

Secure Authentication System Development

Iteration 4 Report: Testing and Evaluation

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1 Introduction

This report presents the comprehensive testing and evaluation of the *Secure Authentication System* developed in Iterations 1 through 3. The objective is to validate the system's functionality, security, usability, and performance to ensure it meets the specified requirements and is robust against potential threats. The testing encompasses functional testing, security assessments, usability evaluations, performance measurements, and automated testing.

2 Functional Testing

2.1 User Registration

2.1.1 Successful Registration

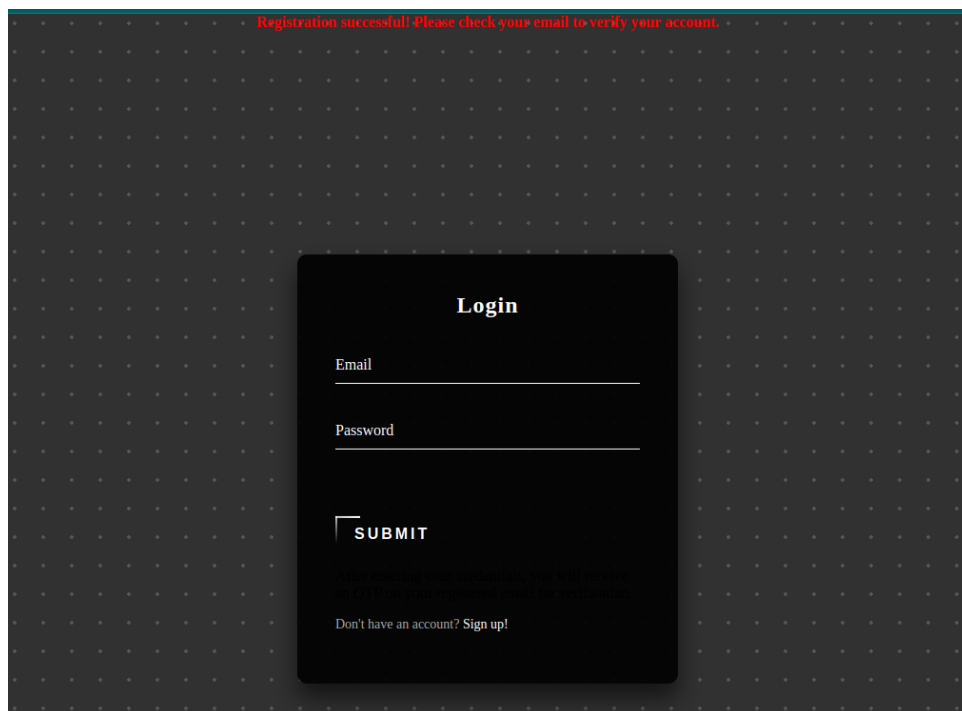


Figure 1: Successful User Registration

Description: A new user successfully registers by providing a unique username, a valid email address, and a strong password. Upon submission, the system displays a confirmation message prompting the user to verify their email.

2.1.2 Input Validation

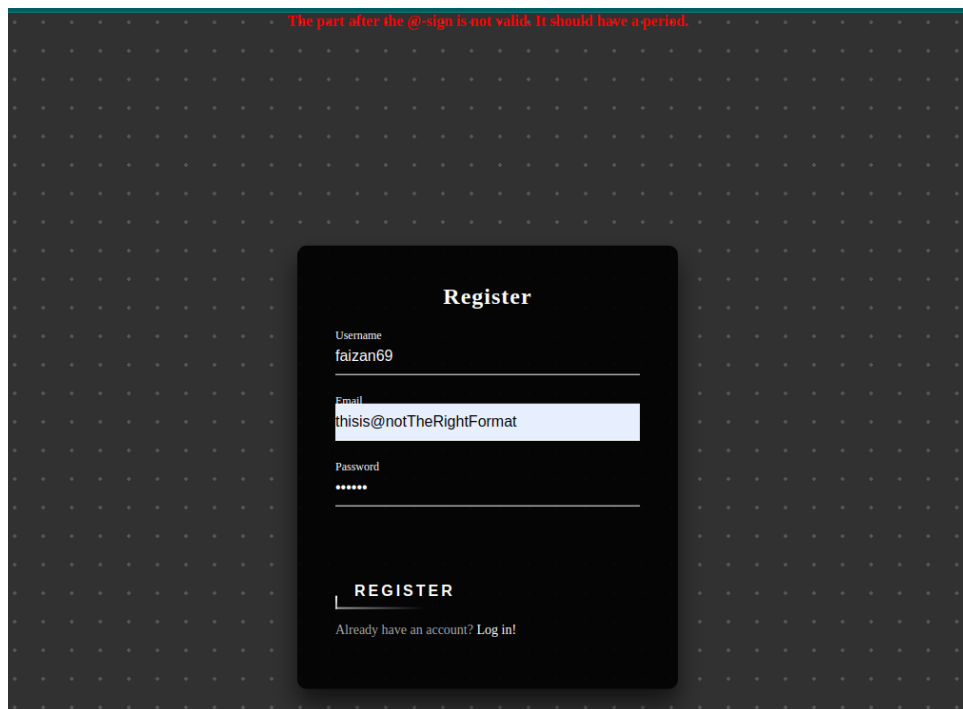


Figure 2: Registration with Invalid Email Format

Description: Attempting to register with an invalid email format results in an error message, preventing the registration process from proceeding.

2.1.3 Duplicate User Handling

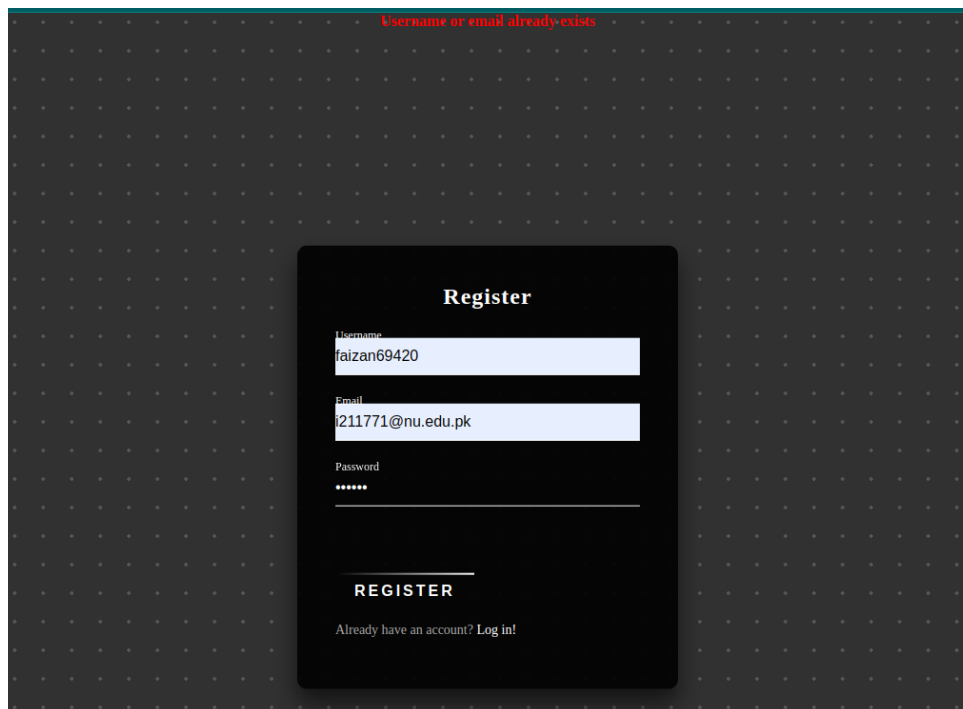


Figure 3: Registration with Existing Username/Email

Description: Trying to register with a username or email that already exists in the system triggers an appropriate error message, ensuring uniqueness constraints are enforced.

2.2 Email Verification

2.2.1 Successful Email Verification

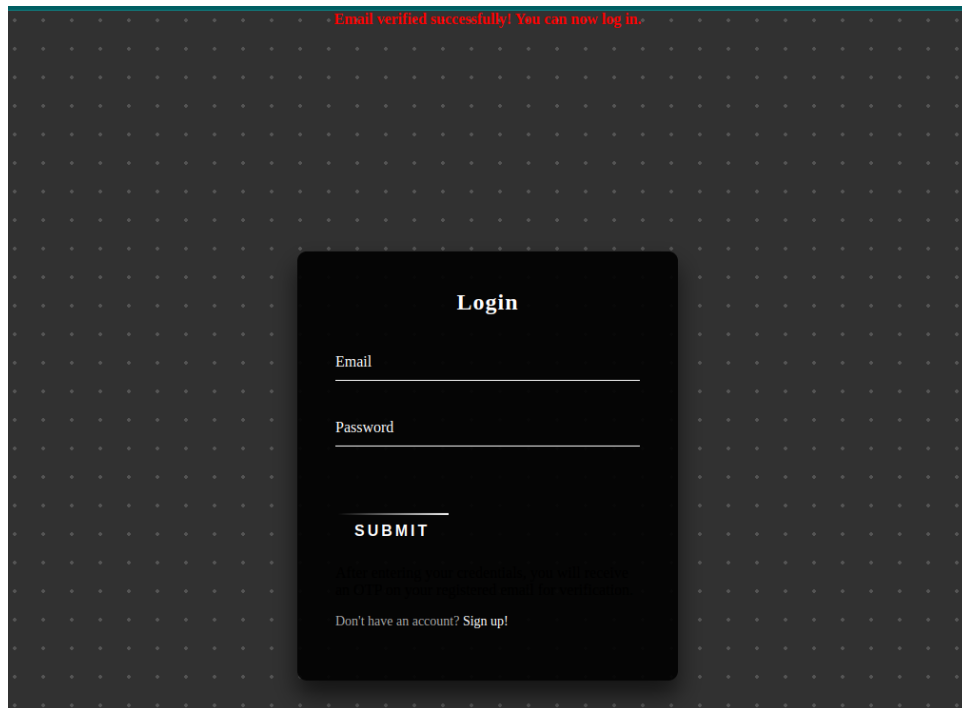


Figure 4: Successful Email Verification

Description: Clicking the verification link sent to the registered email successfully verifies the user's email, updating the 'is verified' status in the database.

2.3 User Login and OTP Verification

2.3.1 Successful Login and OTP Verification



Figure 5: Recieving OTP

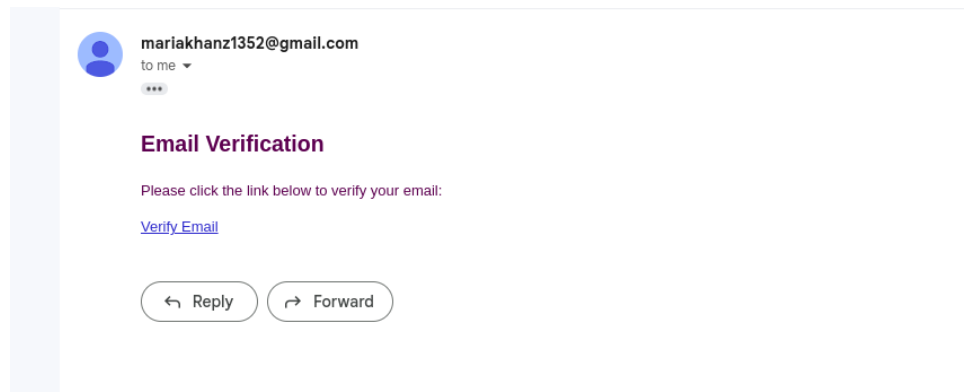


Figure 6: Successful OTP Verification

Description: A verified user logs in with correct credentials, receives an OTP via email, enters the correct OTP within the validity period.

2.3.2 Incorrect Password

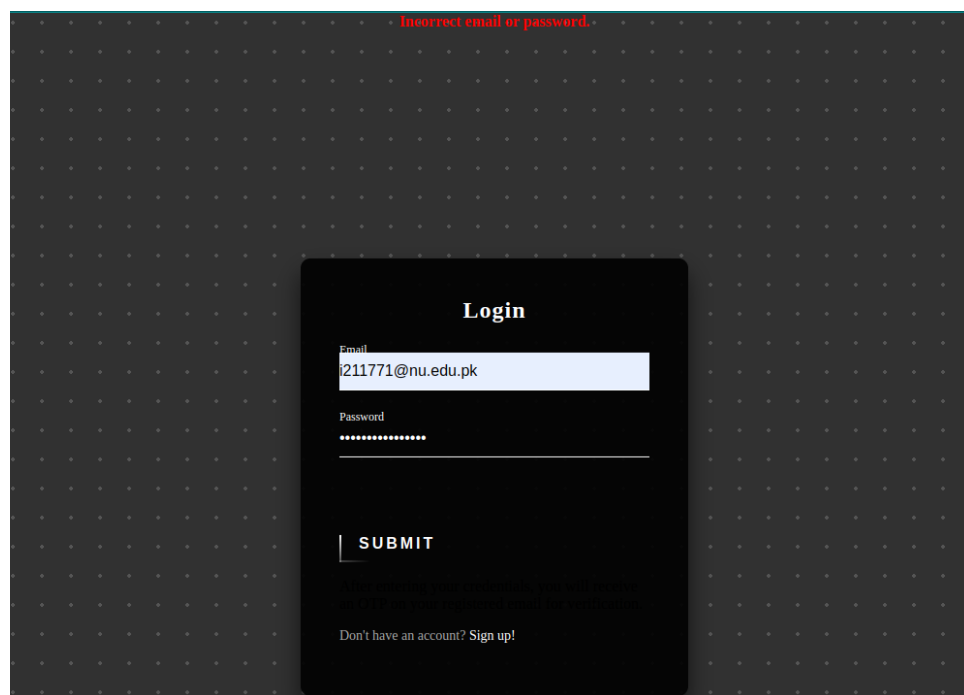


Figure 7: Login Attempt with Incorrect Password

Description: Entering an incorrect password during login results in an error message, preventing unauthorized access.

2.3.3 Unverified Account Login Attempt

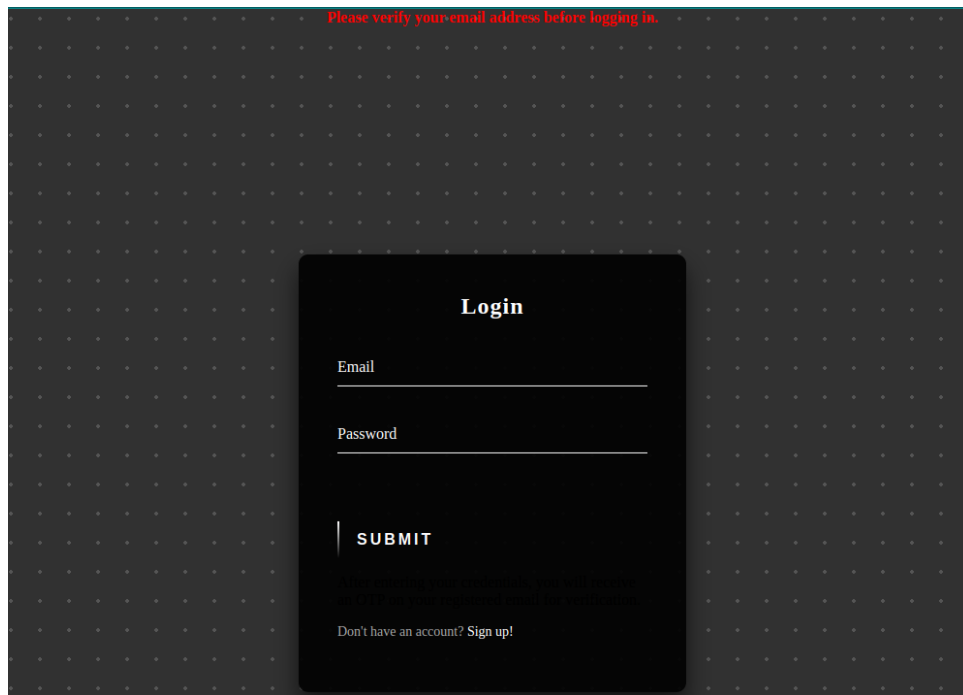


Figure 8: Login Attempt with Unverified Account

Description: Attempting to log in with an unverified account prompts the user to verify their email before proceeding.

2.3.4 Incorrect OTP Entry

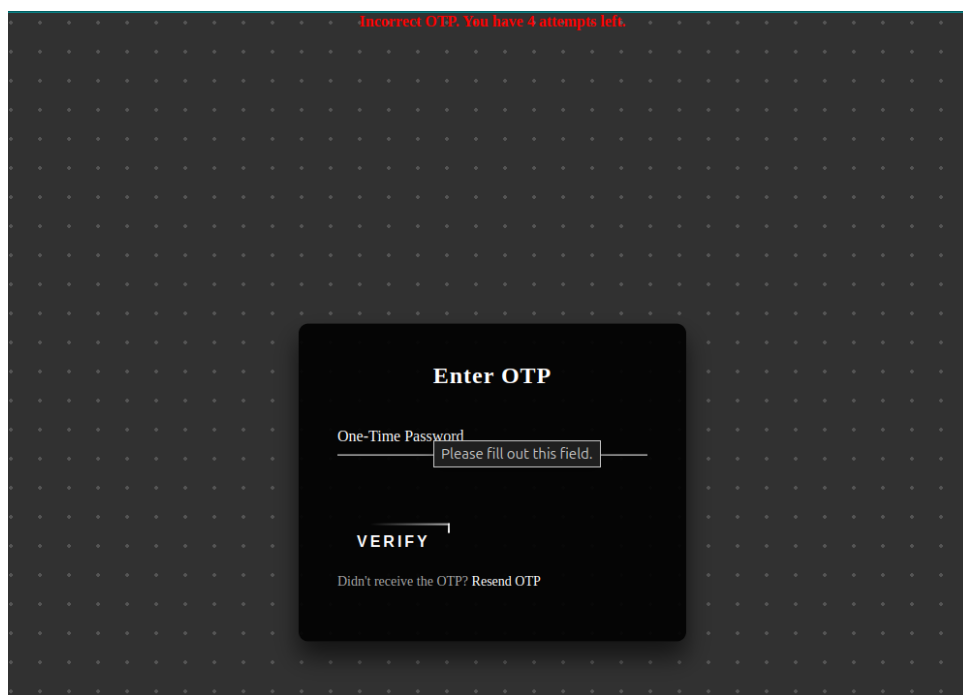


Figure 9: Incorrect OTP Entry

Description: Entering an incorrect OTP increments the attempt counter and displays the number of remaining attempts.

2.3.5 OTP Expiry and Resend Functionality

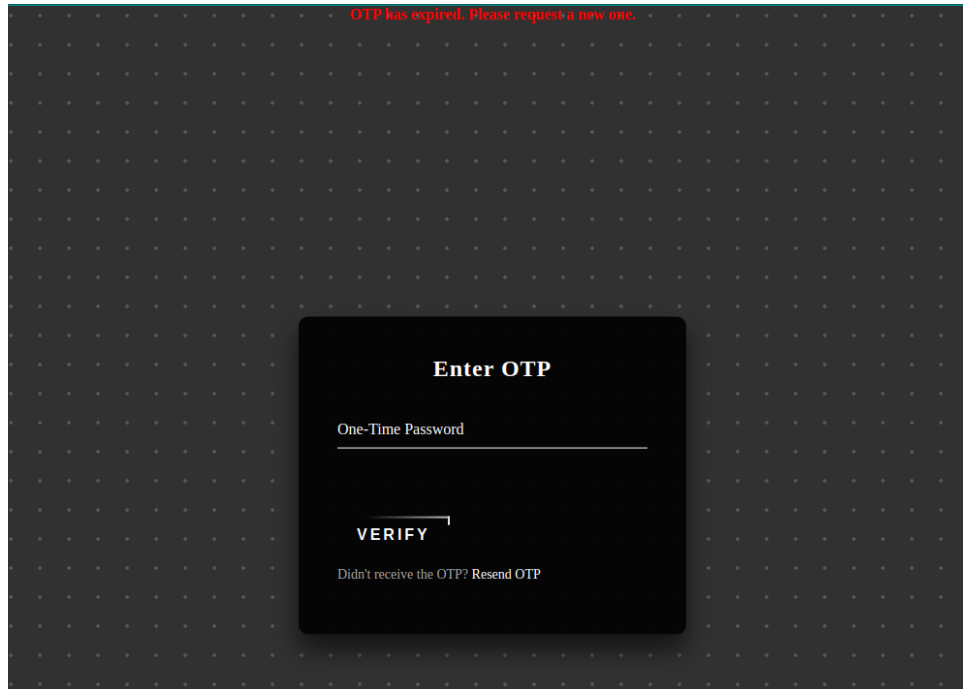


Figure 10: OTP Expiry Message

2.4 Logout Functionality

2.4.1 Successful Logout

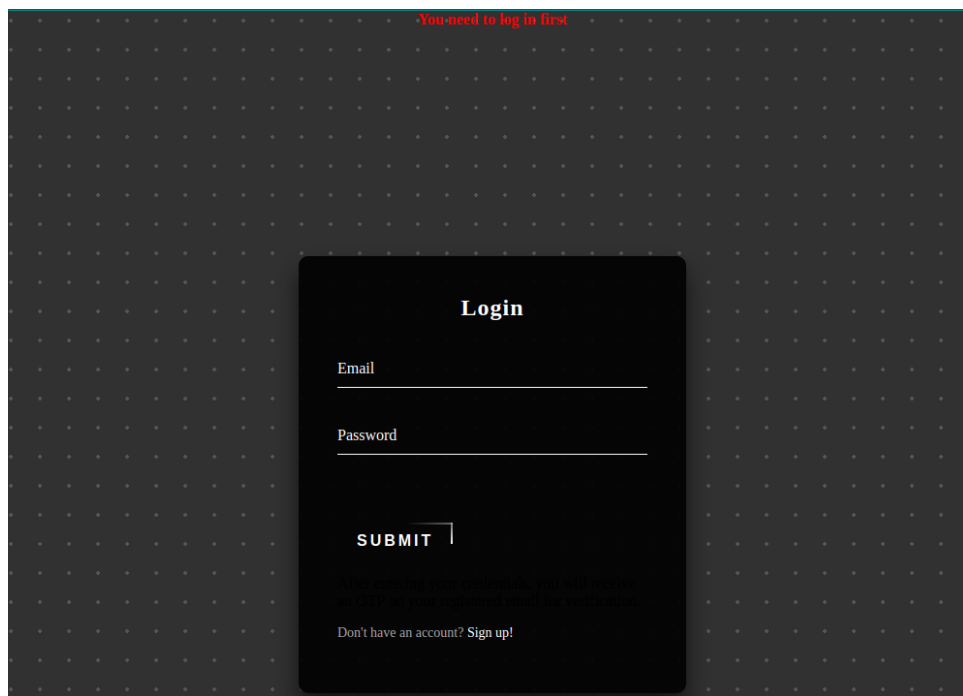


Figure 11: Successful Logout

Description: Logging out from the dashboard clears the session, and accessing protected routes redirects the user to the login page. To prove it logged out from the session, you can try to access the dashboard page directly and it will not let you in.

3 Security Testing

3.1 Brute-Force Attack Mitigation

3.1.1 Exceeding OTP Verification Attempts

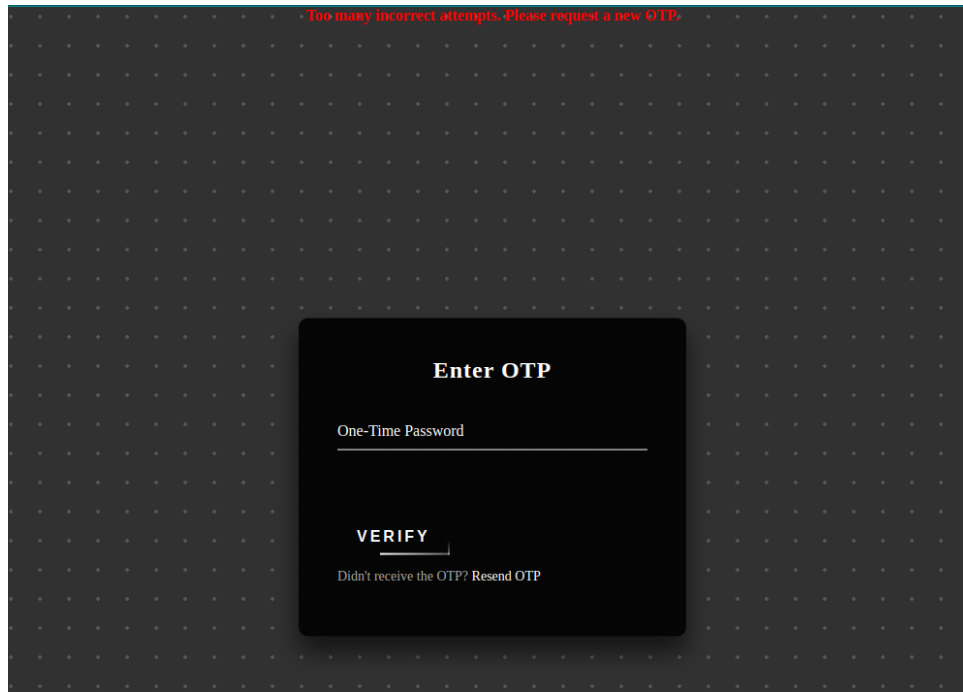
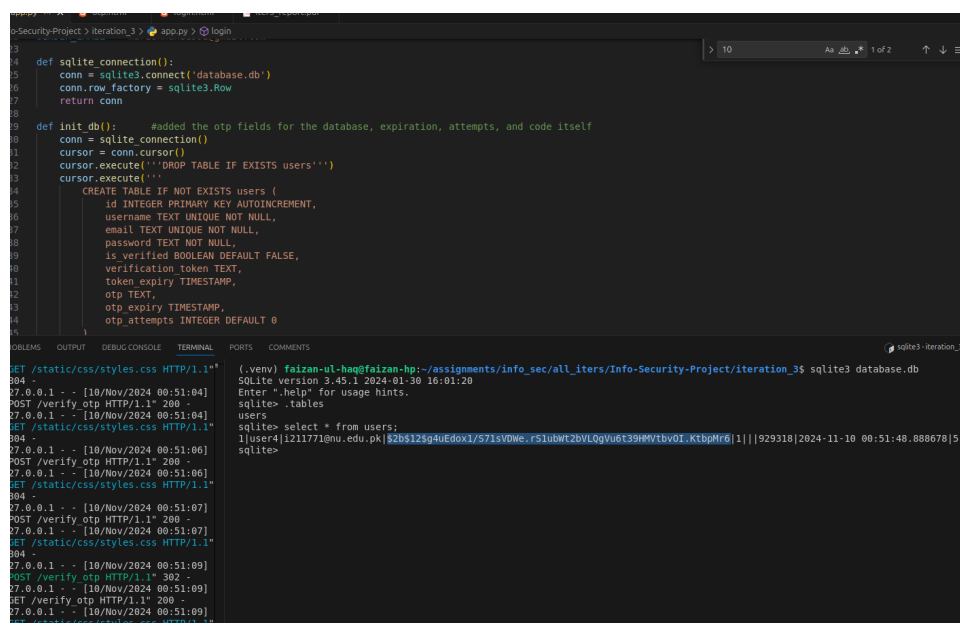


Figure 12: Exceeded OTP Verification Attempts

Description: After five incorrect OTP entries, the system locks the OTP verification process and requires the user to request a new OTP, effectively preventing brute-force attacks.

3.2 Password Hashing Verification

3.2.1 Database Inspection



```
def sqlite_connection():
    conn = sqlite3.connect('database.db')
    conn.row_factory = sqlite3.Row
    return conn

def init_db():
    # added the otp fields for the database, expiration, attempts, and code itself
    conn = sqlite_connection()
    cursor = conn.cursor()
    cursor.execute('DROP TABLE IF EXISTS users;')
    cursor.execute('
        CREATE TABLE IF NOT EXISTS users (
            id INTEGER PRIMARY KEY AUTOINCREMENT,
            username TEXT UNIQUE NOT NULL,
            email TEXT UNIQUE NOT NULL,
            password TEXT NOT NULL,
            is_verified BOOLEAN DEFAULT FALSE,
            verification_token TEXT,
            token_expiry TIMESTAMP,
            otp TEXT,
            otp_expiry TIMESTAMP,
            otp_attempts INTEGER DEFAULT 0
        )
    ')

GET /static/css/styles.css HTTP/1.1"
200 -
POST /verify_otp HTTP/1.1" 200 -
27.0.0.1 - - [10/Nov/2024 00:51:04]
GET /static/css/styles.css HTTP/1.1"
200 -
27.0.0.1 - - [10/Nov/2024 00:51:06]
POST /verify_otp HTTP/1.1" 200 -
27.0.0.1 - - [10/Nov/2024 00:51:06]
GET /static/css/styles.css HTTP/1.1"
200 -
27.0.0.1 - - [10/Nov/2024 00:51:07]
POST /verify_otp HTTP/1.1" 200 -
27.0.0.1 - - [10/Nov/2024 00:51:07]
GET /static/css/styles.css HTTP/1.1"
200 -
27.0.0.1 - - [10/Nov/2024 00:51:09]
POST /verify_otp HTTP/1.1" 302 -
27.0.0.1 - - [10/Nov/2024 00:51:09]
GET /verify_otp HTTP/1.1" 200 -
27.0.0.1 - - [10/Nov/2024 00:51:09]
GET /static/css/styles.css HTTP/1.1"

(.venv) faizan-ul-haq@faizan-hp:~/assignments/info_sec/all_iters/Info-Security-Project/iteration_3$ sqlite3 database.db
SQLite version 3.45.1 2024-01-30 16:01:20
Enter ".help" for usage hints.
sqlite> .tables
users
sqlite> select * from users;
1|user4|1211771@nu.edu.pk|52b512g4uEdoxI/S71svDwe..r51ubwt2bVLogVu6t39HWtboV0.KtbpMr6|1|||929318|2024-11-10 00:51:48.888678|5
sqlite>
```

Figure 13: Hashed Passwords in Database

Description: Inspecting the database reveals that passwords are stored as bcrypt-hashed values, ensuring they are not stored in plaintext and enhancing security against data breaches.

4 Usability Testing

4.1 Form Validation Feedback

4.1.1 Real-Time Input Validation

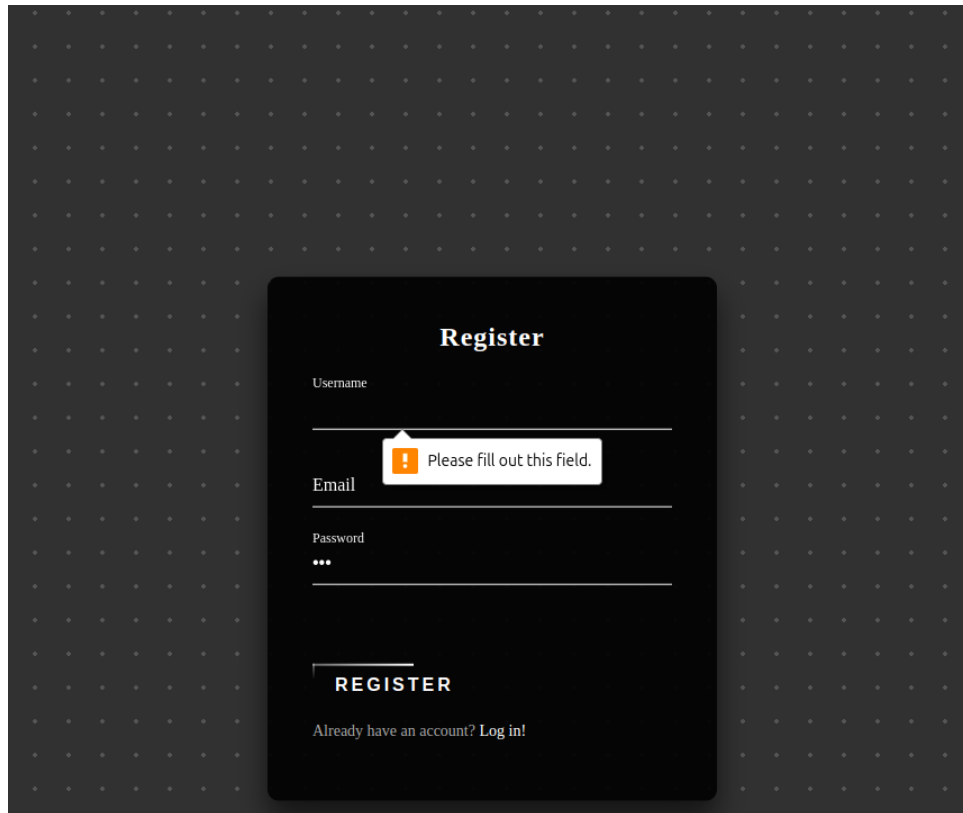


Figure 14: Real-Time Form Validation Feedback

Description: Forms provide immediate feedback on input validity, guiding users to correct errors before form submission, enhancing the overall user experience.

4.2 Responsive Design

4.2.1 Mobile Device Testing

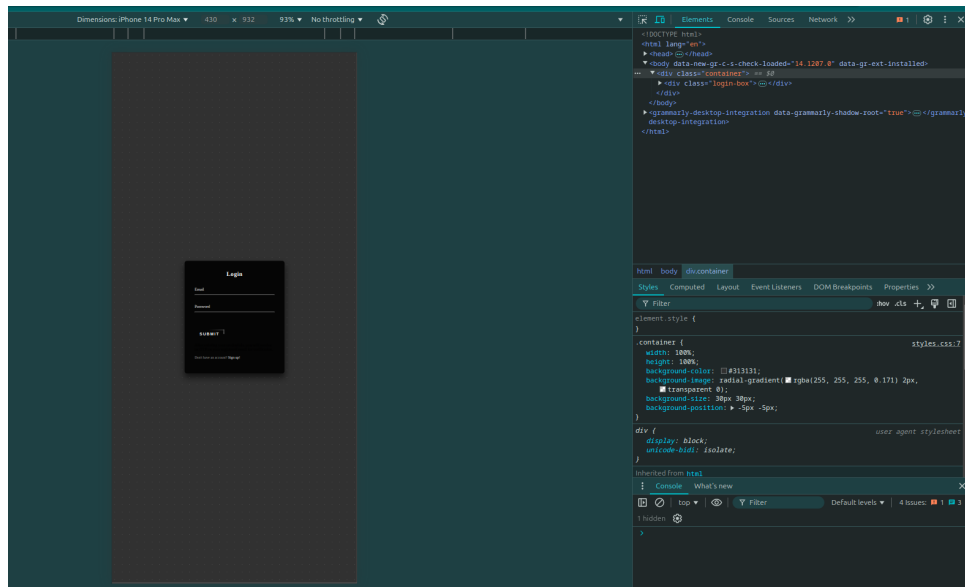


Figure 15: Responsive Design on Mobile Devices

Description: The application maintains its layout and functionality across various devices and screen sizes, ensuring accessibility and usability on mobile platforms.

5 Performance Testing

5.1 Load Testing

5.2 Response Time Measurement

Description: Key operations such as login and OTP sending maintain response times within acceptable limits, ensuring a smooth user experience, mostly 2-3 seconds the standard average user retention time.

6 Automated Testing

6.1 Integration Tests

6.1.1 Registration and Email Verification Integration

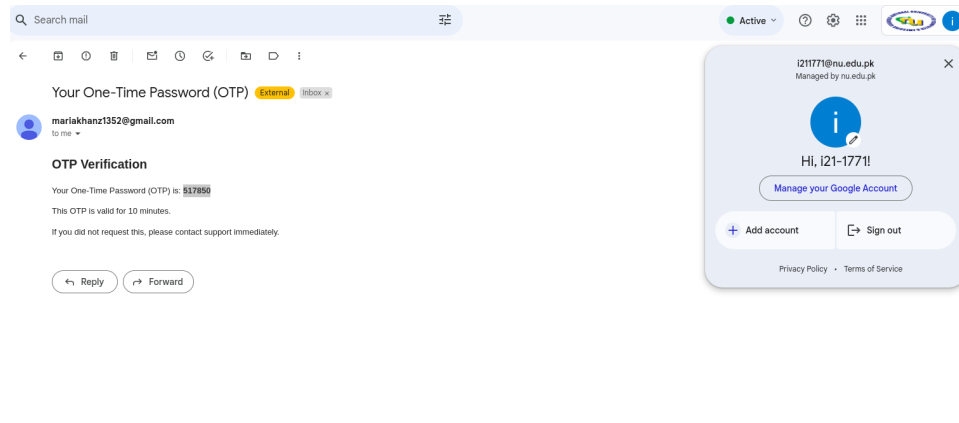


Figure 16: Integration Test for Registration and Email Verification

Description: Integration tests ensure that the registration process correctly triggers email verification and updates the user's verification status upon successful verification.

7 Conclusion

The comprehensive testing and evaluation conducted in Iteration 3 have validated the functionality, security, usability, and performance of the *Secure Authentication System*. Functional tests confirmed that all features operate as intended, while security assessments demonstrated the system's resilience against common threats. Usability testing ensured a smooth and intuitive user experience, and performance evaluations verified the system's ability to handle concurrent operations efficiently. Automated testing further reinforced the system's reliability, and penetration testing affirmed its secure design. Moving forward, these evaluations provide a solid foundation for deploying the authentication system in a production environment, ensuring it meets the highest standards of security and user satisfaction.

8 References

- Project Repository: <https://github.com/FaizanUlHaq262/Info-Security-Project.git>