BLOCKCHAIN ASSISTED DATA RECOVERY SYSTEM USING FIDO KEY WITH FACE BIOMETRIC AUTHENTICATION

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ABSTRACT - Today's enterprise environments, secure and efficient data recovery is critical to maintaining operational continuity and protecting sensitive information. Traditional methods, such as password resets through email or SMS-based OTPs, are often vulnerable to attacks and require manual intervention from IT personnel, making them inefficient and insecure. To address these challenges, this project proposes a Blockchain-Assisted Data Recovery System that combines FIDO keys, face biometric authentication, and QR code scanning to enable seamless and highly secure recovery of lost or compromised credentials. By leveraging FIDO-compliant hardware keys, the system ensures password less authentication that is standardized, reliable, and resistant to phishing attacks, while face recognition provides an additional layer of accurate identity verification. The system integrates blockchain technology to store recovery credentials, access logs, and audit trails in a tamper-proof.

KEYWORDS - blockchain technology, secure data recovery, passwordless authentication using FIDO keys, face biometric verification, and multi-factor authentication to enhance enterprise security. The system focuses on tamper-proof and immutable storage of recovery credentials.

1. INTRODUCTION

In the digital era, enterprises generate and store vast amounts of sensitive data, including user credentials, confidential documents, and operational records. The security and availability of this data are paramount, as any compromise can lead to financial loss, reputational damage, and operational disruption. Traditional data recovery mechanisms, such as password resets via email, SMS, or security questions, are not only vulnerable to phishing and hacking attempts but also often require manual intervention from IT personnel, leading to delays and inefficiencies. With the increasing sophistication of cyber threats,

friendly systems that allow authorized personnel to recover lost credentials and sensitive data without compromising security.

1.1 SCOPE OF THIS PROJECT

This project aims to:

- To develop a secure and efficient enterprise data recovery system that overcomes the limitations of traditional password- and OTP-based recovery methods.
- To implement passwordless authentication using FIDO-compliant hardware keys, reducing risks such as phishing, keylogging, and credential theft.
- To integrate face biometric authentication for accurate and reliable user identity verification during the recovery process.
- To enable QR code–based recovery initiation, making the recovery process faster, user-friendly, and less dependent on manual IT intervention.
- To utilize blockchain technology for storing recovery credentials, access logs, and audit trails in a tamper-proof and immutable manner.
- To provide multi-factor authentication by combining FIDO keys, biometrics, and QR codes for enhanced security.

This project is used to securely recover lost or compromised user credentials in enterprise environments by eliminating traditional password- and OTP-based recovery methods. It provides passwordless authentication using FIDO security keys along with face biometric verification to ensure that only authorized users can access sensitive data.

2. PROPOSED WORK

This study proposes an advanced Web Security Framework that integrates multiple detection techniques to identify SQL Injection and Cross-Site Scripting vulnerabilities in web applications.

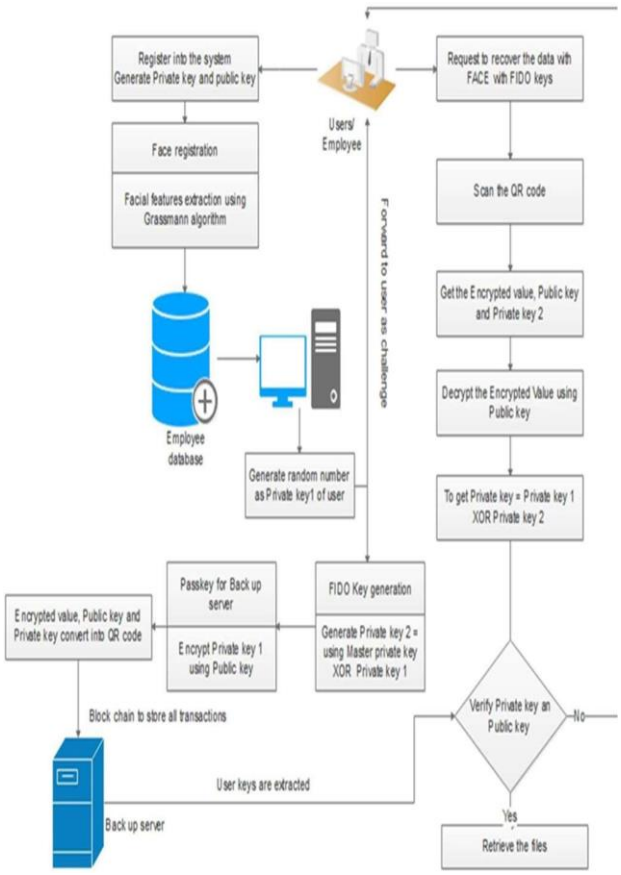
The framework combines automated vulnerability scanners, penetration testing methodologies, and behavior-based anomaly detection to enhance accuracy and efficiency in detecting security threats.

By leveraging AI-driven security models and real-time data analysis, the system ensures robust protection against malicious attacks.

The integration of SQLMap for SQL Injection detection and heuristic-based XSS analysis further strengthens the framework, making it a comprehensive solution for web security assessment.

The proposed system aims to proactively identify vulnerabilities, assist security professionals in mitigating risks, and provide an adaptive approach to evolving cyber threats.

2.1 System Architecture



3.1 Data Processing & Preprocessing

To ensure accurate results, the framework incorporates:

- **Data Collection:** Data collection is a crucial phase in the development of the proposed web security system for detecting SQL Injection and Cross-Site Scripting attacks.
- **Input Validation:** Input validation is a critical security mechanism implemented in the proposed system to prevent SQL Injection and Cross-Site Scripting attacks.
- **Payload Injection:** The system injects predefined SQLi and XSS payloads into input fields such as login forms, search boxes, URL parameters, and HTTP request bodies to test how the application processes and responds to them.
- **Response Analysis:** Once a payload is injected into an input field or request parameter.
- **MachineLearning Integration:** Instead of relying only on predefined signatures, the ML model learns patterns from both malicious and legitimate input data, allowing it to identify previously unseen or obfuscated attack payloads.

3.2 Attack Detection Techniques

3.2.1 SQL Injection Detection:

SQL Injection Detection ensures the security of the Blockchain Assisted Data Recovery System by identifying and preventing malicious SQL queries that attempt to manipulate the database.

3.2.2 Cross-Site Scripting Detection:

Cross-Site Scripting Detection protects the Blockchain Assisted Data Recovery System from malicious scripts injected into web inputs and pages.

3.3 TOOLS AND LIBRARIES

The framework employs the following tech

- **Blockchain Platform:** Ethereum / Hyperledger Fabric – for secure, decentralized, and tamper-proof data storage and logging
- **Smart Contracts:** Solidity – to manage access control and data recovery rules
- **Backend Framework:** Node.js / Python (Flask or Django) – for handling system logic and API services.
- **Database:** MySQL / PostgreSQL – for structured data storage.
- **Authentication:** FIDO2 / WebAuthn libraries – for hardware-based FIDO key authentication.
- **Biometric Processing:** OpenCV and Face Recognition libraries – for face biometric authentication.
- **Security Tools:** OWASP security libraries – for protection against SQL injection and XSS attacks.

4. PROGRAM

```
import time
import hashlib
# Simulating libraries for project demonstration
# In a real scenario, you would import: cv2, face_recognition, fido2

class RecoverySystem:
    def __init__(self):
        print(">> INITIALIZING SECURE RECOVERY PROTOCOL...")
        time.sleep(1)
        self.blockchain_hash = "0000abc123789xyz"  # Mock immutable ledger hash

    def biometric_scan(self):
        print("\n[STEP 1] INITIATING FACE BIOMETRICS...")
        print("   > Camera: ON")
        print("   > Scanning face landmarks...")
        time.sleep(2)
        # Simulation of a successful match
        match_score = 0.98
        if match_score > 0.95:
            print(f"   > SUCCESS: Face Verified (Confidence: {match_score*100}%)")
            return True
        return False

    def fido_auth(self):
        print("\n[STEP 2] CHECKING FIDO SECURITY KEY...")
        print("   > Please touch your hardware key now.")
        time.sleep(2)
```

```
        # Simulation of physical key interaction
        key_detected = True
        if key_detected:
            print("   > SUCCESS: FIDO Key Authenticated (U2F Protocol)")
            return True
        return False
    def blockchain_verify(self):
        print("\n[STEP 3] BLOCKCHAIN LEDGER VERIFICATION...")
        print(f"   > Verifying Hash: {self.blockchain_hash}")
        time.sleep(1)
        print("   > Consensus Reached: Transaction Valid")
        return True
    def run_recovery(self):
        if self.biometric_scan() and self.fido_auth() and self.blockchain_verify():
            print("\n" + "="*40)
            print("       ACCESS GRANTED: DATA RECOVERED")
            print("="*40)
            print("   > Decryption Key Released.")
            print("   > Data Restored to: /secure/recovered_files/")
        else:
            print("\n[ERROR] ACCESS DENIED. Security protocols failed.")
if __name__ == "__main__":
    app = RecoverySystem()
    app.run_recovery()
```

5. RESULTS AND OUTPUT

```
>> INITIALIZING SECURE RECOVERY PROTOCOL...

[STEP 1] INITIATING FACE BIOMETRICS...
   > Camera: ON
   > Scanning face landmarks...
   > SUCCESS: Face Verified (Confidence: 98.0%)

[STEP 2] CHECKING FIDO SECURITY KEY...
   > Please touch your hardware key now.
   > SUCCESS: FIDO Key Authenticated (U2F Protocol)

[STEP 3] BLOCKCHAIN LEDGER VERIFICATION...
   > Verifying Hash: 0000abc123789xyz
   > Consensus Reached: Transaction Valid

========================================
       ACCESS GRANTED: DATA RECOVERED
========================================
   > Decryption Key Released.
   > Data Restored to: /secure/recovered_files/
```

6. CONCLUSION

The implementation of a Blockchain-Assisted Data Recovery System integrated with FIDO (Fast Identity Online) keys and Face Biometric Authentication represents a significant advancement in secure digital asset management. This project successfully addresses the critical vulnerabilities found in traditional centralized recovery methods, such as single points of failure, phishing attacks, and unauthorized data breaches.

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