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Privacy Preserving in Cloud Computing Through Biometric Identification

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ABSTRACT: Biometric identification has become increasingly popular in recent years. With the development of cloud computing, database owners are motivated to outsource the large size of biometric data and identification tasks to the cloud to get rid of the expensive storage and computation costs, which however brings potential threats to users' privacy. In this paper, we propose an efficient and privacy-preserving biometric identification outsourcing scheme. Specifically, the biometric data is encrypted and outsourced to the cloud server. To execute a biometric identification, the database owner encrypts the query data and submits it to the cloud. The cloud performs identification operations over the encrypted database and returns the result to the database owner. A thorough security analysis indicates the proposed scheme is secure even if attackers can forge identification requests and collude with the cloud. Compared with previous protocols, experimental results show the proposed scheme achieves a better performance in both preparation and identification procedures.

KEYWORDS: Biometric Authentication, Finger Recognition, Finger Extraction, Encryption Etc…

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I. INTRODUCTION

Today Cloud Computing is becoming a hot trend in IT industries. Most of the enterprises are using cloud for storing and maintaining their huge data on cloud servers. But security of critical data over the cloud has become a concern for both cloud service users and providers. Traditional authentication mechanism like password, key generation, encryption mechanism has failed. Hackers are able to crack these passwords. So, the data is not secure until we have a secure mechanism to protect the data from intruders and hackers. In this paper, we are presenting a secure authentication mechanism unlike password or key which can't be hacked easily. Biometrics is an automatic identification of a person by using certain physiological features associated with the person. Biometrics data is unique for every individual. So our project aims at using Biometric data of user for the authentication process. Biometric System is a combination of sensors, feature extractor and matching modules which implements biometric recognition algorithms. The sensors scan the biometric trait of the user and produce its digital representation. A quality check is generally performed to ensure that the acquired biometric sample is reliable and can be processed by the subsequent feature extraction and matching modules. The feature extraction module will discard the useless and extraneous data present in the taken sample and extracts useful information called features that can be used for matching. During matching, the query biometric sample is matched with the reference information which is stored in the database to establish the identity associated with the query. This operation is done in two stages, first is the Enrolment and second is the recognition. In Enrolment stage the biometric information of the person is stored in the database. We are implementing our project to match fingerprint data of user for authentication in cloud. We will store the users fingerprint data in compressed form on a cloud database for the time and use that for matching whenever a user tries to login the next time. We are using Biometric scanner to extract fingerprint of user. Fingerprint data will be transmitted in the compressed from for security of users Biometric data. There is a matching module to match the fingerprints against the one stored on the database. If the fingerprint matches, it will allow the registered user to login. Since it will be an overhead for the cloud service providers, our project aims at creating a separate web client between user and cloud service provider to provide a secure service of Biometric Authentication.

This paper is organized in five sections. After this introduction, in Section II, literature survey discussed of the paper, section III about the System Analysis, Section IV about System Design, as well as the novel feature of the proposed method. Finally, Sections V and VI provide the simulation results and the conclusions, respectively.

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II. RELATED WORK

This section of Literature Survey eventually reveals home facts of Biometric Authentication based on the analysis of many authors work as follows:

Chandra Shekhar Vorugunti [1] has introduced a new concept of BioAaaS to maintain secure authentication. Based on SAAS model of Cloud it provides a light weight and secure authentication mechanism. It contains two steps for authentication. First is Enrolment and next is Verification. In Enrolment process the biometric data is converted into a binary form. The feature extractor then converts the binary string into a set of features. In verification process same process will be processed when the user logins to the cloud. The matching module matches the features of the stored data and login data. Thus they have provided a service to do heavy weight cryptographic encryption and decryption operation on user's biometric data.

D J Craft [2] reports on fast hardware implementation of lossless data compression algorithms. It proposed Adaptive Lempel-Ziv Algorithm (LZ1 & LZ2). LZ algorithm are symbol based that is they operate one data one character at a time. They achieve compression by locating frequency occurring sequences of such symbol in input data stream. ALDC have two extensions as BLDC & CLDC. BLDC pre-processing works well on only bitmapped image data. CLDC is combination of ALDC & BLDC. The main difference between LZ1 & LZ2 is in the data structure employed & the way reference to sequence are coded. Cong Li et al. [3] proposed Burrow Wheeler Transformation based DNA sequence data multi-compression using Open MP & MPI. They proposed data compression (DNA sequence) using fewer bits rather than encoded data to represent information. BWT based DNA compression includes few steps. First DNA sequence data is encoded with 0/1 which has 4 characters. Then BWT transformation is performed over it. Again MTF transformation is performed. Then we compress data with classical algorithm.

Kiran Kumar K et al. [4] have described that there are two properties of fingerprint namely uniqueness and permanence that are used for identification and verification. These properties are judged by minutae and ridges. The method used in this paper has 8 stages. They are gray-level fingerprint image, binarization, thinning, minutae extraction, false minutae, matching scores, ridges extraction, minutae and ridge score fused using strength factor. The block filters preserve the outermost pixels along each ridge.

Jeff Collier [5] proposed a system for developing a software that would address the challenges such as in-memory map/reduce. It also deals with the node that has ability to leave and re-join the cloud by applying compression and image processing algorithms.

Hu Chun et al. [6] have proposed a situation where biometric data is kept encrypted in whole process of transmission and matching. It uses two approaches homomorphism encryption and garbled circuit. It provides highly computing capability.

Surender Sharma et al. [7] have introduced health care monitoring system application that provides the patients with necessary healthcare information yet it also gives a chance to threats of intervention that would make the critical data insecure. They have used Body Area wireless sensor network as monitoring component. The cloud based HMA was therefore developed using master slave like pattern, where the master could have generic functions while slave would have functionalities specific to the medical condition. Thus they have utilized biometric encryption for providing protection to the data. Here the user's biometric characteristics work as decryption key here fuzzy extractor scheme has been used to convert the scanned fingerprint data to some random string and an helper string to apply cryptographic techniques. This framework accomplishes both the goals, secure access and data protection.

Krishnaraj Madhavji Sunjiv Soyjaudah [8] discussed about eight points of vulnerabilities that can be hacked. In cloud data is moved dynamically so security is a major concern and there are the problems which arise in the management of biometric data. So a cancellable biometric authentication system is proposed by him. Cancellable Biometric Authentication is a concept in which the original image is first distorted then shared on cloud. This distorted biometric image is used for authentication. This provides security and privacy as the original biometric are never revealed to authentication server. Data Hiding is also done using this technique to overcome the replay attack. This is done by secretly embedding the private information in biometric image.

Dr. Anandhakumar P et al. [9] has addressed the issues that arouse during storing different documents and files and photo contents on Cloud. Huge amount of photos are maintained by cloud providers. Huffman coding cannot achieve high levels of compression also all the binary strings or codes in the encoded data are of different lengths. So it is difficult to decode. The representative signal (RS) based approach is suitable only when images are highly correlated to each other so it fails badly in case of illumination changes. To overcome these drawbacks LZ-77 algorithm is proposed in this paper. Lz-77 replaces the repeatedly occurring data with reference to single copy which already exists in an uncompressed data stream. It uses length-distance pair to encode the match. As

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compression is in cloud environment, k-means algorithm is used to transfer up by using Map-Reduce concept. They also proposed an idea for effective compression of photo albums which also reduces the time complexity.

III.PROPOSED METHOD

This section introduces the system model, attack model, design goals and the notations used in the following sections.

A. System Model

As shown in Fig.1, three types of entities are involved in the system including the database owner, users and the cloud. The database owner holds a large size of biometric data (i.e., fingerprints, irises, voice, and facial patterns etc.), which is encrypted and transmitted to the cloud for storage. When a user wants to identify himself/ herself, a query request is be sent to the database owner. After receiving the request, the database owner generates a ciphertext for the biometric trait and then transmits the ciphertext to the cloud for identification. The cloud server figures out the best match for the encrypted query and returns the related index to the database owner. Finally, the database owner computes the similarity between the query data and the biometric data associated with the index, and returns the query result to the user.

In our scheme, we assume that the biometric data has been processed such that its representation can be used to execute biometric match. Without loss of generality, similar to [17], [18], we target fingerprints and use Finger Codes [19] to represent the fingerprints. More specifically, a Finger Code consists of n elements and each element is a l-bit integer (typically n = 640 and l = 8). Given two Finger Codes x = [x1; x2; _ _ _ ; xn] and y = [y1; y2; _ _ _ ; yn], if their Euclidean distance is below a threshold _, they are usually considered as a good match, which means the two fingerprints are considered from the same person.

B. Attack Model

First of all, the cloud server is considered to be “honest but curious” as described in [13]–[15], [17]. The cloud strictly follows the designed protocol, but makes efforts to reveal privacy from both the database owner and the user. We assume that an attacker can observe all the data stored in the cloud including the encrypted biometric database, encrypted queries and matching results. Moreover, the attacker can act as a user to construct arbitrary queries. Thus, we categorize the attack model into three levels as follows:

- Level 1: Attackers can only observe the encrypted data stored in the cloud. This follows the well-known cipher text-only attack model [20].
- Level 2: In addition to the encrypted data stored in the cloud, attackers are able to get a set of biometric traits in the database D but do not know the corresponding ciphertexts in the database C , which is similar to the known-candidate attack model [21].
- Level 3: Besides all the abilities in level-2, attackers in level-3 can be valid users. Thus, attackers can forge as many identification queries as possible and obtain the corresponding ciphertexts. This attack follows the known-plaintext attack model [20].

A biometric identification scheme is secure if it can resist the level attack. Note that that if the proposed scheme can resist level-2 and level-3 attacks, it does not mean that the attacker can both be the valid user and observe some plaintexts of the biometric database simultaneously. This sophisticated attack is too strong and no effective methods are designed to defend against this kind of attack [14]. In this paper, we focus on the collusion attack between a malicious user and the cloud server. The relationship between the plaintexts of the biometric database and the ciphertexts is not known to the attacker, which is similar to the attack model proposed in [14].

C. Design Goals

In order to achieve practicality, both security and efficiency are considered in the proposed scheme. To be more specific, design goals of the proposed scheme are described as follows:

- Efficiency: Computational costs should be as low as possible at both the database owner side and the user side. To gain high efficiency, most biometric identification operations should be executed in the cloud.
- Security: During the identification process, the privacy of biometric data should be protected. Attackers and the semi-honest cloud should learn nothing about the sensitive information

D. Notations

Here, we list the main notations used in the remaining section as follows.

- Bi is the the i-th sample Finger Code, denoted as an n- dimensional vector bi = [bi1; bi2; _ _ _ bin].

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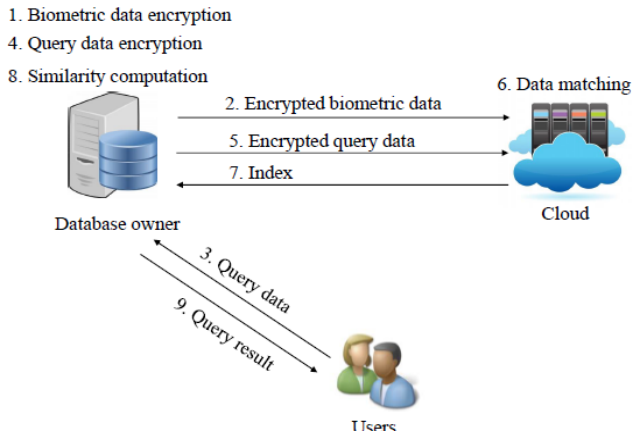
- Bi is the extended sample Finger Code of bi, denoted as an (n + 1) - dimensional vector Bi = [bi1; bi2; _ _ _ bi(n+1)], where bi(n+1) = -0:5(b2i1 +b2i 2 + _ _ _ + b2 in).

IV. System Design

A. System Architecture



As shown in Fig.1, three types of entities are involved in the system including the database owner, users and the cloud. The database owner holds a large size of biometric data (i.e., fingerprints, irises, voice, and facial patterns etc.), which is encrypted and transmitted to the cloud for storage. When a user wants to identify himself/herself, a query request is be sent to the database owner. After receiving the request, the database owner generates a cipher text for the biometric trait and then transmits the cipher text to the cloud for identification. The cloud server figures out the best match for the encrypted query and returns the related index to the database owner. Finally, the database owner computes the similarity between the query data and the biometric data associated with the index, and returns the query result to the user. In our scheme, we assume that the biometric data has been processed such that its representation can be used to execute biometric match. Without loss of generality, similar to [17], [18], we target fingerprints and use Finger Codes [19] to represent the fingerprints.

B. Implementation

Modules:

- System Model
- Encryption Model
- Biometric Identification
- Security Model

C. Modules Description:

System Construction Module

- The database owner, users and the cloud. The database owner holds a large size of biometric data (i.e., fingerprints, irises, voice, and facial patterns etc.), which is encrypted and transmitted to the cloud for storage. When a user wants to identify him/her, a query request is being sent to the database owner. After receiving the request, the database owner generates a cipher text for the biometric trait and then transmits the cipher text to the cloud for identification.
- In our scheme, we assume that the biometric data has been processed such that its representation can be used to execute biometric match. Without loss of generality, similar to we target fingerprints and use Finger Codes to represent the fingerprints.

Encryption Model:

- The proposed scheme can resist level-2 and level-3 attacks, it does not mean that the attacker can both be the valid user and observe some plaintexts of the biometric database simultaneously. This sophisticated attack is too strong and no effective methods are designed to defend against this kind of attack.

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- We focus on the collusion attack between a malicious user and the cloud server. The relationship between the plaintexts of the biometric database and the ciphertexts is not known to the attacker, which is similar to the attack model proposed in.

Biometric Identification:

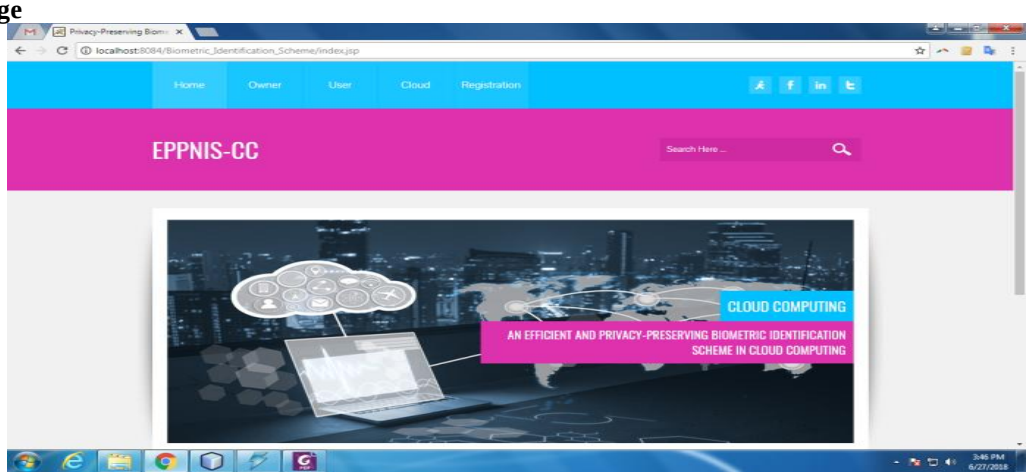
- The identification processes are as follows. When a user has a query fingerprint to be identified, he/she first gets the query Finger Code derived from the query fingerprint image. The Finger Code is also an n-dimensional vector. Then, the user sends Finger Code to the database owner.
- After receiving Finger Code, the database owner extends Finger Code to Finger Codes by adding the element equals to 1. Then the database owner randomly generates the matrix.
- the cloud begins to search the FingerCode which has the minimum Euclidean distance with the query Finger Code the owner gets the corresponding sample Finger Code in the database and calculates the accurate Euclidean distance.
- Finally, the database owner returns the identification result to the user.

Security Model:

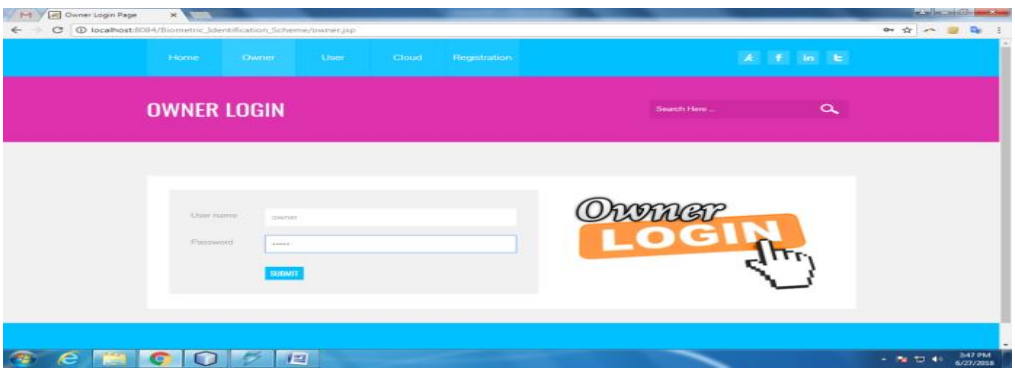
- The attack scenario, an attacker can obtain some plaintexts of the biometric database, but does not know the corresponding ciphertexts. We consider computation which is obtained by multiplying FingerCode. Since the mapping relationship between FingerCode and computation is not known, it is impossible for the attacker to compute FingerCode.
- The knowledge of encrypted data in the cloud, the attacker can forge a large number of query FingerCodes as inputs. In the following, we will show the proposed scheme is secure by proving that the secret keys cannot be recovered.
- The attacker cannot recover the secret key even if he is a malicious user. Therefore, the attacker cannot recover the biometric data as well.

V SIMULATION RESULTS

1. **Webpage**



2. **Owner Login**



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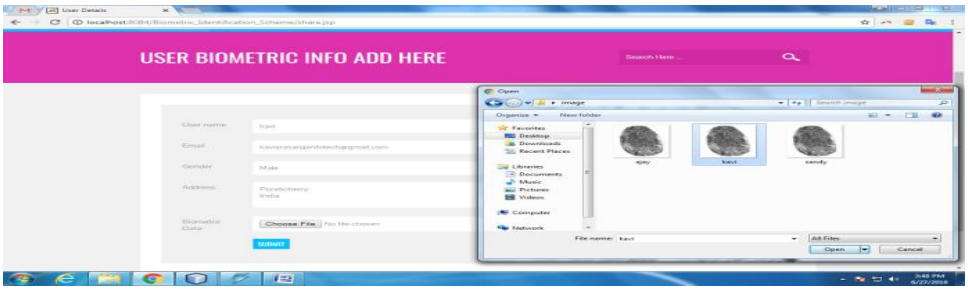
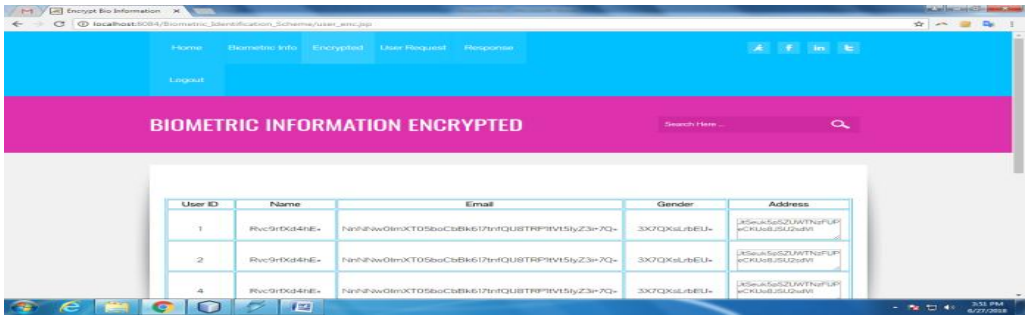
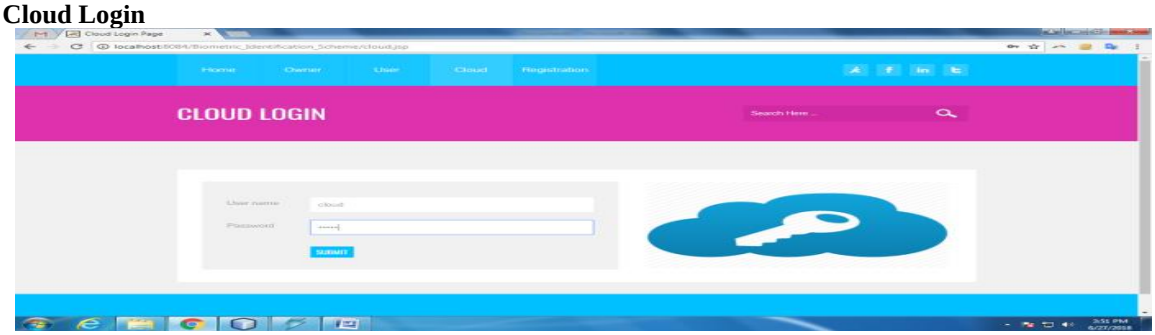
3. **User Biometric info add Here**



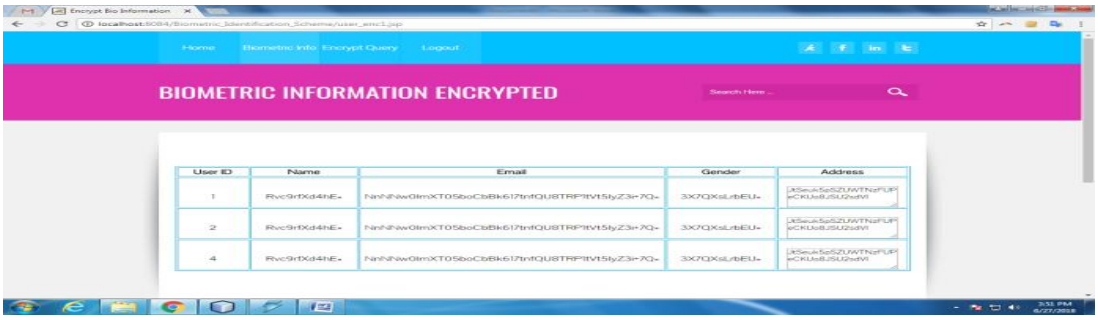
4. **Biometric Information Encrypted**



5. **Cloud Login**



6. **Biometric information encrypted**



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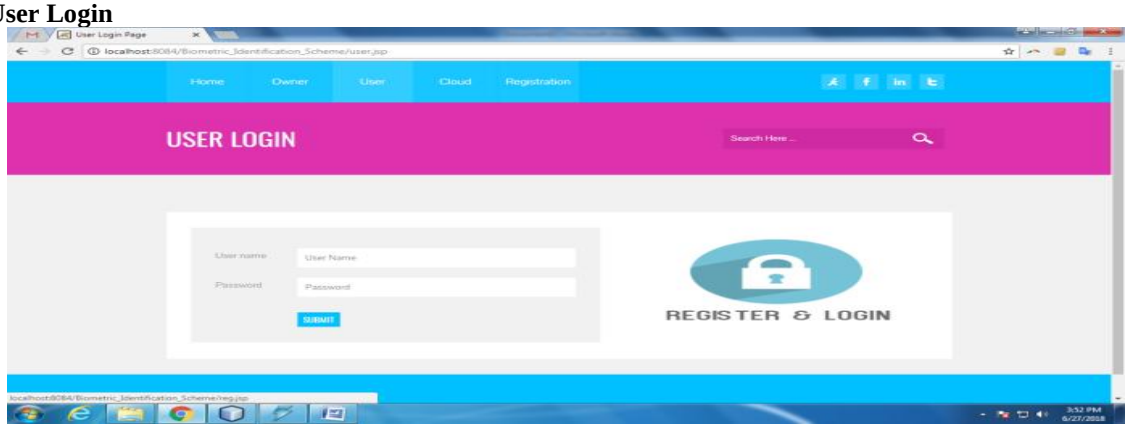
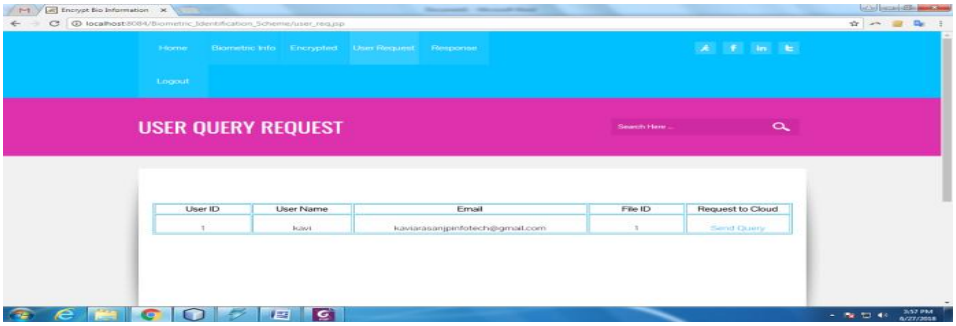
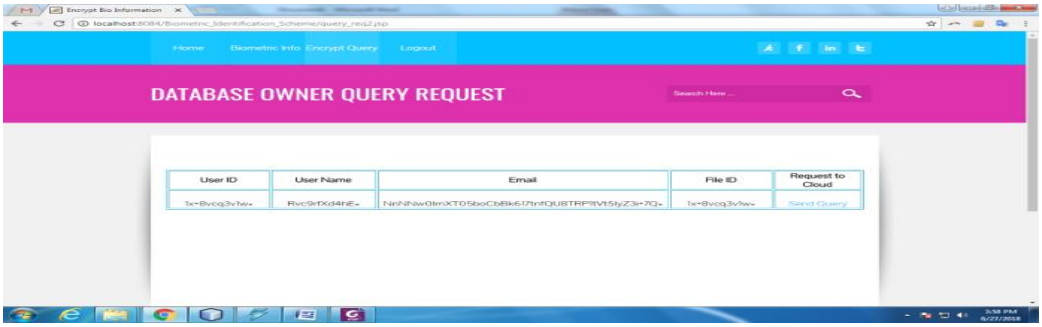
7. **User Login**



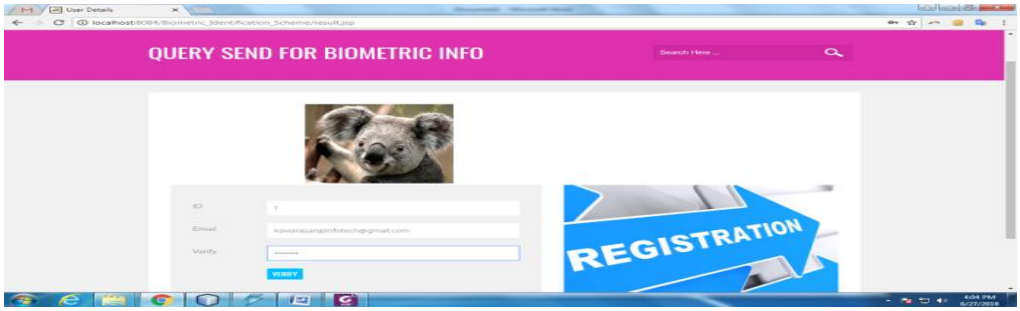
8. **User Query request**



9. **Database owner query request**



10. **Query send for biometric info**



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11. Decrypt biometric information

VI CONCLUSION

In this paper, we proposed a novel privacy-preserving biometric identification scheme in the cloud computing. To realize the efficiency and secure requirements, we have designed a new encryption algorithm and cloud authentication certification. The detailed analysis shows it can resist the potential attacks. Besides, through performance evaluations, we further demonstrated the proposed scheme meets the efficiency need well.

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