Homomorphic Encryption for Data Security

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1 Introduction

A homomorphic encryption technique allows user to operate ciphertext directly. When user decrypts the resultant cipher, it is same as if operations are carried out on plaintext. Thus, making use of homomorphic encryption assures customers that their data is secure in all state: storage, transmission and processing. Suppose we want to add two numbers 10 and 15, stored in encrypted form (assume 10 as 100 and 15 as 150). The cloud server adds two numbers and store sum as 250, that user decrypts it to the final answer 25.

2 Literature

With rapid proliferation of data over Internet, security became major issue that garnered attention of researchers from academic as well as industry. Traditional standard encryption methods provide security to data in storage state and transmission state. But in processing state, performing operations on data require decryption of data. At this state data is available to cloud provider. Traditional encryption methods are not sufficient to secure data completely. Homomorphic encryption allows user to operate encrypted data directly without decryption.

3 Objectives

Standard encryption techniques used for encryption require decryption to perform operations on data. Decrypting data at cloud data server makes data available to cloud provider. Homomorphic encryption allows users to operate directly on encrypted data.

4 Methodology/ Experimentation

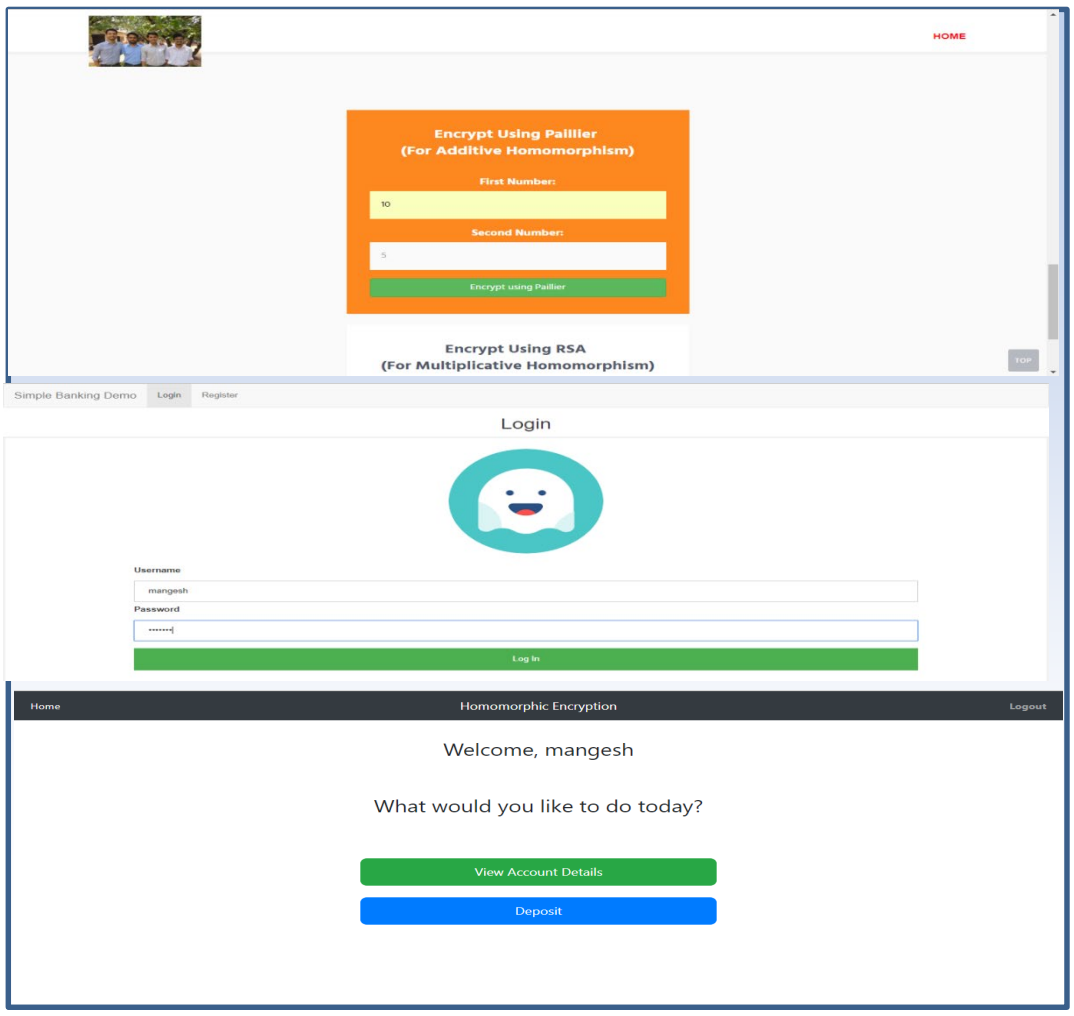
RSA

Key Generation: KeyGen(p,q)	
Input: $p,q \in \mathbb{P}$	
Compute	$n = p \cdot q$ $\varphi(n) = (p-1)(q-1)$
Choose e such that Determine d such that	$\gcd(e, \varphi(n)) = 1$ $e \cdot d \equiv 1 \bmod \varphi(n)$
Output: (pk, sk) public key: $pk = (e, n)$ secret key: $sk = (d)$	
Encryption: Enc(m, pk)	
Input: $m \in \mathbb{Z}_n$	
Compute	$c = m^e \bmod n$
Output: $c \in \mathbb{Z}_n$	
Decryption: Dec(c, sk)	
Input: $c \in \mathbb{Z}_n$	
Compute	$m = c^d \bmod n$
Output: $m \in \mathbb{Z}_n$	

Paillier

Key Generation: KeyGen(p,q)	
Input: $p,q \in \mathbb{P}$	
Compute Choose $g \in \mathbb{Z}^*_{n^2}$ such that	$n = pq$ $\gcd(L(g^\lambda \bmod n^2), n) = 1$ with $L(u) = \frac{u-1}{n}$
Output: (pk, sk) public key: $pk = (n, g)$ secret key: $sk = (p, q)$	
Encryption: Enc(m, pk)	
Input: $m \in \mathbb{Z}_n$	
Choose Compute	$r \in \mathbb{Z}^*_n$ $c = g^m \cdot r^n \bmod n^2$
Output: $c \in \mathbb{Z}_{n^2}$	
Decryption: Dec(c, sk)	
Input: $c \in \mathbb{Z}_{n^2}$	
Compute	$m = \frac{L(c^\lambda \bmod n^2)}{L(g^\lambda \bmod n^2)} \bmod n$
Output: $m \in \mathbb{Z}_n$	

5 Results and Conclusion



6 References

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