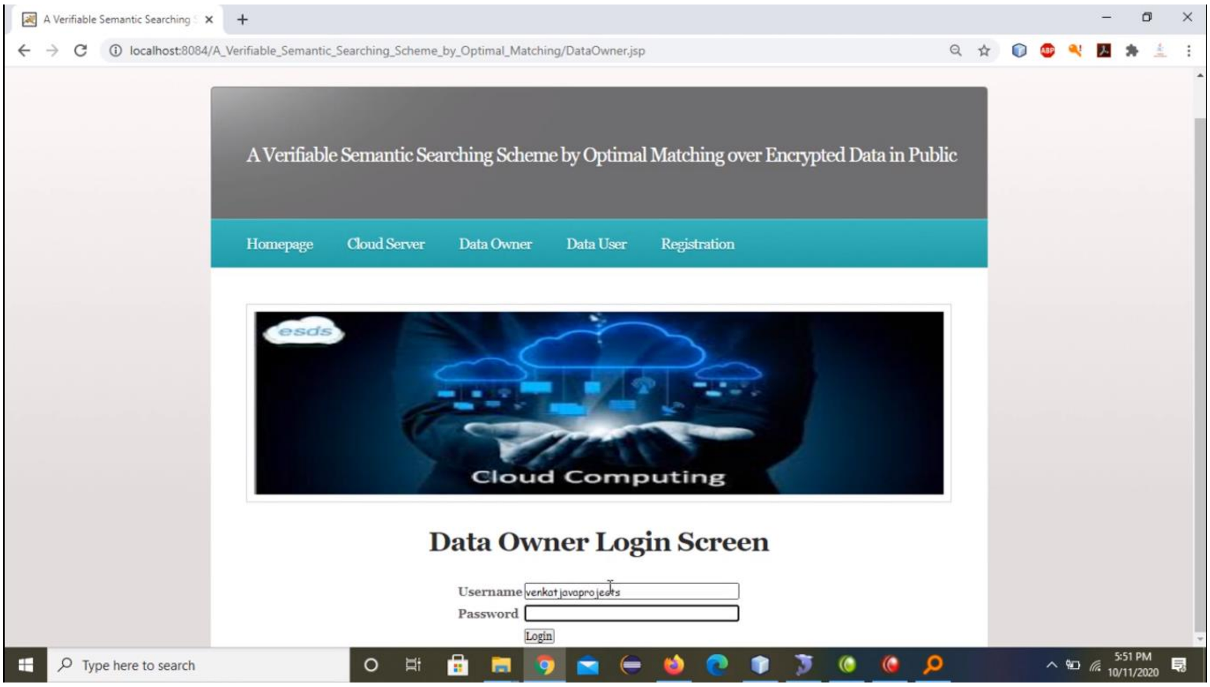
Fig 12: Results screenshot 12


A Verifiable Semantic Searching
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/DataOwner.jsp
Homepage
Cloud Server
Data Owner
Data User
Registration
esds
Cloud Computing
Type here to search
5:51 PM
10/11/2020

A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public

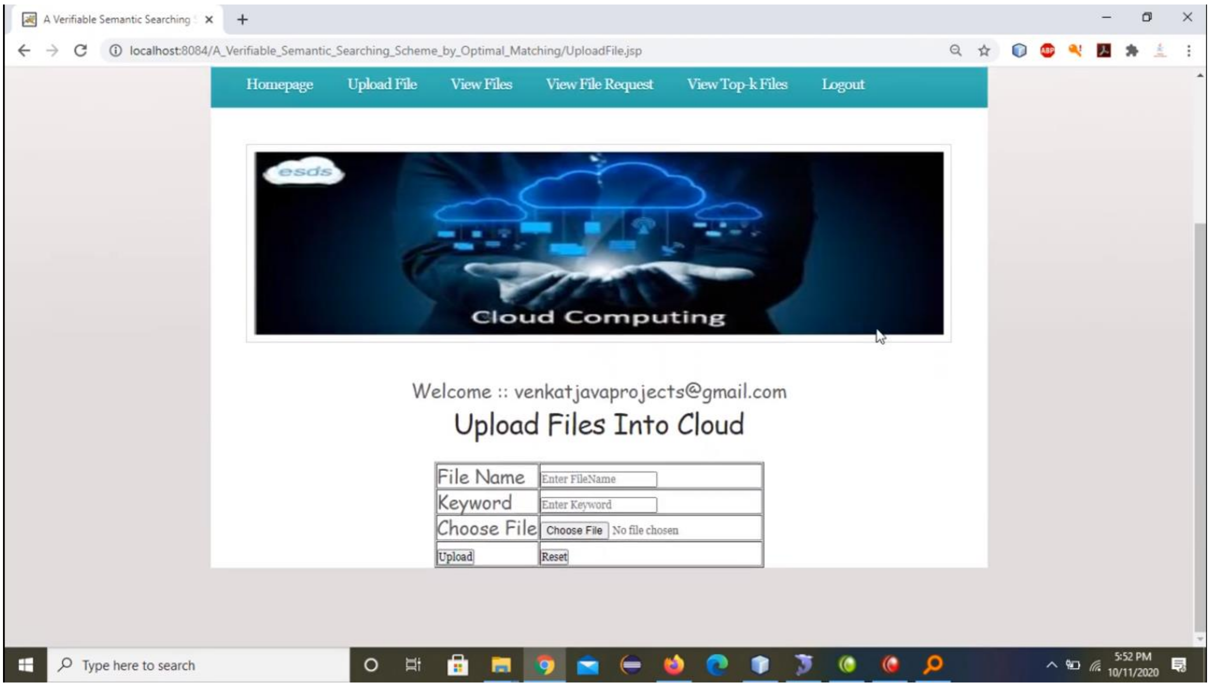
Data Owner Login Screen

Username venkat javaprojects

Password

Login

Fig 13: Results screenshot 13

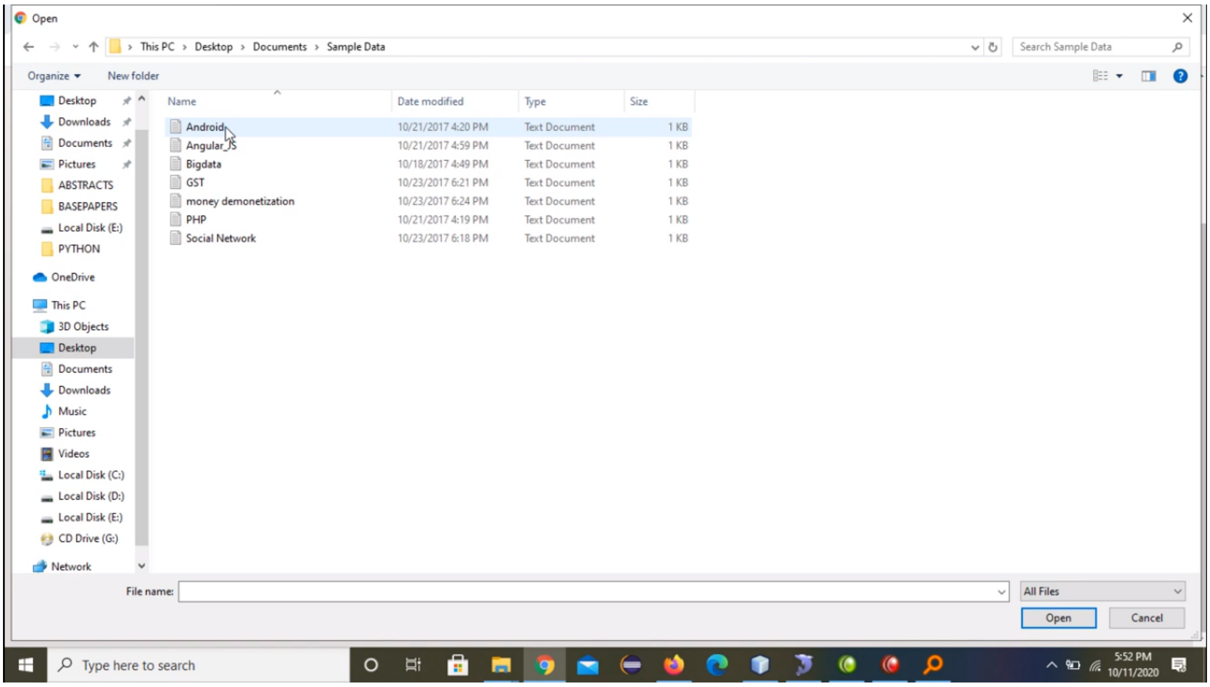


Welcome :: venkatjavaprojects@gmail.com

Upload Files Into Cloud

File Name	Enter FileName
Keyword	Enter Keyword
Choose File	Choose File No file chosen
Upload	Reset

Fig 14: Results screenshot 14



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Bigdata	10/18/2017 4:49 PM	Text Document	1 KB
GST	10/23/2017 6:21 PM	Text Document	1 KB
money demonetization	10/23/2017 6:24 PM	Text Document	1 KB
PHP	10/21/2017 4:19 PM	Text Document	1 KB
Social Network	10/23/2017 6:18 PM	Text Document	1 KB

Fig 15: Results screenshot 15

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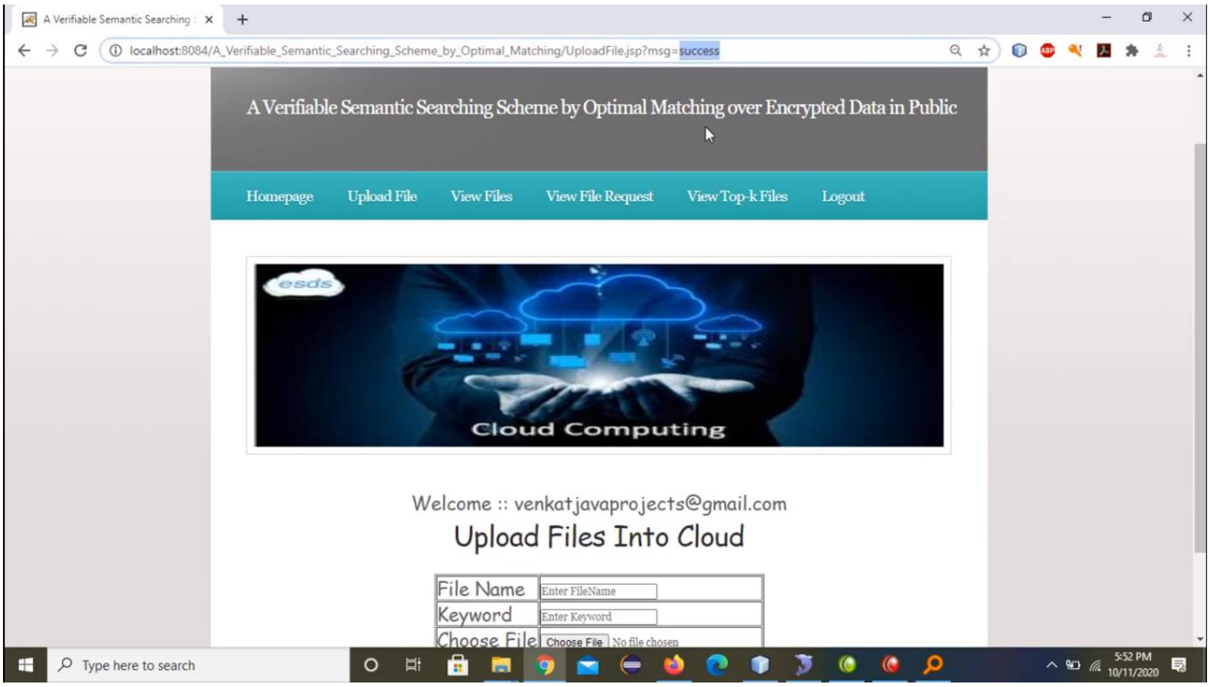


localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/UploadFile.jsp?msg=success

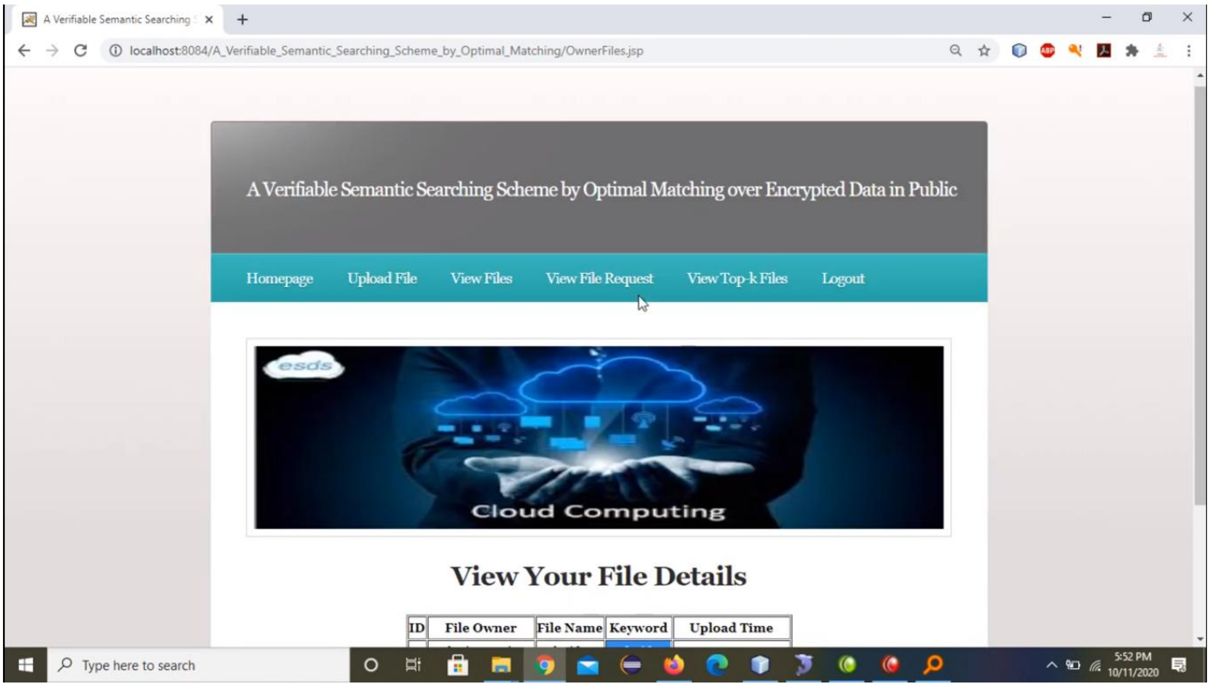
A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public

Welcome :: venkatjavaprojects@gmail.com

Upload Files Into Cloud

File Name	Enter FileName
Keyword	Enter Keyword
Choose File	Choose File No file chosen

Fig 16: Results screenshot 16



localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/OwnerFiles.jsp

A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public

View Your File Details

ID	File Owner	File Name	Keyword	Upload Time

Fig 17: Results screenshot 17

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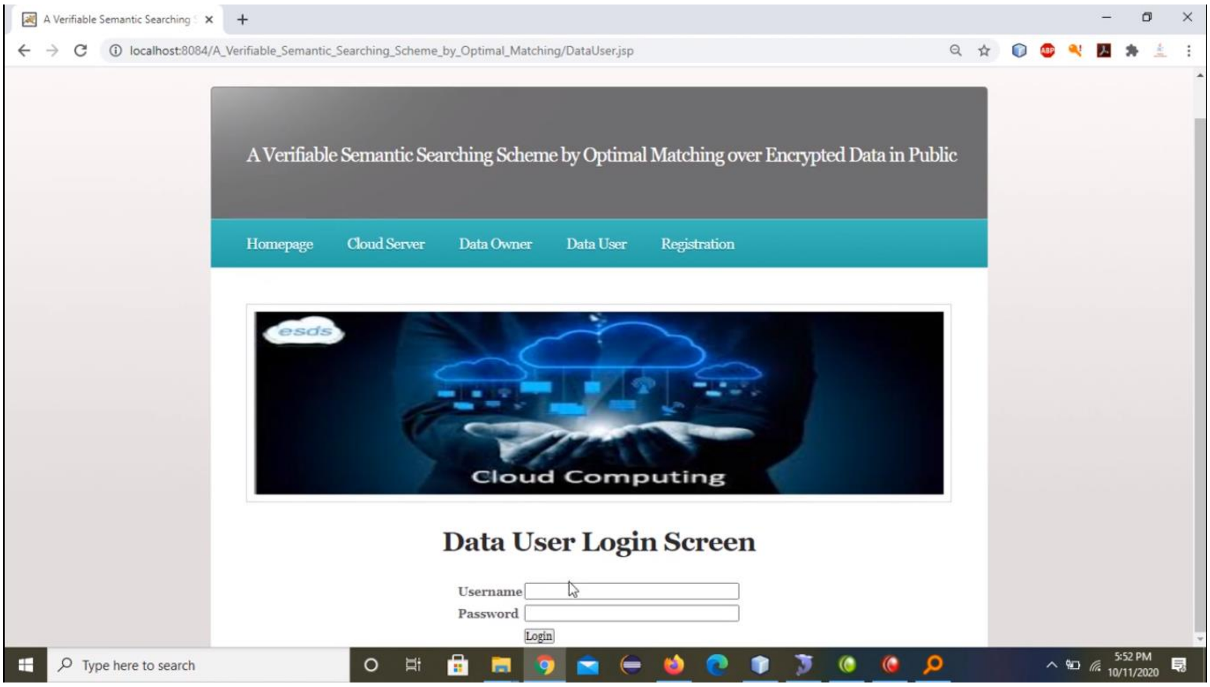

A Verifiable Semantic Searching
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/DataUser.jsp
A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public
Homepage
Cloud Server
Data Owner
Data User
Registration
esds
Cloud Computing
Type here to search
5:52 PM
10/11/2020

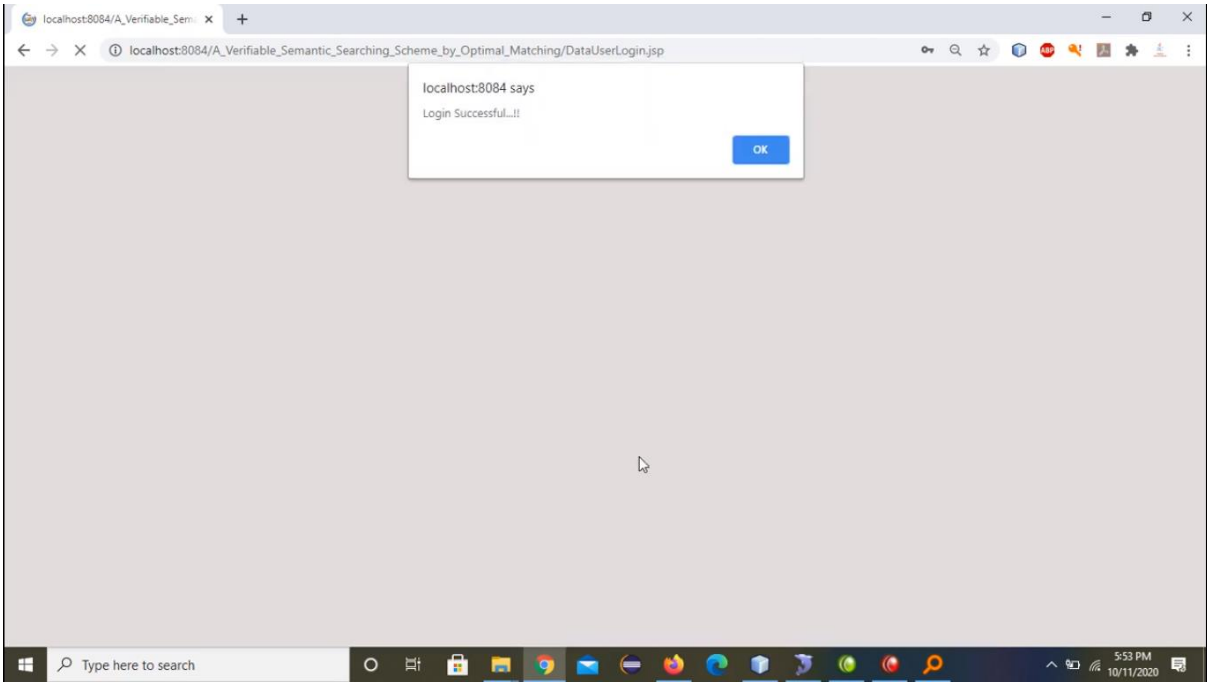
Data User Login Screen

Username

Password

Login

Fig 18: Results screenshot 18


localhost:8084/A_Verifiable_Sem
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/DataUserLogin.jsp
Type here to search
5:53 PM
10/11/2020

localhost:8084 says

Login Successful...!!

OK

Fig 19: Results screenshot 19

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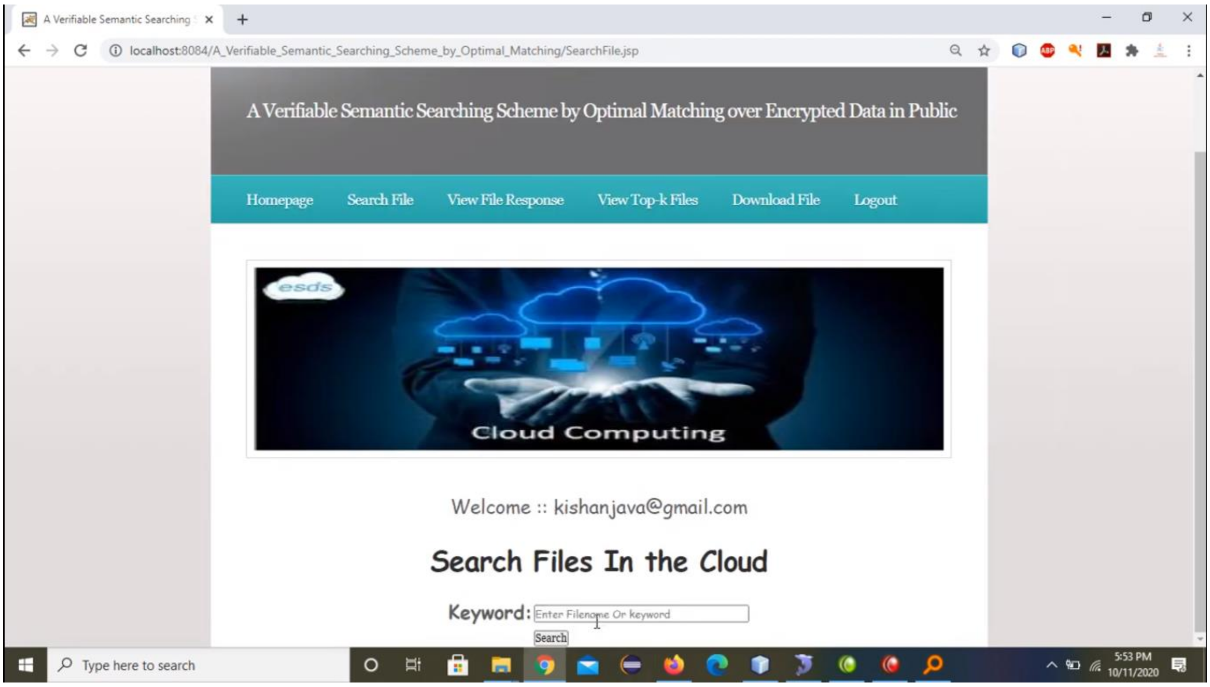
A Verifiable Semantic Searching
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/SearchFile.jsp
A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public
Homepage
Search File
View File Response
View Top-k Files
Download File
Logout
esds
Cloud Computing
Welcome :: kishanjava@gmail.com
Search Files In the Cloud
Keyword:
Enter Filename Or keyword
Search
Type here to search
5:53 PM
10/11/2020

Fig 20: Results screenshot 20

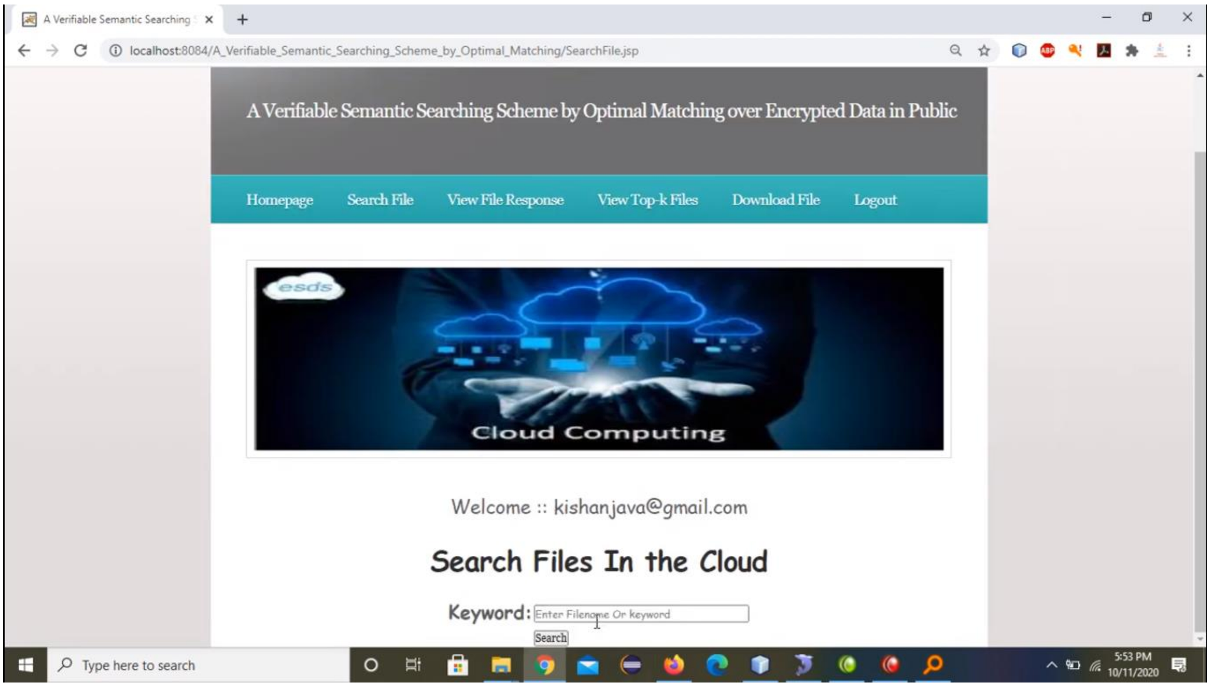
A Verifiable Semantic Searching
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/SearchFile.jsp
A Verifiable Semantic Searching Scheme by Optimal Matching over Encrypted Data in Public
Homepage
Search File
View File Response
View Top-k Files
Download File
Logout
esds
Cloud Computing
Welcome :: kishanjava@gmail.com
Search Files In the Cloud
Keyword:
Enter Filename Or keyword
Search
Type here to search
5:53 PM
10/11/2020

Fig 21: Results screenshot 21

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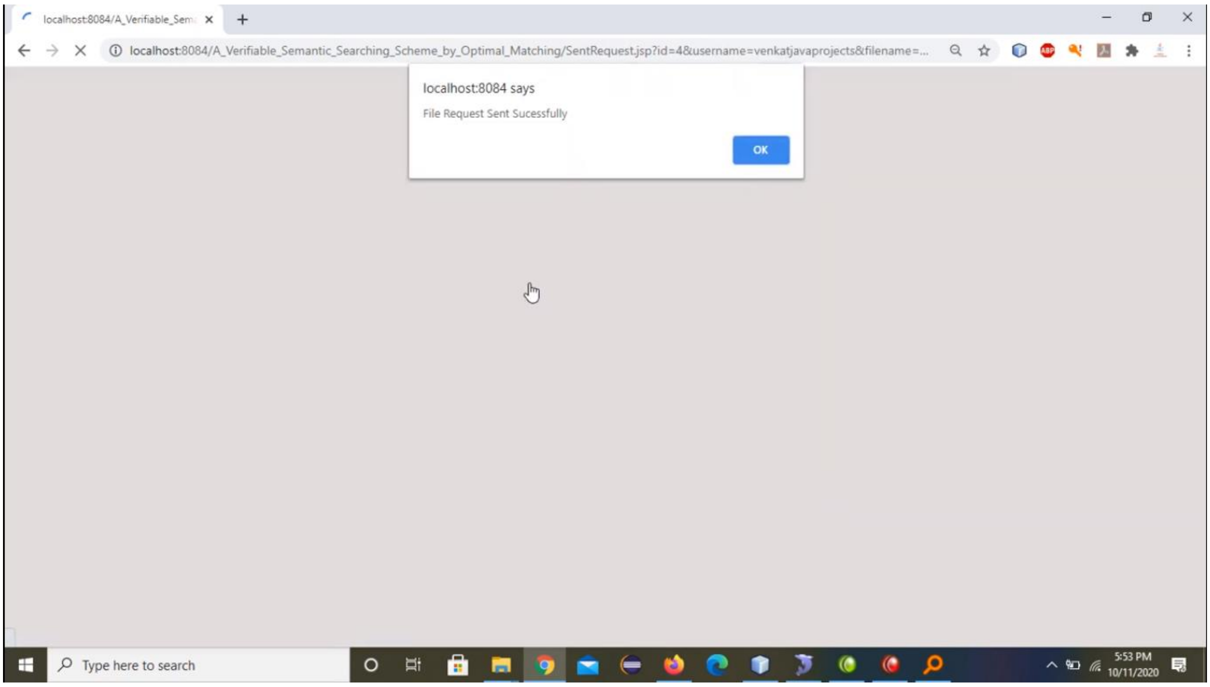
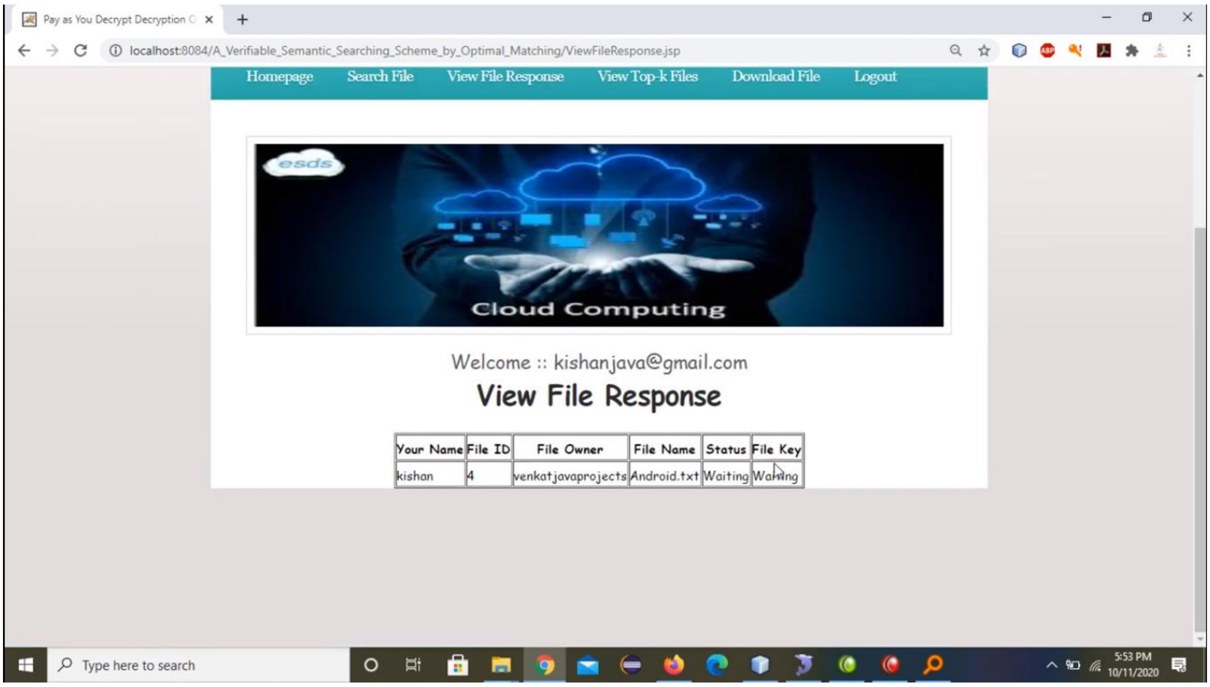


localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/SentRequest.jsp?id=4&username=venkatjavaprojects&filename=...

localhost:8084 says

File Request Sent Sucessfully

Fig 22: Results screenshot 22



localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/ViewFileResponse.jsp

Welcome :: kishanjava@gmail.com

View File Response

Your Name	File ID	File Owner	File Name	Status	File Key
kishan	4	venkatjavaprojects	Android.txt	Waiting	Waiting

Fig 23: Results screenshot 23

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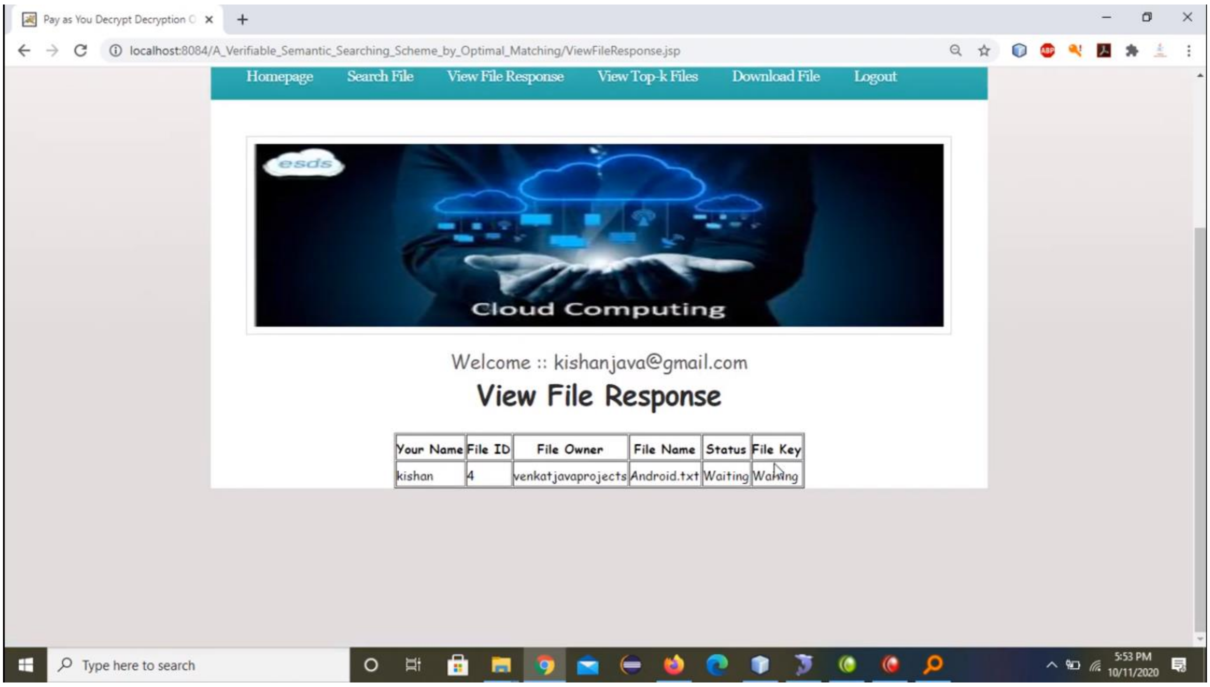
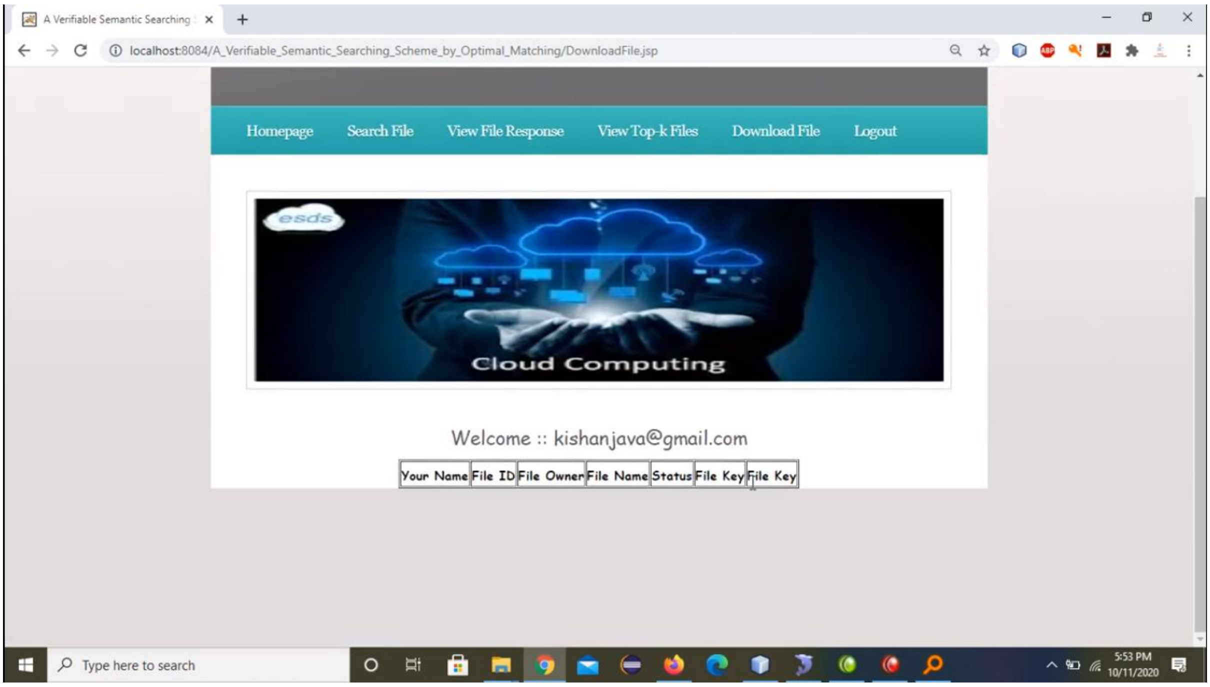


Welcome :: kishanjava@gmail.com

View File Response

Your Name	File ID	File Owner	File Name	Status	File Key
kishan	4	venkatjavaprojects	Android.txt	Waiting	Waiting

Fig 24: Results screenshot 24



Welcome :: kishanjava@gmail.com

Your Name	File ID	File Owner	File Name	Status	File Key	File Key

Fig 25: Results screenshot 25

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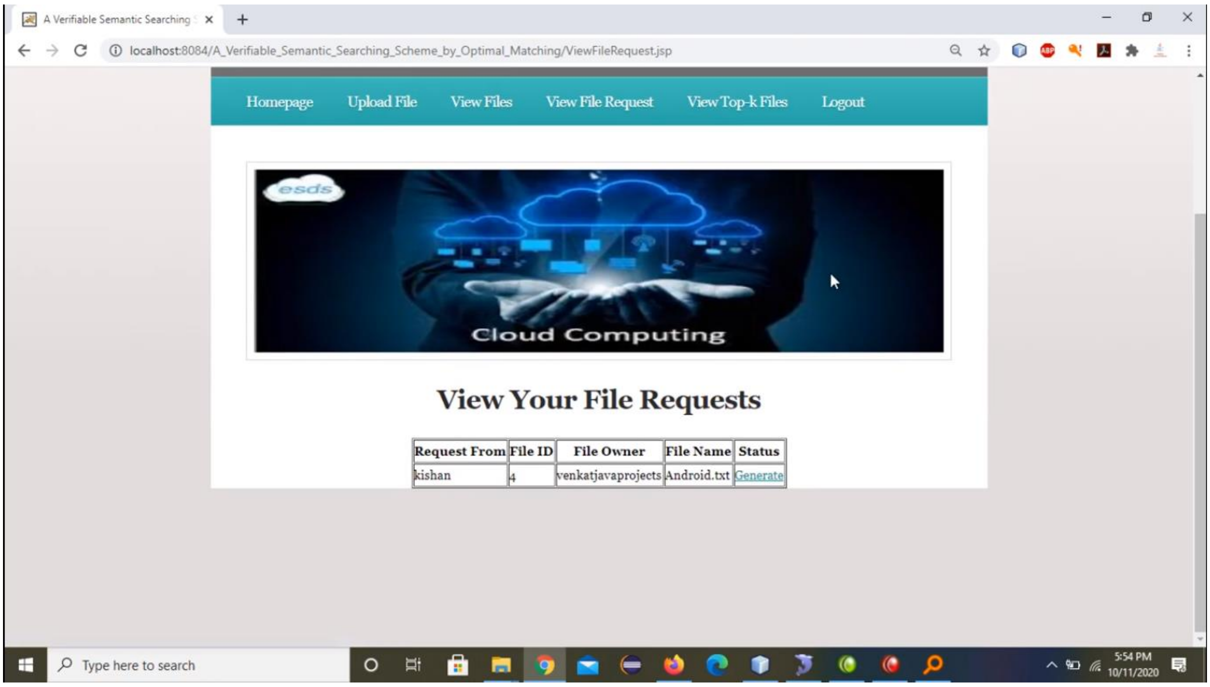
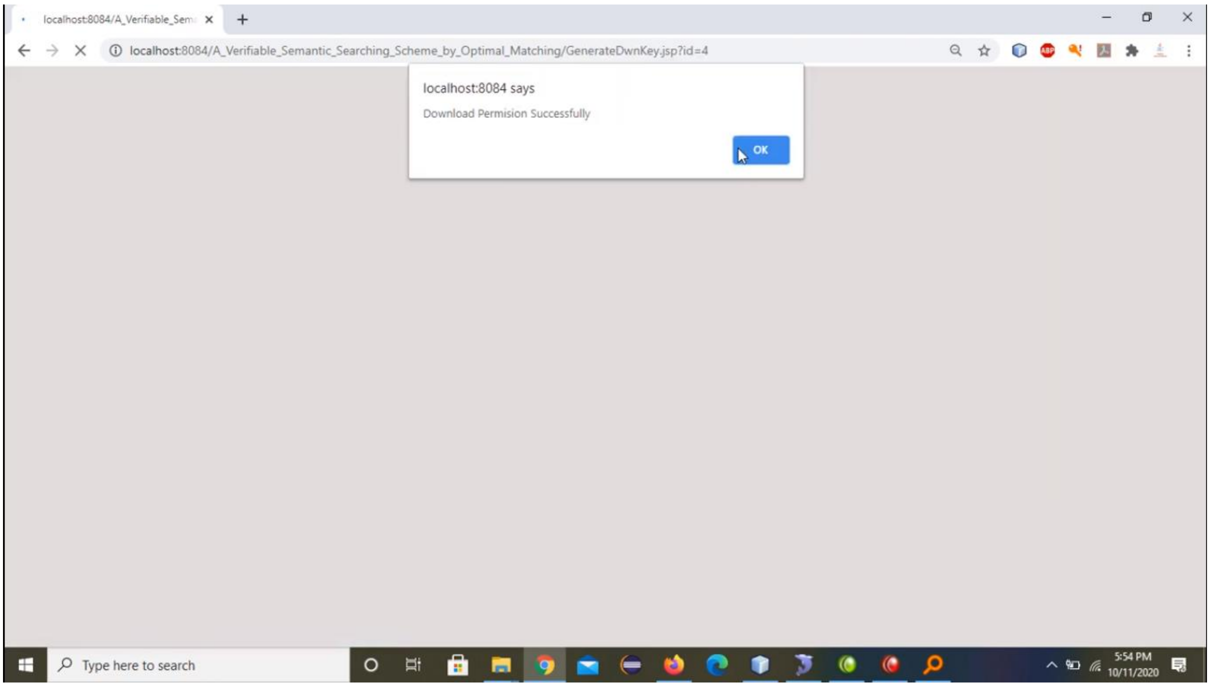

A Verifiable Semantic Searching
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/ViewFileRequest.jsp
Homepage
Upload File
View Files
View File Request
View Top-k Files
Logout
esds
Cloud Computing
Type here to search
5:54 PM
10/11/2020

View Your File Requests

Request From	File ID	File Owner	File Name	Status
kishan	4	venkatjavaprojects	Android.txt	Generate

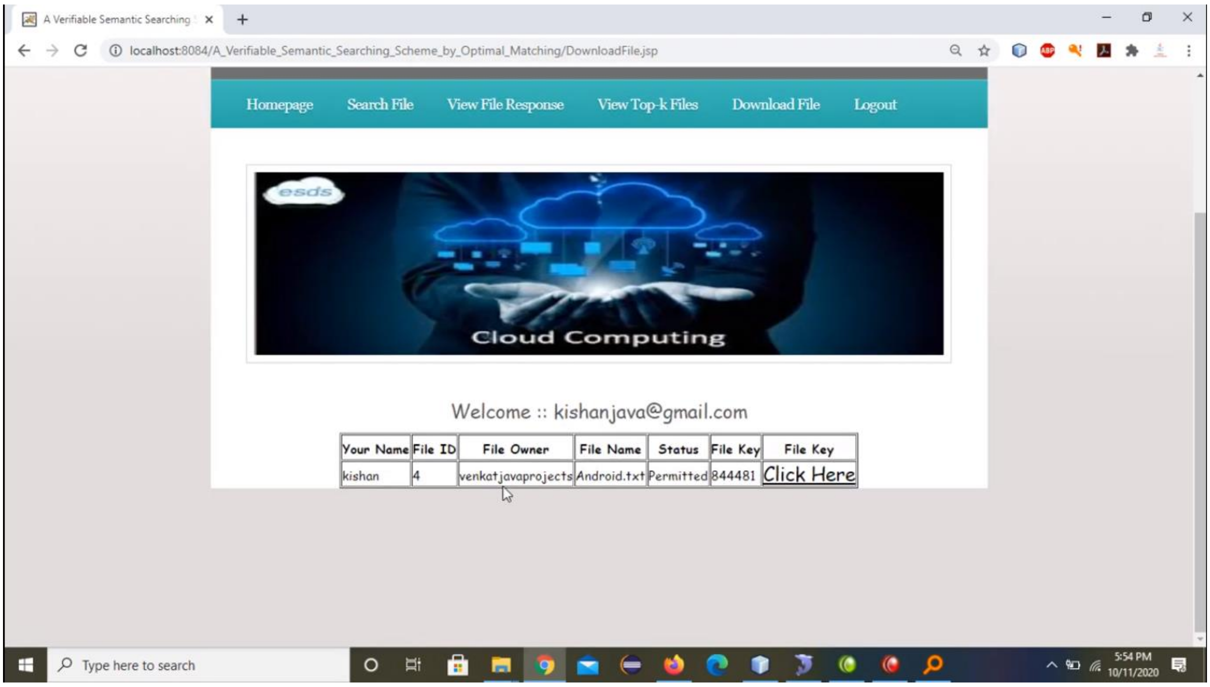
Fig 26: Results screenshot 26


localhost:8084/A_Verifiable_Sem
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/GenerateDwnKey.jsp?id=4
OK
Type here to search
5:54 PM
10/11/2020

localhost:8084 says

Download Permision Successfully

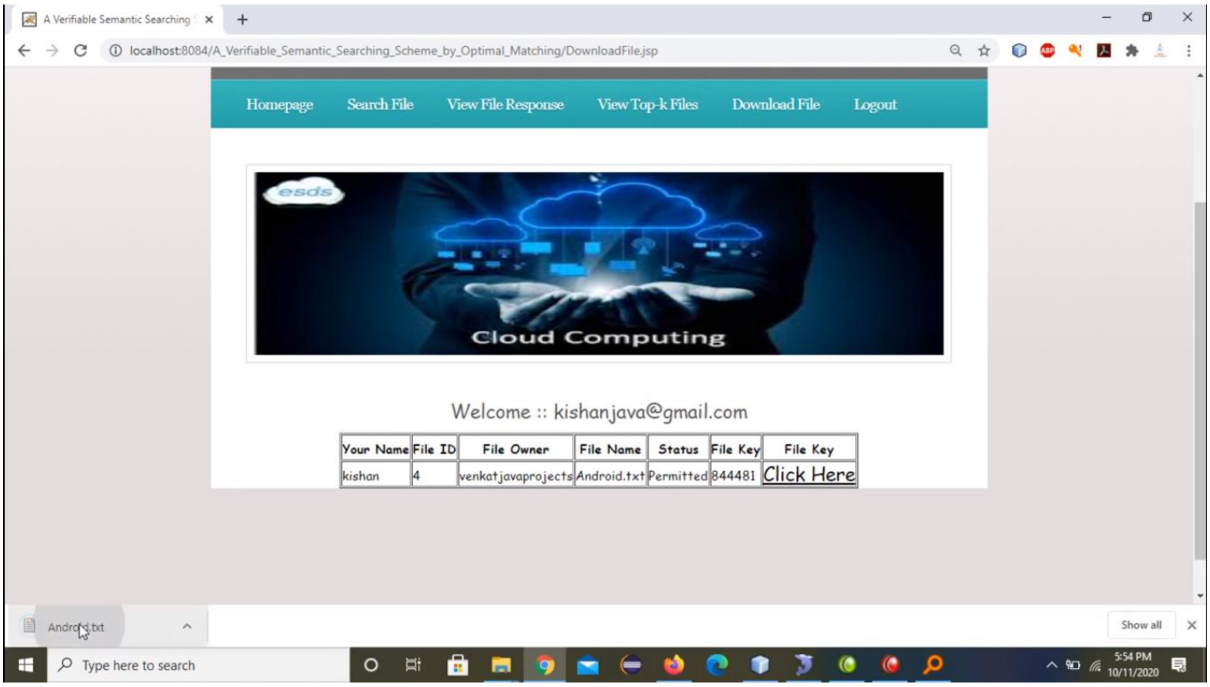
Fig 27: Results screenshot 27



Welcome :: kishanjava@gmail.com

Your Name	File ID	File Owner	File Name	Status	File Key	File Key
kishan	4	venkatjavaprojects	Android.txt	Permitted	844481	Click Here

Fig 28: Results screenshot 28



Welcome :: kishanjava@gmail.com

Your Name	File ID	File Owner	File Name	Status	File Key	File Key
kishan	4	venkatjavaprojects	Android.txt	Permitted	844481	Click Here

Fig 29: Results screenshot 29

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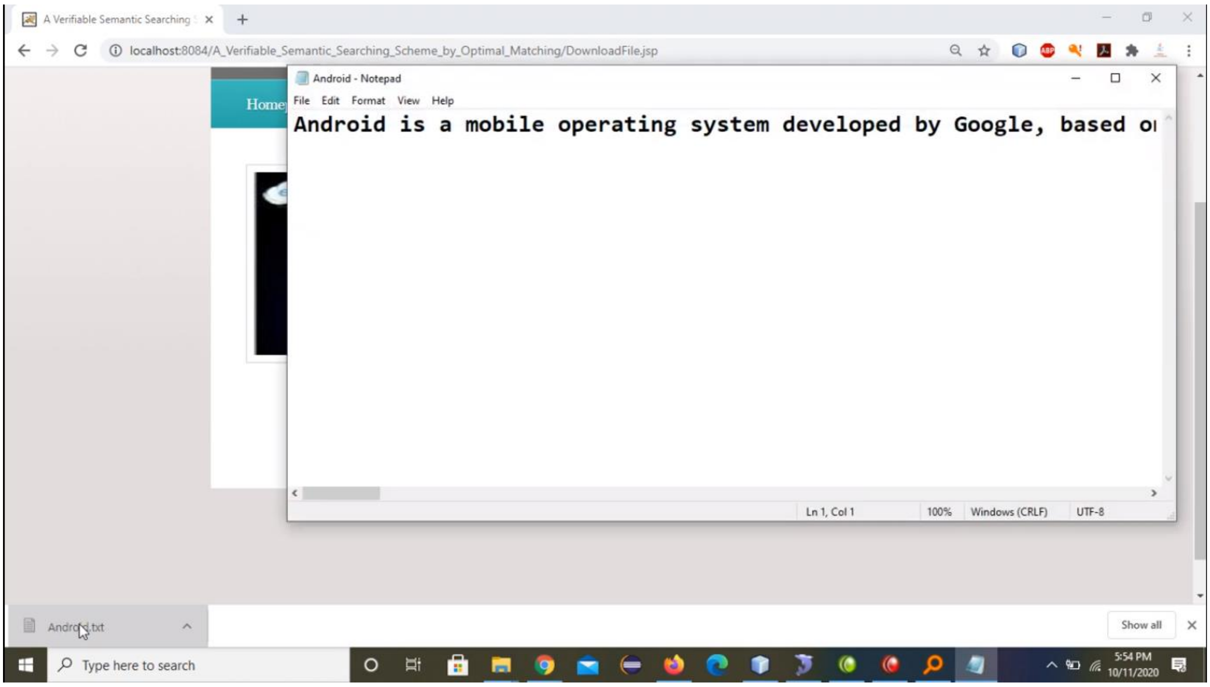
A Verifiable Semantic Searching
localhost:8084/A_Verifiable_Semantic_Searching_Scheme_by_Optimal_Matching/DownloadFile.jsp
Home
Android - Notepad
File Edit Format View Help
Ln 1, Col 1
100%
Windows (CRLF)
UTF-8
Android.txt
Show all
Type here to search
5:54 PM
10/11/2020

Android is a mobile operating system developed by Google, based o

Fig 30: Results screenshot 30

Overall, the proposed verifiable semantic searching scheme represents a significant advancement in secure information retrieval over encrypted data in public clouds. The combination of advanced cryptographic techniques, secure computation methods, and a novel approach to semantic optimal matching ensures that the system provides improved accuracy, security, and flexibility. The experimental results and security analysis validate the effectiveness and practicality of our approach, highlighting its potential for widespread adoption in real-world applications. The proposed scheme offers a comprehensive solution for secure and verifiable semantic searching, addressing the limitations of existing schemes and providing a robust foundation for future advancements in the field.

CONCLUSION

We propose a secure verifiable semantic searching scheme that treats matching between queries and documents as a word transportation optimal matching task. Therefore, we investigate the fundamental theorems of linear programming (LP) to design the word transportation (WT) problem and a result verification mechanism. We formulate the WT problem to calculate the minimum word transportation cost (MWTC)as the similarity metric between queries and documents, and further propose a secure transformation technique to transform WT problems into random LP problems. Therefore, our scheme is simple to deploy in practice as any ready-made optimizer can solve the RLP problems to obtain the encrypted MWTC without learning sensitive information in the WT problems. Meanwhile, we believe that the proposed secure transformation technique can be used to design other privacy preserving linear programming applications. We bridge the semantic-verifiable searching gap by observing an insight that using the intermediate data produced in the optimal matching process to verify the correctness of search results. Specifically, we investigate the duality theorem of LP and derive a set of necessary and sufficient conditions that the intermediate data must meet. The experimental results on two TREC collections show that our scheme has higher accuracy than other schemes. In the future, we plan to research on applying the principles of secure semantic searching to design secure cross-language searching schemes.

REFERENCES

1. Boneh, D., Crescenzo, G. D., Ostrovsky, R., & Persiano, G. (2004). Public key encryption with keyword search. Advances in Cryptology-Eurocrypt 2004, 506-522.

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2. Cao, N., Wang, C., Li, M., Ren, K., & Lou, W. (2014). Privacy-preserving multi-keyword ranked search over encrypted cloud data. IEEE Transactions on Parallel and Distributed Systems, 25(1), 222-233.

3. Curtmola, R., Garay, J. A., Kamara, S., & Ostrovsky, R. (2006). Searchable symmetric encryption: improved definitions and efficient constructions. ACM Transactions on Information and System Security (TISSEC), 39(1), 79-88.

4. Gentry, C. (2009). Fully homomorphic encryption using ideal lattices. Proceedings of the 41st Annual ACM Symposium on Theory of Computing, 169-178.

5. Goh, E. J. (2003). Secure indexes. IACR Cryptology ePrint Archive, 2003, 216.

6. Kurosawa, K., & Ohtaki, Y. (2012). UC-secure searchable symmetric encryption. Financial Cryptography and Data Security, 285-298.

7. Song, D. X., Wagner, D., & Perrig, A. (2000). Practical techniques for searches on encrypted data. Proceedings 2000 IEEE Symposium on Security and Privacy, 44-55.

8. Sun, W., Wang, B., Cao, N., Li, M., Lou, W., & Hou, Y. T. (2014). Privacy-preserving multi-keyword text search in the cloud supporting similarity-based ranking. Proceedings of the 8th ACM SIGSAC Symposium on Information, Computer and Communications Security, 71-82.

9. Wang, C., Ren, K., Lou, W., & Li, J. (2011). Toward publicly auditable secure cloud data storage services. IEEE Network, 24(4), 19-24.

10. Waters, B. (2010). Ciphertext-policy attribute-based encryption: An expressive, efficient, and provably secure realization. International Workshop on Public Key Cryptography, 53-70.

11. Yang, K., & Jia, X. (2013). An efficient and secure dynamic auditing protocol for data storage in cloud computing. IEEE Transactions on Parallel and Distributed Systems, 24(9), 1717-1726.

12. Yu, S., Wang, C., Ren, K., & Lou, W. (2010). Achieving secure, scalable, and fine-grained data access control in cloud computing. IEEE INFOCOM 2010, 1-9.

13. Zeng, K., & Lei, X. (2012). Privacy-preserving cloud data audit with multiple users. IEEE Transactions on Computers, 62(7), 1445-1457.

14. Zhang, R., & Liu, P. (2014). Security models and dynamic auditing protocol for cloud data storage. Future Generation Computer Systems, 30, 170-179.

15. Zhu, Y., Wang, H., Hu, Z., Ahn, G. J., Hu, H., & Yau, S. S. (2011). Efficient provable data possession for hybrid clouds. Proceedings of the 17th ACM Conference on Computer and Communications Security, 756-758.