Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 4, April : 2023

# BSSPD: A BLOCKCHAIN-BASED SECURITY SHARING SCHEME FOR PERSONALDATA WITH FINE-GRAINED ACCESS CONTROL

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**ABSTRACT**

In the AI-driven era, open sharing and privacy protection are at the centre of data governance. Users upload their data to the cloud server for storage and distribution as part of the existing data-sharing solutions, which are indispensible for a common data-sharing management platform. Users will, however, lose complete ownership of their data the instant they upload it to the server, and security and privacy will become a crucial concern. The foundation of data governance in the AI-driven era is open sharing and privacy protection. Users upload their data to the cloud server for storage and distribution, which is a necessary component of the present data-sharing solutions. Nevertheless, as soon as users upload their data to the server, they lose complete control over it, making security and privacy a serious concern. The data owner in this user-centric scheme encrypts the sharing data and stores it on IPFS, maximising the decentralisation of the system. According to the specific access policy, the address and decryption key of the shared data will be encrypted with CP-ABE. The data owner utilises blockchain to publish his data-related information and distribute keys to data users. The data can only be downloaded and decrypted by the data user whose characteristics comply with the access policy. The BSSPD provides an attribute-level revocation of a specific data user without affecting others, and the data owner has fine-grained access control over his data.

## 1 INTRODUCTION

Blockchain is a distributed public ledger system that operates on a peer-to-peer network and is distinguished by its decentralisation and lack of trust. It is gaining popularity across a variety of industries and use cases. A distributed network of peer nodes that maintains an immutable transaction log is known as a blockchain. By applying transactions that have been verified by a consensus procedure and arranged into blocks with a hash that links each block to the one before it, these nodes each keep a copy of the ledger. Figure 1 depicts the usual structure of a blockchain. Figure 1. The fundamental design of a blockchain A distributed ledger that keeps track of all network transactions serves as the brain of a blockchain network. A blockchain also uses cryptographic techniques to ensure that the data is append-only, which ensures that once a transaction is added to the ledger, it cannot be changed. It is simple to verify that data has not been altered after the event thanks to this immutability attribute. The blockchain's earliest and most well-known application is the Bitcoin money, but Ethereum took a different tack by including many of Bitcoin's fundamental traits while also including smart contracts to build a platform for distributed applications. A category of public permissionless blockchain technology includes Bitcoin and Ethereum. In essence, these are public networks that are accessible to everyone and allow for anonymous communication. Almost anyone can participate in a permissionless blockchain, and each participant is anonymous. Permissionless blockchains often use transaction fees or a native cryptocurrency that is "mined" to offset the prohibitive costs of taking part in a byzantine fault-tolerant consensus system based on "proof of work" in order to reduce the lack of trust.

**2. RELEATED WORK**

[1] **D. D. Detwiler** This study conducts a "One nations move to increase food safety with blockchain" Although the spinach on the grocery store shelf is a vibrant green and appears delectable, how can you be sure it is safe to consume? What if your retailer could verify every stop that spinach took on the way to the store, as well as where it was cultivated, handled, kept, and inspected, with absolute certainty? Blockchain, a shared, distributed ledger technology, gives your retailer access to this data. By directly integrating growers, processors, distributors, suppliers, retailers, and regulators with a common, immutable view of their transaction history, blockchain-based solutions have the potential to change the food business.

[2] **Boneh, D., Franklin, M. Identity based encryption from the Weil pairing. In: Kilian,** We suggest an identity-based encryption system that is fully operational (IBE). Under the random oracle model, the system has chosen ciphertext security while assuming a special case of the computational Diffie- Hellman problem. The foundation of our system is a bilinear map between groups. One such map is the Weil pairing on elliptic curves. We provide clear definitions for safe identity-based encryption techniques and list many uses for these systems.

[3] **Boneh, D., Boyen, X. Efficient** "elective-ID secure identity based en- cryption without random oracles" We provide an identity-based encryption method that is 100 percent secure and whose security proof does not rely on the random oracle heuristic. The decisional bilinear Diffie-Hellman assumption underlies security. The security reduction from the underlying complexity assumption resulted in a significant penalty factor for prior designs of this sort. The current system's security reduction is polynomial across all parameters.

[4] **Boneh, D., Boyen, X. Secur "**identity based encryption without random oracles**"** Using no random oracles, we introduce the first effective Identity-Based Encryption (IBE) technique. We initially discuss our IBE construction before reducing the decisional Bilinear Diffie-Hellman (BDH) problem to describe the security of our system. Additionally, we demonstrate that a new signature scheme that is secure without random oracles under the computational Diffie-Hellman assumption can be created using our techniques.

[5] **R. S. Wahby, I. Tzialla, A. Shelat, J. Thaler and M. Walfish "**Cluster computing in zero knowledge, EUROCRYPT**"** For scalability and economic considerations, large computations that may be conducted in distributed parallel are frequently carried out on computer clusters. Similar calculations are employed in a variety of applications, including, but not limited to, statistical machine translation, webgraph mining, and machine learning. But frequently, just the output of the computation can be published because the input data is secret. In these circumstances, zero-knowledge proofs would enable the verification of the output's validity without disclosing (extra) information about the input. We examine theoretical and applied elements of zero-knowledge proofs for cluster computations in this paper. We create zero-knowledge proof systems and assess them for:

(i) A proof confirms the accuracy of a cluster computation, and

(ii) creating the proof is a cluster computation in and of itself, with a structure and complexity comparable to the original one.

We specifically concentrate on MapReduce, a beautiful and well-liked cluster computing method. A monolithic NP statement that accounts for all mappers, all reducers, and shuffling can theoretically demonstrate the soundness of a MapReduce computation using previous zero-knowledge proof techniques. Yet, it is unclear how to produce the evidence for such monolithic claims using distributed systems' parallel execution. The correctness of a cluster computation is attested to by a proof, and the cluster computation used to generate the proof shares the same complexity and structural characteristics as the original cluster computation. In particular, we concentrate on MapReduce, a sophisticated and well-liked cluster computing method. A monolithic NP statement that reasons about all mappers, all reducers, and shuffling is theoretically able to demonstrate the correctness of a MapReduce computation. This is possible since previous zero-knowledge proof systems can do this. Although a distributed system can execute these statements in parallel, it is unclear how to produce the proof for such monolithic claims.

**3 Implementation Study**

Block chain generator: After generating the block chain, which creates 10 block chain users and 10 block chain private keys, we connect to the Solidarity network to store the data as blocks using the master key.

User login: First, the user must register. Then, after registering, the user can upload a message and a document, which will be stored in the block chain. The user can then view the information that has been shared with them, but only authorised users will be able to see the data; everyone else will not be able to.

4 **PROPOSED WORK**

ABE is regarded as the most suitable solution to address issues with data security and privacy protection in a distributed setting. In order to accomplish fine-grained access control over data on the blockchain, researchers have lately adopted ABE. A decentralised access control system was presented by Jemel and Serhrouchni [26]. For the first time, researchers executed a CP-ABE algorithm on blockchain nodes to validate the legality of user access rights. SetPolicy and GetAccess are the two sorts of transactions that the scheme envisions. But, it does not make use of Smart Contracts, and it is clear that the plan cannot fulfil more demanding needs. Based on ABE and blockchain, Sun et al. developed a paradigm of safe storage and efficient sharing for electronic medical data [27] that offers superior access management. Medical information about patients is encrypted using ABE and stored on IPFS by doctors. It does not, however, make use of smart contracts. It cannot perform more complex business operations; it can only broadcast some ABE parameters that are recorded in transactions. Users share secret keys in a sharing method Wang et al. suggested [28]. It understands that the owner of the data has a precise access control on that data. The recovery of ciphertext keywords is also made possible via the Ethereum Smart Contract. Nevertheless, many off-chain communications are necessary between users, and more critically, the permit revocation is not implemented. To record and retain medical data, Pournaghi et al. suggested MedSBA, a safe and effective sharing system based on blockchain and ABE [29]. By broadcasting a new strategy to cover the previous transaction, it implements the update and revocation of permissions, however users who do not want their rights revoked will be forced to update their keys.

ADVANTAGES OF THE PROPOSED SYSTEM:

1. HIGH ACCURACY
2. STRONG EFFICIENCY

**5 METHODOLOGIES AND ALOGRITHAM**

Elliptic Curve Cryptography (ECC) is a contemporary family of public-key cryptosystems that is based on the algebraic structures of elliptic curves over finite fields and on the challenge of the Elliptic Curve Discrete Logarithm Problem (ECDLP).ECC implements encryption, signatures, and key exchange, which are the three main asymmetric cryptosystem features.

Since ECC utilises fewer keys and signatures than RSA for the same level of security and offers very quick key generation, quick key agreement, and quick signatures, it is seen as the logical modern replacement for the RSA cryptosystem.

ECC Keys:

The ECC uses integer private keys that fall inside the field size range of the curve, which is typically 256 bits. The following is an example of a 256-bit ECC private key in hexadecimal format: 0x51897b64e85c3f714bba707e867914295a1377a7463a9dae8ea6a8b914246319.

ECC cryptography is incredibly quick because the key generation is as easy as securely producing a random integer within a given range. An ECC private key that falls inside the range is valid.

The public keys in the ECC are what are known as EC points, which are pairs of x, y-coordinates. EC points can be compressed to just one coordinate plus one bit because of their unique characteristics (odd or even). The resulting 257-bit integer is the compressed public key, which corresponds to a 256-bit ECC private key. 0x02f54ba86dc1ccb5bed0224d23f01ed87e4a443c47fc690d7797a13d41d2340e1a is an example of an ECC public key (equivalent to the above private key, encoded in the Ethereum format, as hex with prefix 02 or 03). The public key in this format requires 33 bytes (66 hex digits), which can be compressed to exactly 257 bits.

**5.1 Curves and key length**

Several underlying elliptic curves can be used with ECC cryptographic techniques. Various curves offer various levels of security (cryptographic strength), performance (speed), and key length, as well as perhaps involving various methods. In addition to having a name (named curves, for example secp256k1 or Curve25519), a field size (which defines the key length, for example 256 bits), security strength (typically the field size / 2 or less), performance (operations/sec) and many other parameters, ECC curves are widely used in cryptographic libraries and security standards. The length of ECC keys is closely related to the underlying curve. The default key length for the ECC private keys in the majority of programmes

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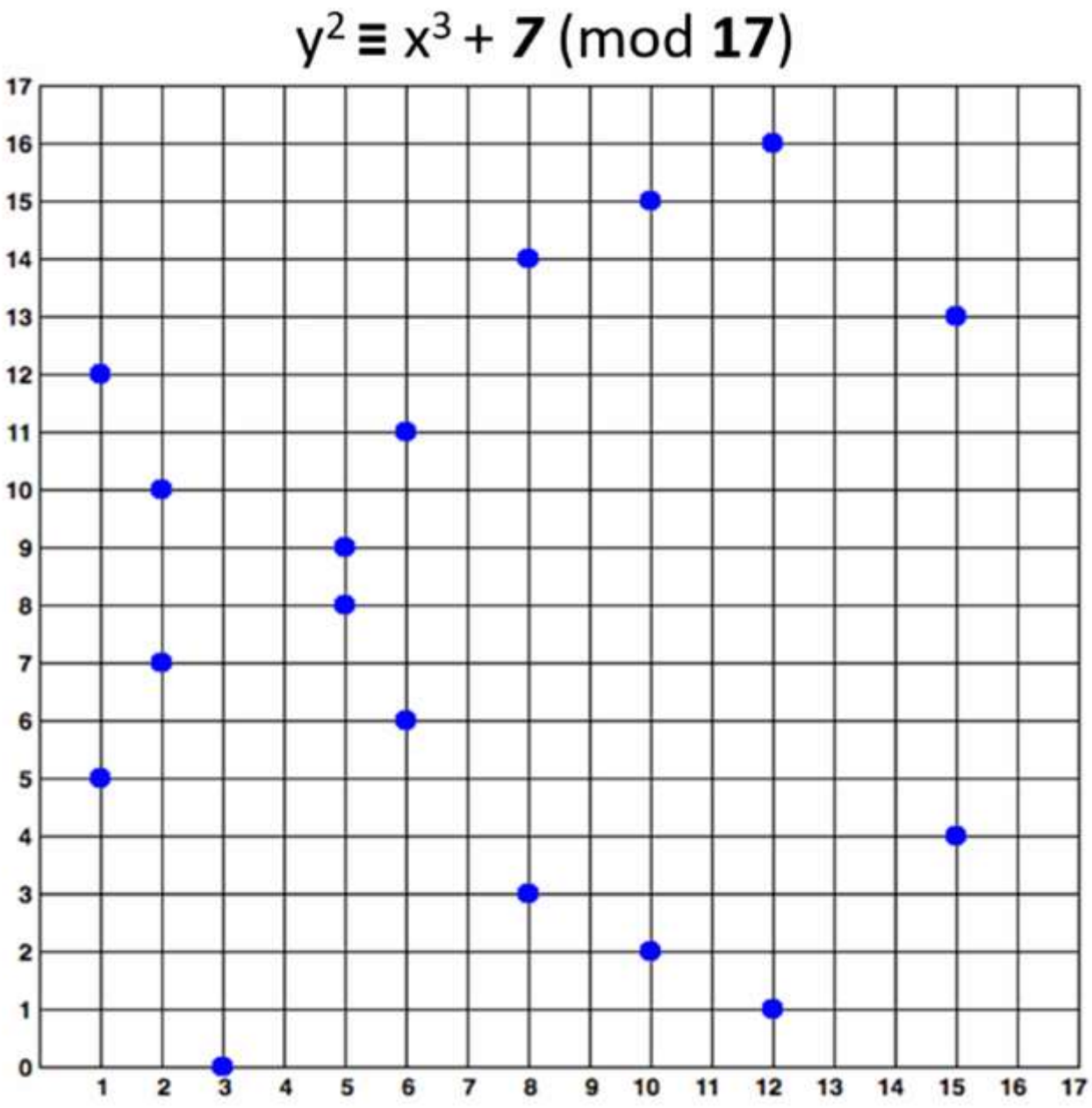
(including OpenSSL, OpenSSH, and Bitcoin) is 256 bits, but many different ECC key sizes are feasible depending on the curve: 192-bit (curve secp192r1), 233-bit (curve sect233k1), 224-bit (curve secp224k1), 256-bit (curves secp256k1 and Curve25519), 283-bit (curve sect283k1), 384-bit (curves p384 and secp384r1), 409-bit (curve sect409r1), 414-bit (curve Curve41417), 448-bit (curve Curve448-Goldilocks), 511-bit (curve M-511), 521-bit (curve P-521), 571-bit (curve sect571k1) and many others. The elliptic curve cryptography (ECC) employs elliptic curves over either a field of infinite size, Fp (where p is prime and p > 3), or F2m (where p = 2 m_). This indicates that the curve's points can only have integer coordinates within the field, which is a square matrix of size p x p. Every algebraic operation performed on the field (such as point addition and multiplication) yields a new point. The modular form of the elliptic curve equation over the finite field Fp is as follows:

- $y2 \equiv x3 + \_\mathbf{a}\_x + \boldsymbol{b} \pmod{\boldsymbol{p}}$

Thus, the secp256k1 "Bitcoin curve" looks like this:

- $y2 \equiv x3 + 7 \pmod{\boldsymbol{p}}$




The blue dots in the accompanying figure make up the elliptic curve over a finite field called y2 x3 + 7 (mod 17). In other

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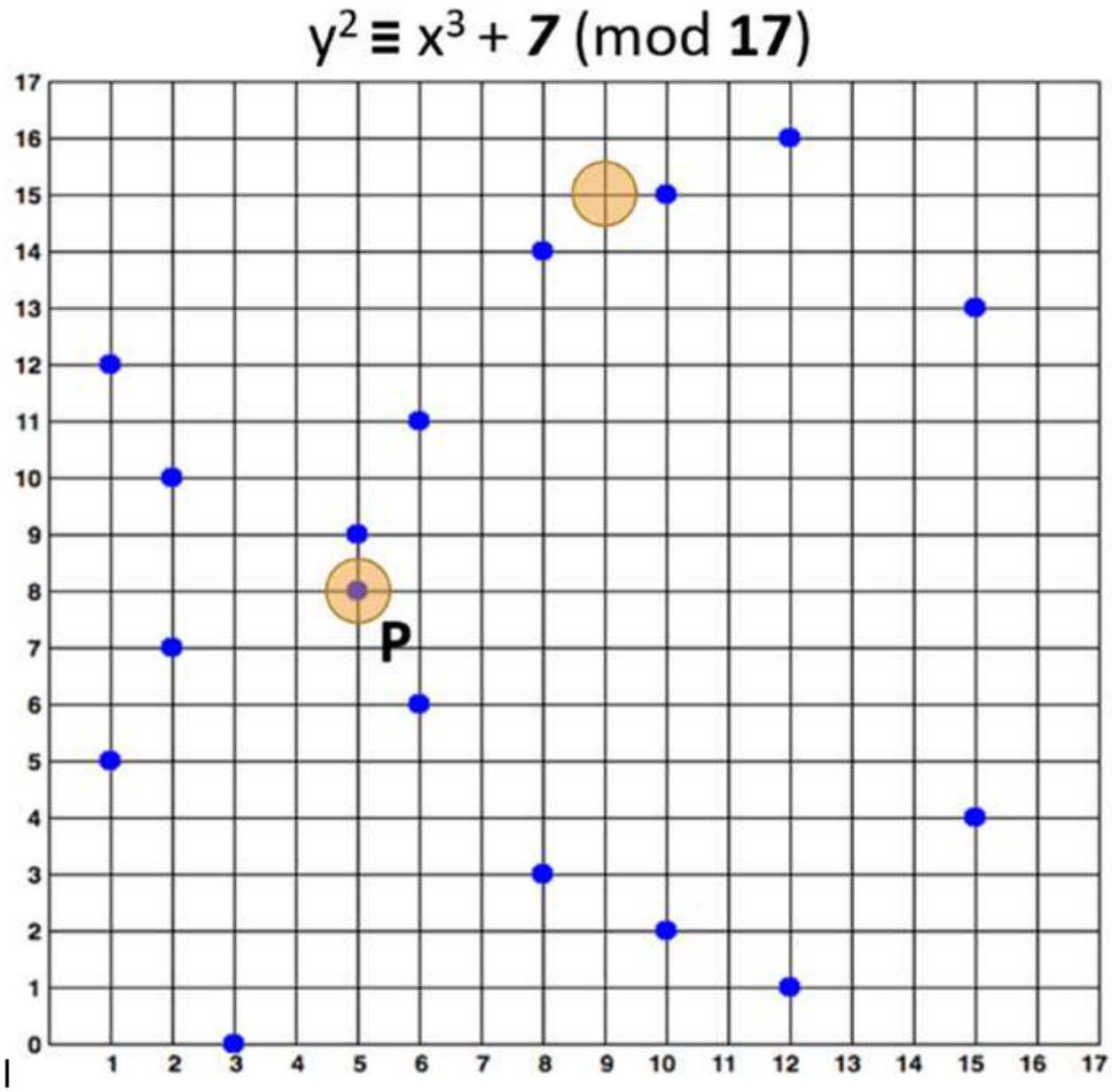
words, the "elliptic curves" employed in cryptography are actually "sets of points in square matrices" rather than traditional "curves."
The curve seen above is "educational." It offers relatively short key lengths (4-5 bits). Developers generally employ curves with 256 bits or greater in the real world.

**Calculations for Elliptic Curves over Finite Fields**

Calculating whether a given point over a finite field conforms to a given elliptic curve is quite simple. As an illustration, a point x, y is only a part of the curve y2 x3 + 7 (mod 17) if and only if:

- x3 + **7** - y2 ≡ 0 (mod **17**)

Because (5**3 + 7 - 8**2)% 17 == 0, the point P 5, 8 is on the curve. The curve does not include the point (9,15), because (9**3 + 7 - 15**2)% 17!= 0. The computations used here are done in Python. The points 5, 8, and 9 in relation to the elliptic curve given above are shown below:




**ECC Point Multiplication by Integer**

An additional point can be obtained by adding two elliptic curve (EC) points. The addition of EC points is the name of this process. G + G = 2 * G is the consequence of adding a point G to itself. The next time we add

G to the outcome, we will get 3 * G, and so on. This is the definition of EC point multiplication.
The outcome of multiplying an integer k by a point G on an elliptic curve over a finite field (EC point) is another EC point P on the same curve, and this operation is quick:

- **P = k * G**

For the sake of simplicity, we will omit the formulas and transformations used in the aforementioned process. Knowing that multiplication an EC point by an integer results in another EC point on the same curve and that this operation is quick is crucial. An exclusive EC point known as "infinity" is produced when multiplying an EC point by 0.
The Wikipedia article on EC point multiplication is open to everyone.For instance, multiply EC Point by an integer.The EC multiplication formulas vary depending on how the curve is represented. We will use an elliptic curve in the standard Weierstrass form for this example.
As an illustration, let's multiply the EC point G = 15, 13 by k = 6 on the elliptic curve over the finite field y2 x3 + 7 (mod 17). We will receive an EC point P = 5, 8 as follows:

- **P = k * G = 6 * {15, 13} = {5, 8}**

This illustration of EC point multiplication is shown below:

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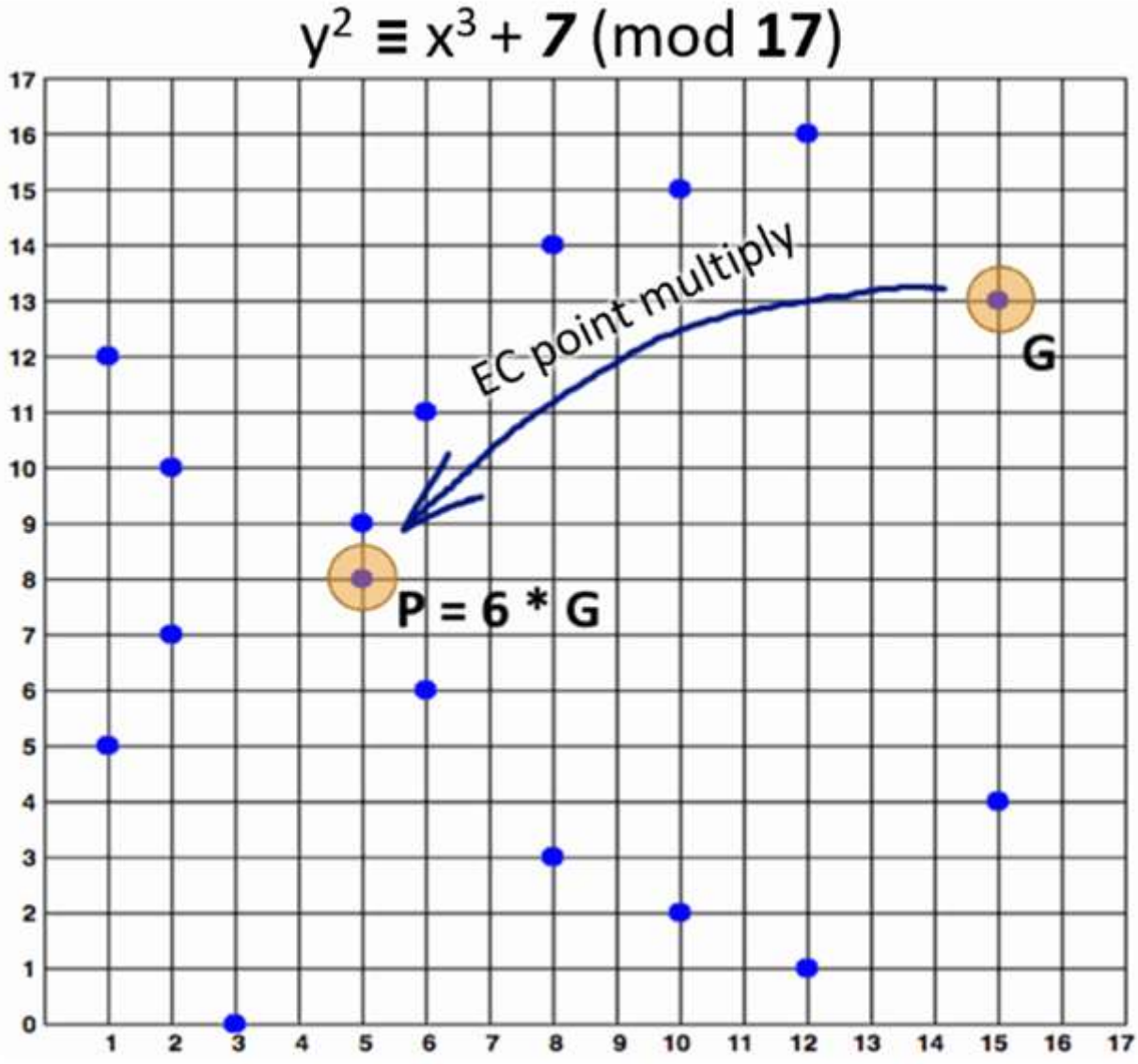

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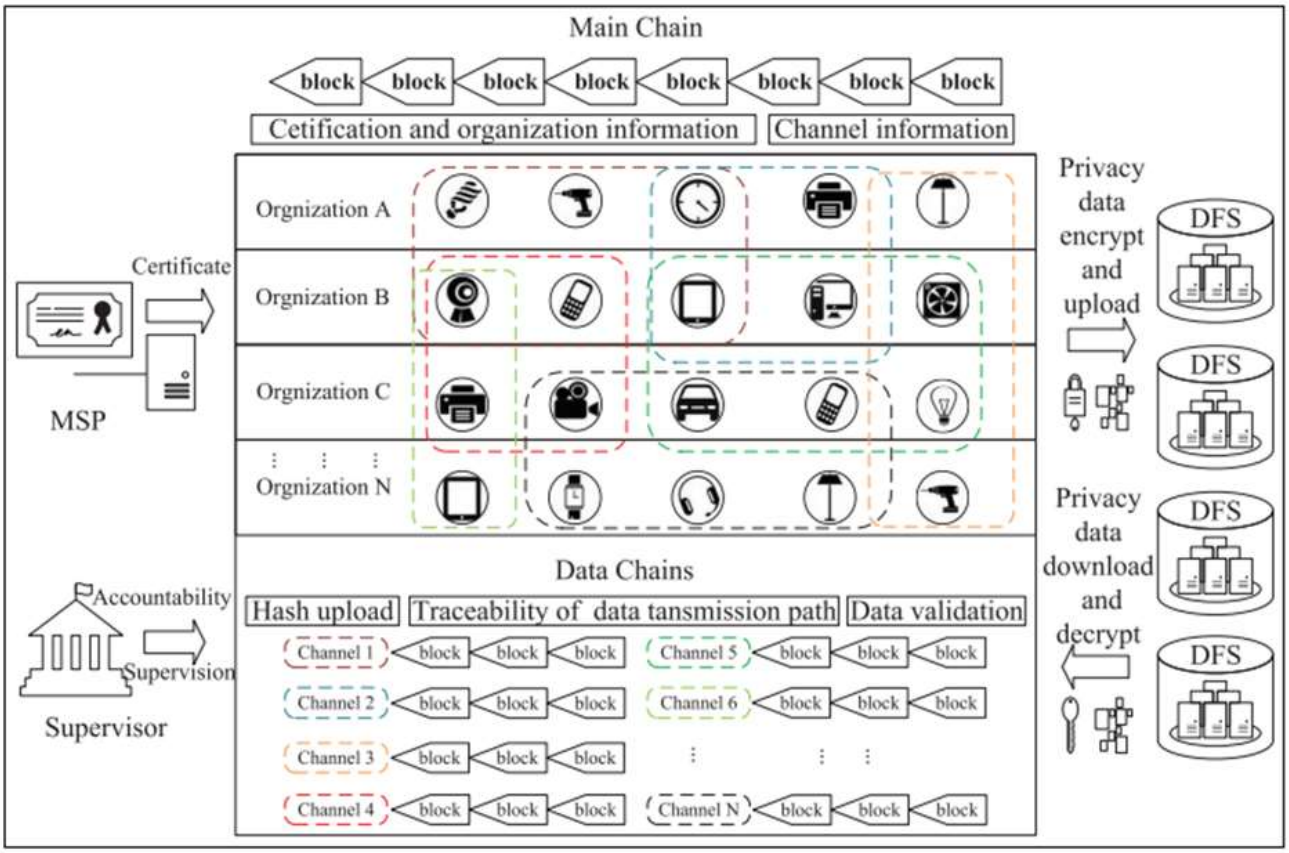


**Fig. 1: propose Architecture**

6 **RESULTS AND DISCUSSION**

**SCREENSHOTS**

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ISSN: 0970-2555
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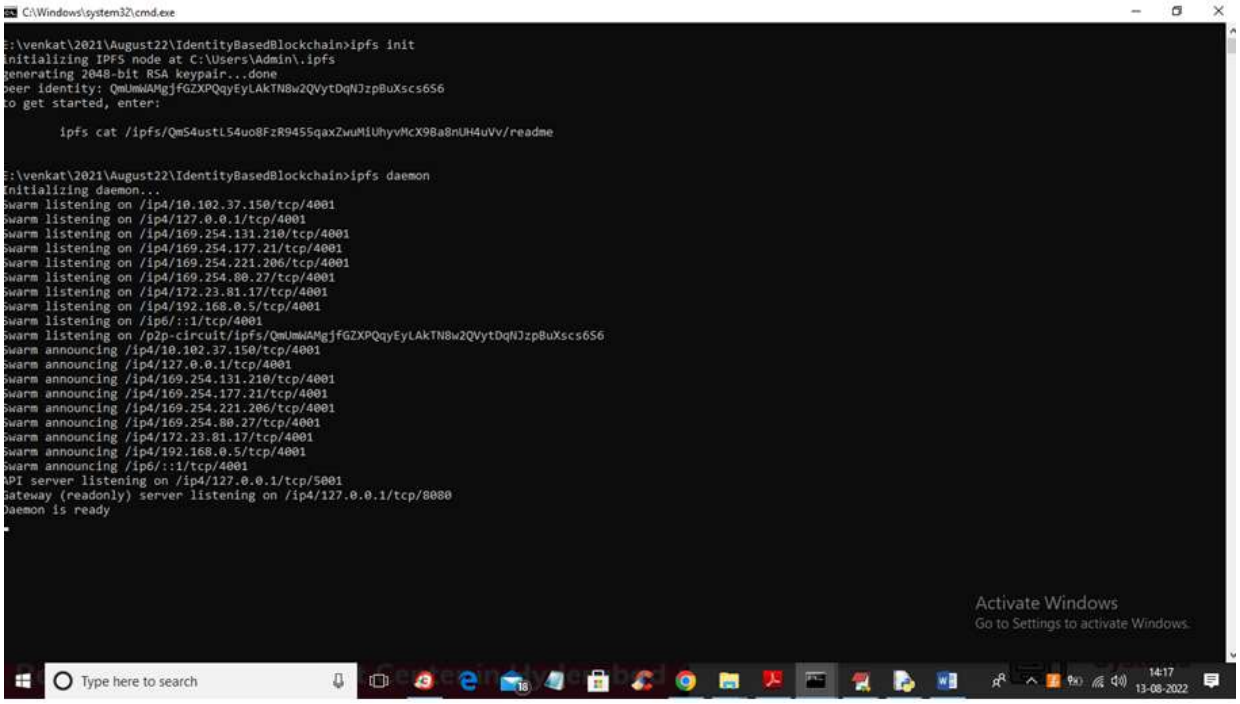


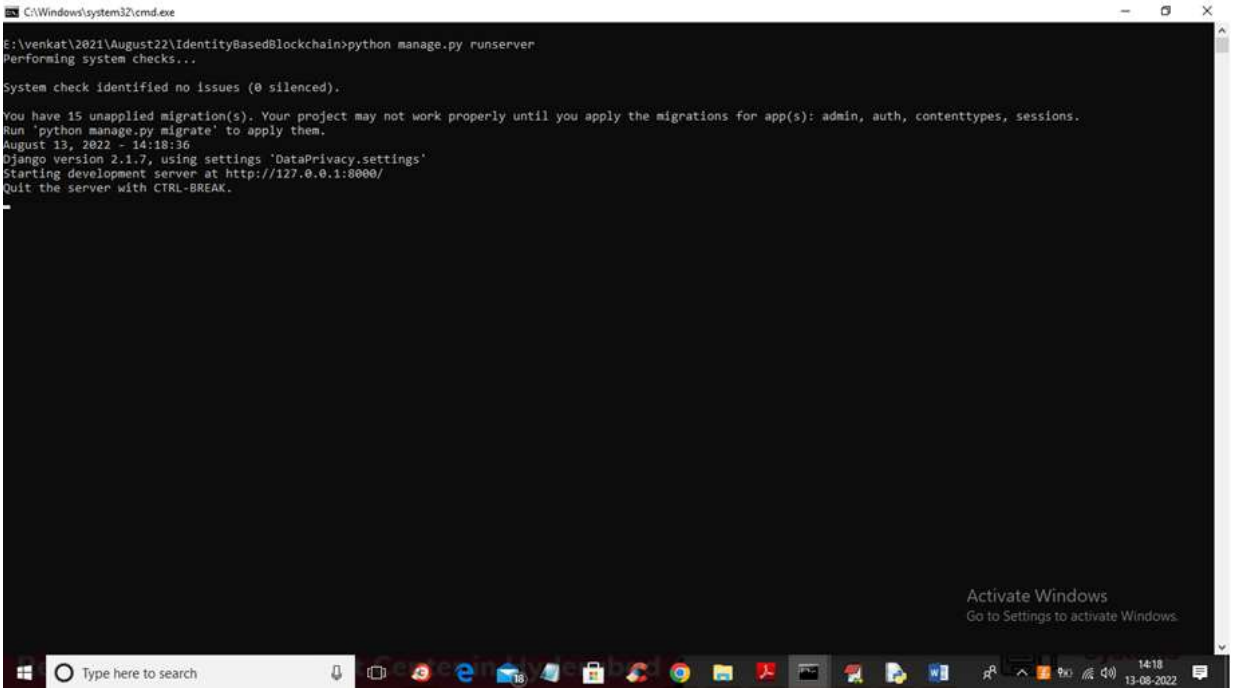

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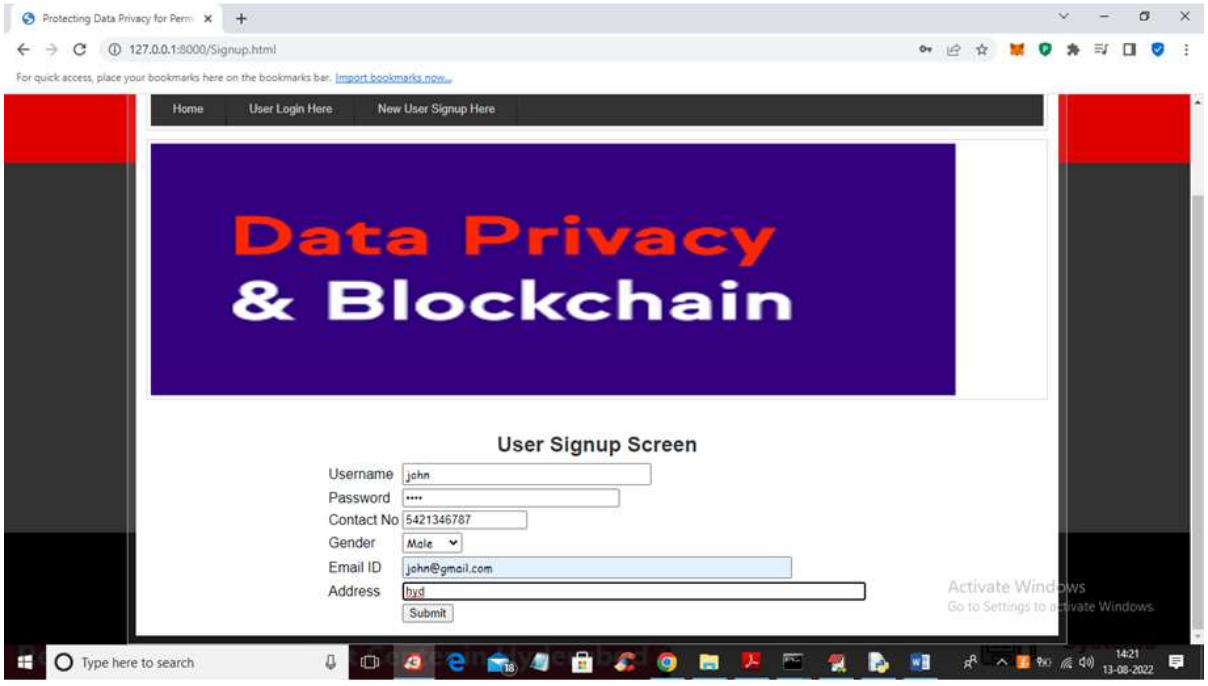
**To create an account, click the link that says "New User Registration Here" in the screen above.**




**User enters sign-up information on the screen above, clicks submit, and the following output appears.**

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ISSN: 0970-2555
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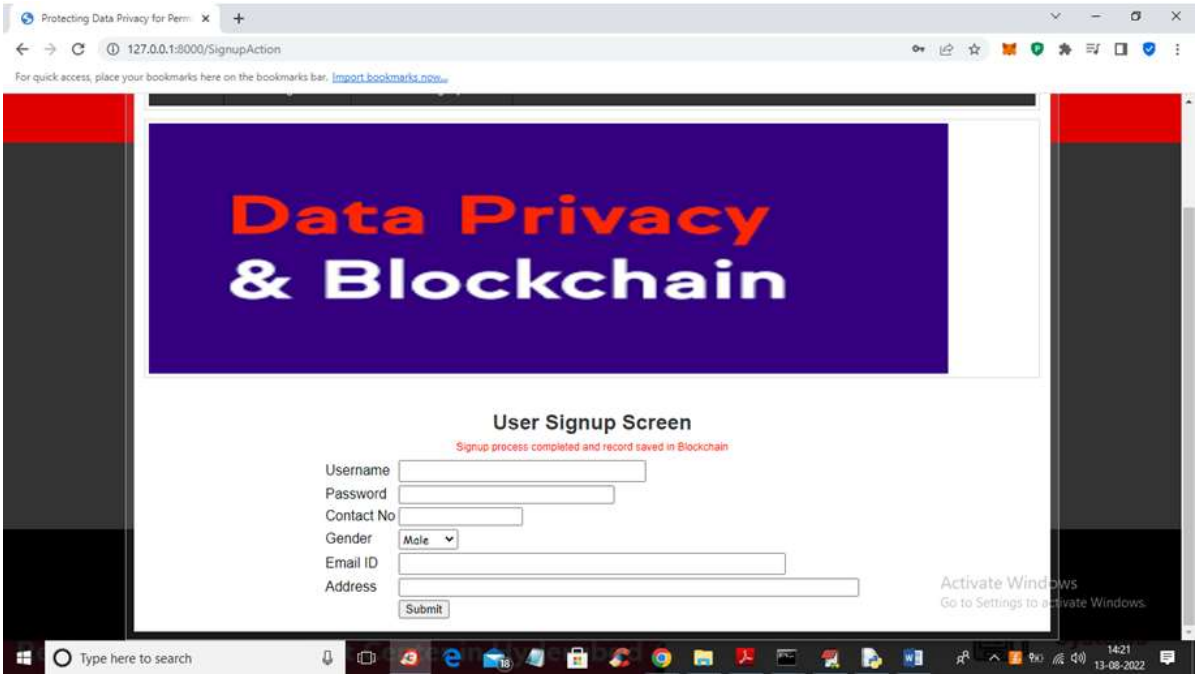


**After completing the above screen's user signup and saving their information to Blockchain, click the "User Login" link to access the following screen.**


**The user is logging in on the screen above, and then they see the screen below.**

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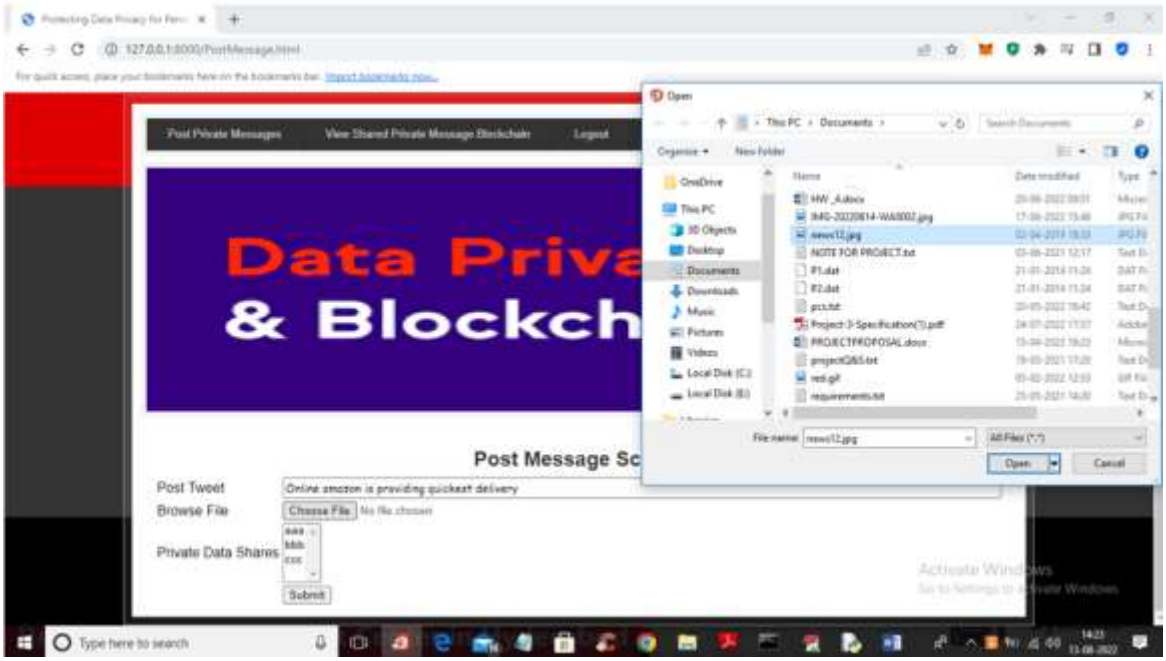
**Users can post messages by clicking the link labelled "Post Private Messages" in the screen above.**




**The user types a message, uploads an image, and then chooses which users to share it with. You can choose several users by holding down the CTRL key, as shown in the screen below.**

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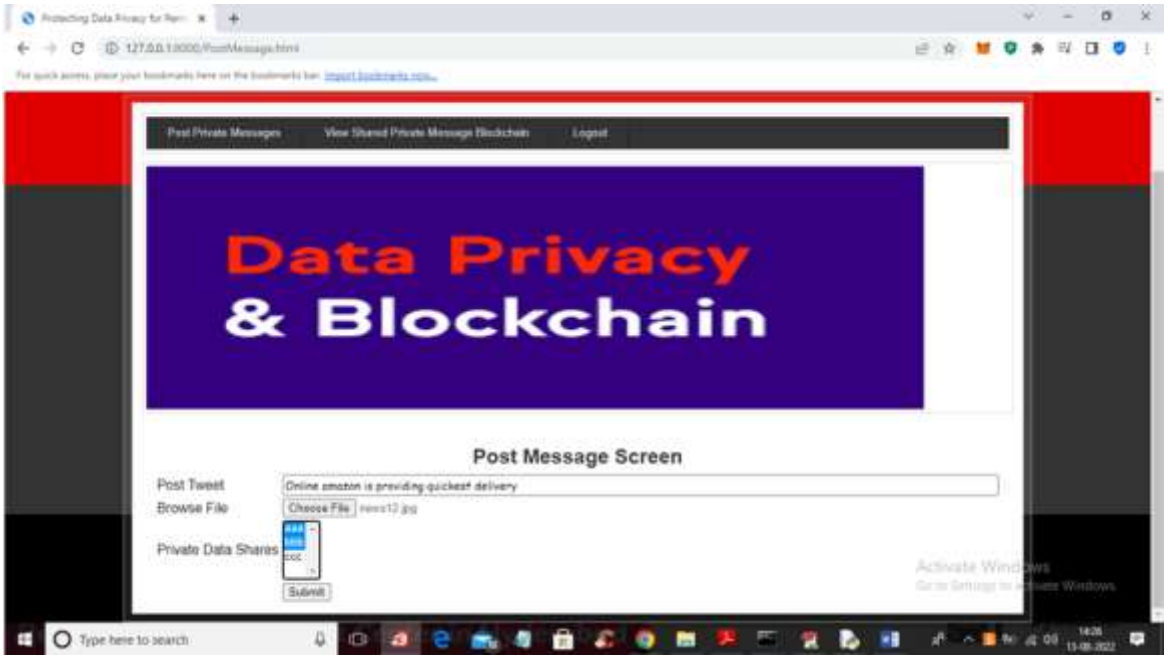
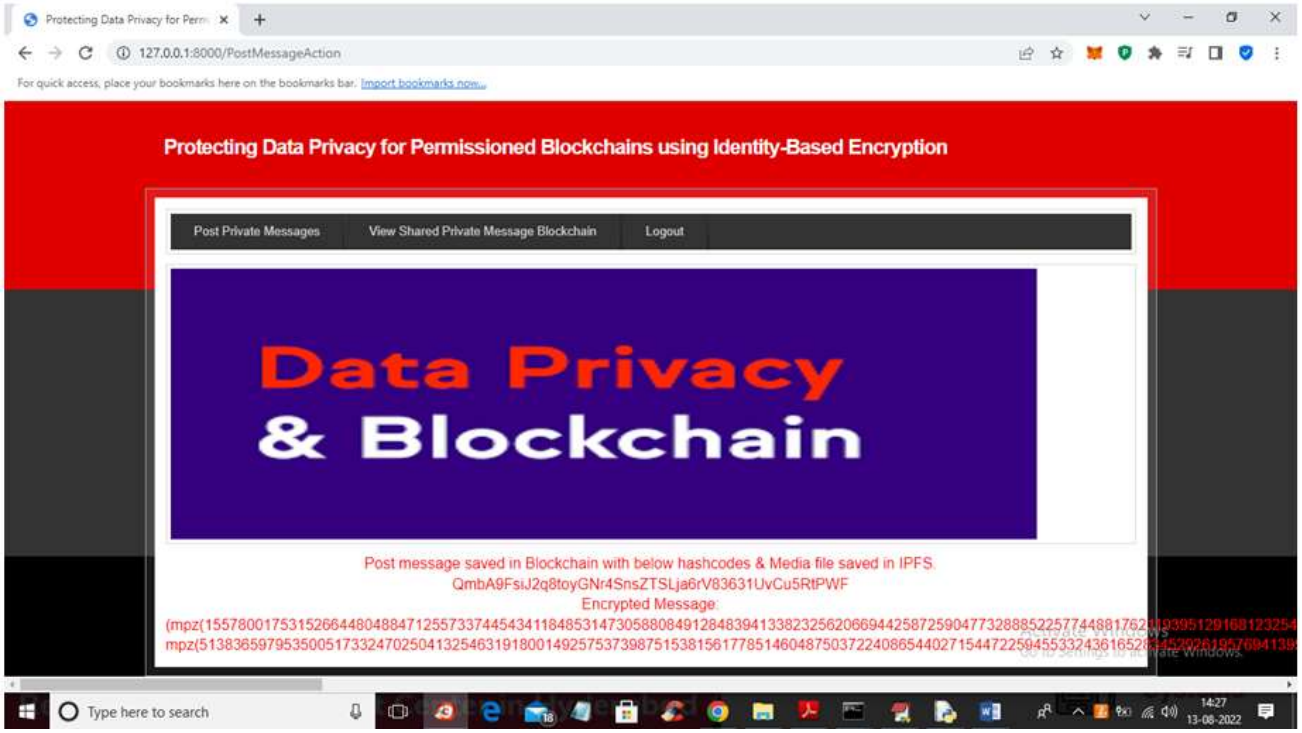



**In the screenshot above, user John is publishing a post and subsequently sharing it with users "aaa" and "bbb," leaving user "ccc" unable to see the post. After pressing the "Submit" button to preserve the post in Blockchain, the user receives the below result.**




**The message in the red colour that says "POST MESSAGE" saved in the blockchain along with a hashcode and an IBE encrypted message can be seen in the screen above.**

## 7. CONCLUSION AND FUTURE WORK

To further demonstrate the privacy, we have suggested an enhanced delicately scheme on top of non-transactional circumstances in permissioned blockchain. Without the use of cutting-edge technologies like ring signature, homomorphic encryption, or zero-knowledge proofs, our approach may conceal the information by converting the plaintext into the ciphertext. Our approach not only eliminates the challenging certificate issuing and management seen in the conventional PKI system, but it also offers a high level of security that can thwart passive and disguised attacks and is functional, efficient, and useful for applications. This system offers an innovative method for maintaining sensitive transaction confidentiality in numerous applications for non-transactional contexts.

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