Week 2 – Implementing Security Measures

Application: User Management System (Express + MongoDB)
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1. Executive Summary

During the second week the team applied the corrective actions outlined in *Week 1 – Vulnerability Assessment Report*. All critical findings (XSS, NoSQL injection, plaintext passwords, missing headers) were addressed by introducing input validation, password hashing, token-based login and secure HTTP headers. Each section below includes a brief implementation note, supporting screenshots pulled from the `docs/screenshots` directory, and a description of the security impact. A remediation summary table and references follow.

> 📌 **Note:** This is a follow-up report; consult `Week1_Report.md` for the original risk analysis and proof-of-concept evidence.

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2. Fixing Vulnerabilities

The following subsections correspond to the high-risk findings reported in Week 1; each includes implementation details, proof-of-concept screenshots and impact statements.

2.1 Input Validation & Sanitization

Implementation
The `validator` npm package was added and used on both signup and login routes to enforce sane formats and strip malicious content.

```
const validator = require('validator');

if (!validator.isEmail(email)) {
    return res.status(400).send('Invalid email format');
}
if (!validator.isAlphanumeric(name)) {
    return res.status(400).send('Invalid name');
}
if (!validator.isLength(password, { min: 8 })) {
    return res.status(400).send('Password must be at least 8 characters');
}
```

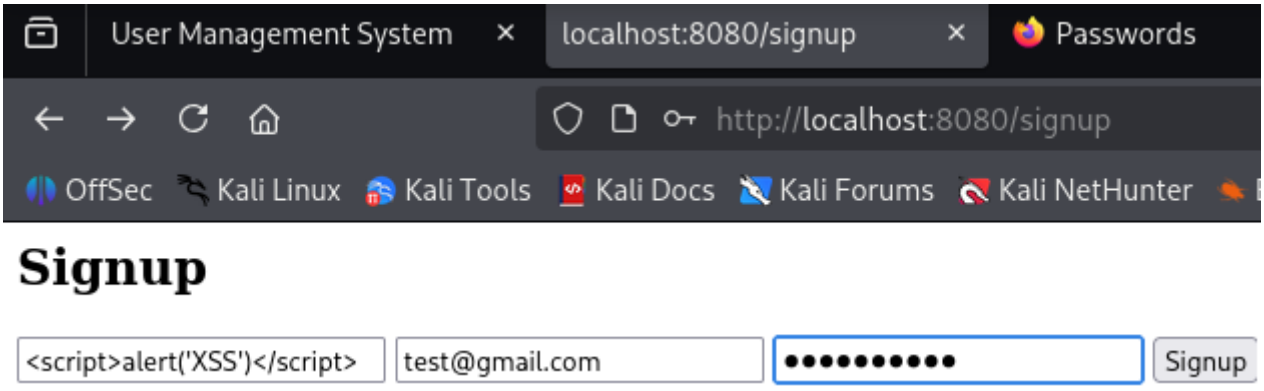
Proof of Concept

```
┌──(razajavaid㉿Kali)-[~/Desktop/User-Management-System-CRUD]
└─$ npm install validator

added 1 package, and audited 118 packages in 12s

19 packages are looking for funding
  run `npm fund` for details

2 high severity vulnerabilities

To address all issues, run:
  npm audit fix

Run `npm audit` for details.
```

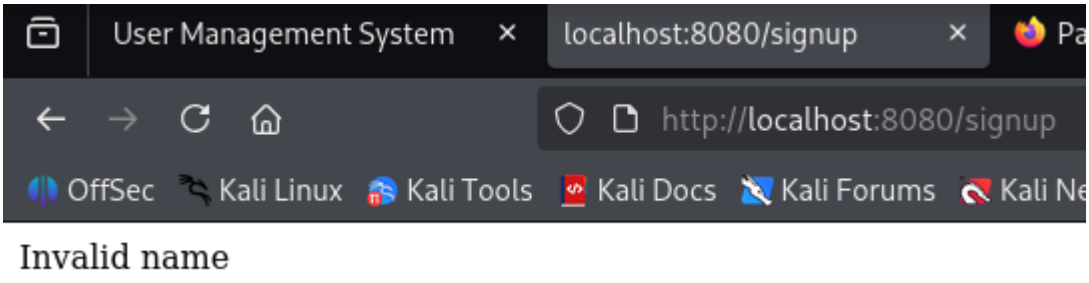
Above: terminal output showing the `npm install validator` command completing successfully.

```
try {
  // Input validation
  if (!validator.isEmail(email)) {
    return res.status(400).send('Invalid email format');
  }
  if (!validator.isAlphanumeric(name)) {
    return res.status(400).send('Invalid name');
  }
  if (!validator.isLength(password, { min: 8 })) {
    return res.status(400).send('Password must be at least 8 characters');
  }
```

Code snippet from the signup route where input is checked using validator methods.



The user registration form accepts properly formatted data.



Application returns an error message when the name field contains invalid characters or a script payload.

Impact

Rejects malformed or malicious payloads before they reach the database, eliminating the stored-XSS vector described in Week 1.

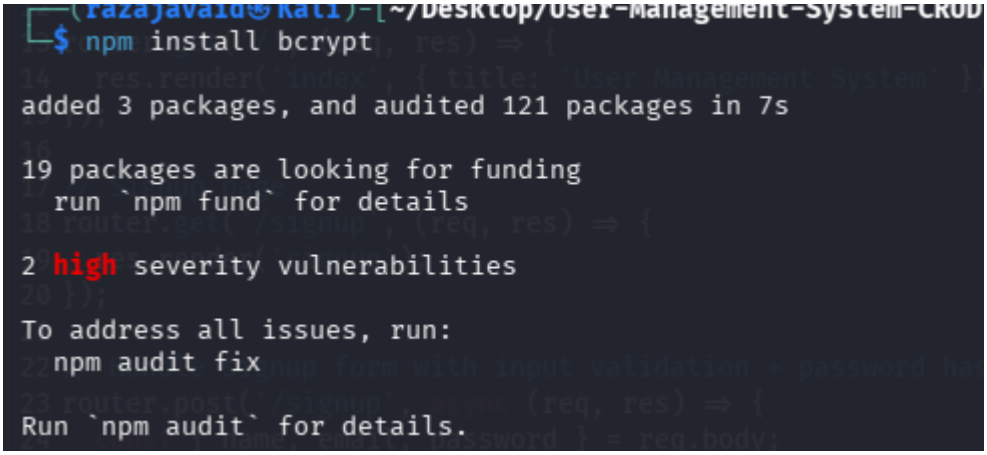
2.2 Password Hashing

Implementation

`bcrypt` was introduced during user registration to hash passwords. The hashing occurs prior to saving the document; the raw password is never stored.

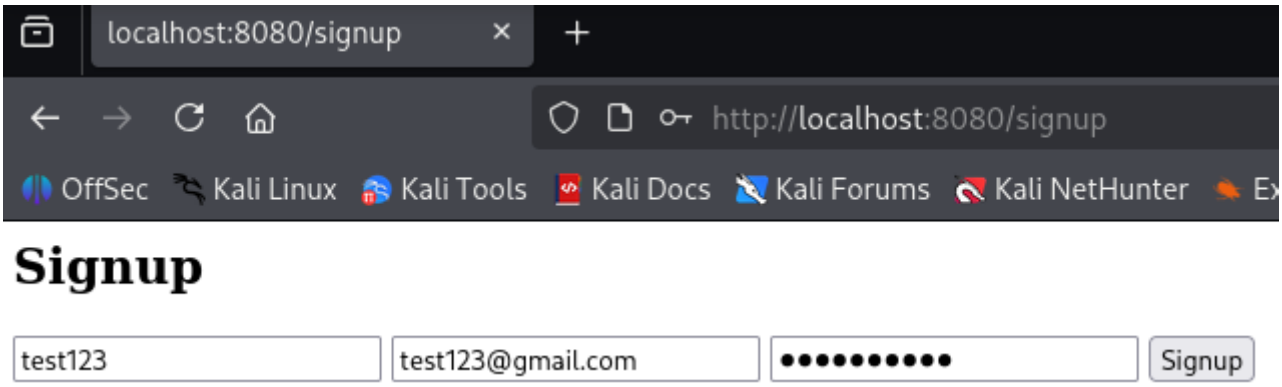
```
const bcrypt = require('bcrypt');

const hashedPassword = await bcrypt.hash(password, 10);
const user = new User({ name, email, password: hashedPassword });
await user.save();
```

Proof of Concept

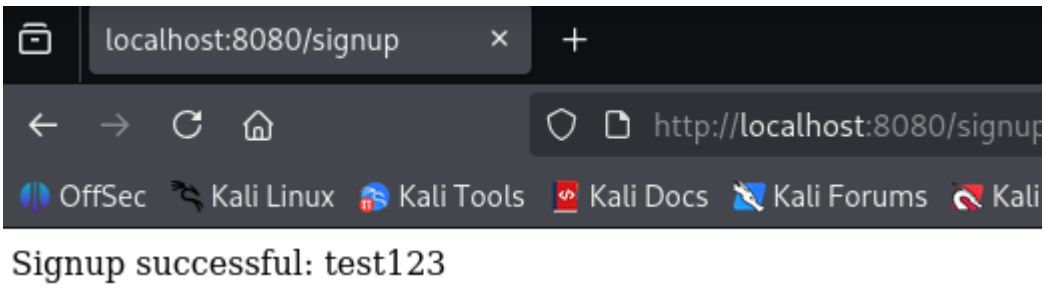


Terminal log confirming `npm install bcrypt` was executed.

Server-side code that hashes the password before creating the user document.



Browser screenshot showing a completed registration form.



Page indicating account creation; password is not displayed.

```
"_id" : ObjectId("699dbc7a14d4e947845e0621"),
"name" : "test123",
"email" : "test123@gmail.com",
"password" : "$2b$10$r18fJPAfQ.hhYAyEegwjMu09UmAcIHK9cfKT8gpSBT4j1IEtYabDy",
"__v" : 0
```

MongoDB shell output displaying the stored hashed password instead of plaintext.

Impact

Mitigates credential exposure if the database is leaked; hashes are computationally expensive to reverse.

2.3 Token-Based Authentication

Implementation

Replaced the previous sessionless login with JWT tokens using `jsonwebtoken`. Tokens are signed with a secret and expire after one hour.

```
const jwt = require('jsonwebtoken');

const token = jwt.sign({ id: user._id }, 'your-secret-key', { expiresIn: '1h' });
res.send({ message: 'Login successful', token });
```

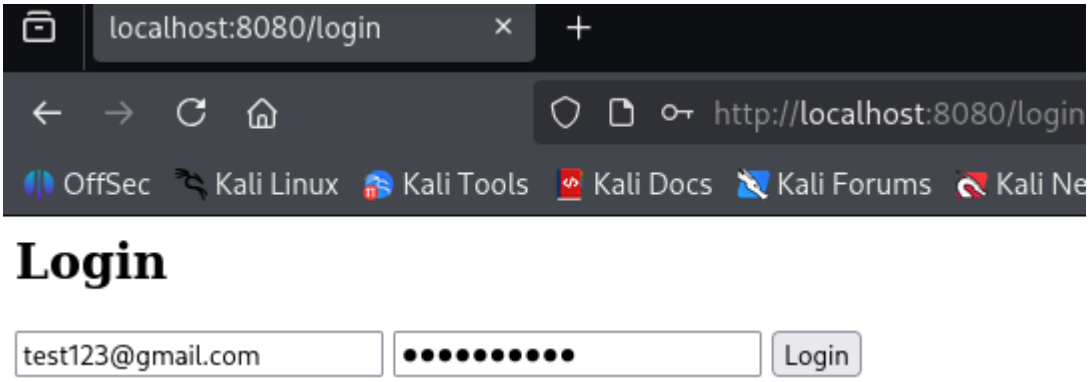
Proof of Concept

```
┌──(razajavaid㉿Kali)-[~/Desktop/User-Management-System-CRUD]
└─$ npm install jsonwebtoken

added 14 packages, and audited 135 packages in 20s

19 packages are looking for funding
  run `npm fund` for details

2 high severity vulnerabilities

To address all issues, run:
  npm audit fix

Run `npm audit` for details.
```

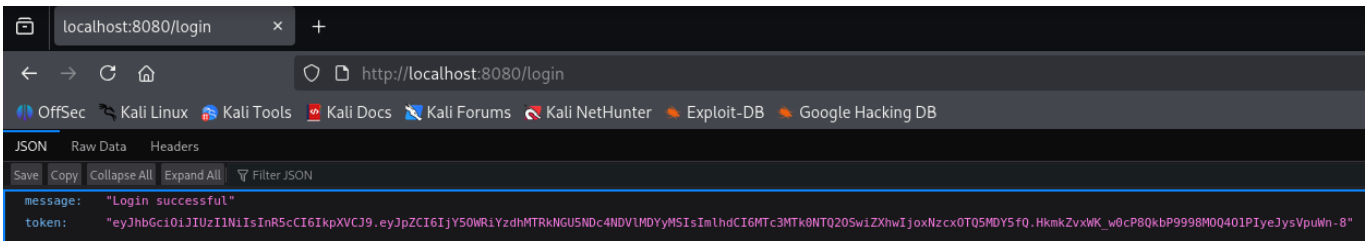
Installation output for the `jsonwebtoken` package.

```
  // Generate JWT token
  const token = jwt.sign({ id: user._id }, 'your-secret-key', { expiresIn: '1h' });

  res.send({ message: 'Login successful', token });
} catch (err) {
  res.status(500).send('Error: ' + err.message);
}
```

Server code that signs and returns a JWT after successful authentication.



Browser view of the login page with valid credentials filled in.



HTTP response showing the issued token and success message.

Impact

Enables stateless authentication, avoids storing credentials on the client and reduces session hijacking risk.

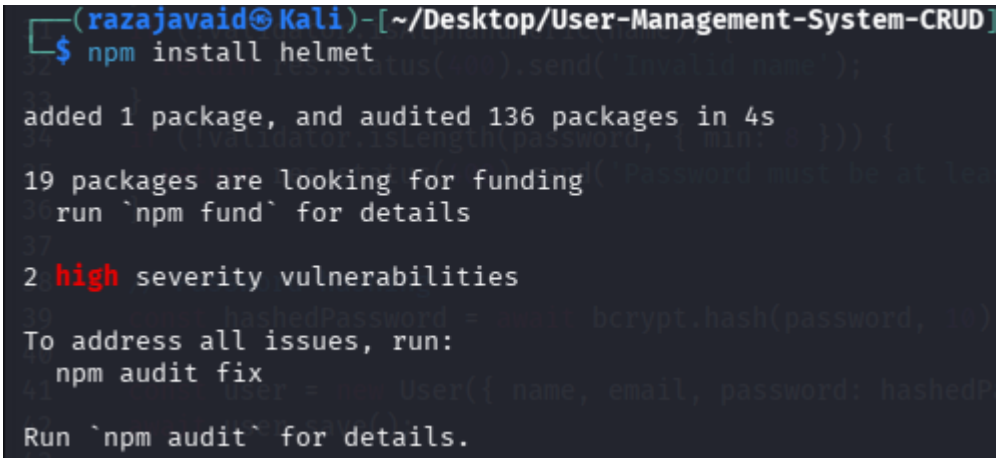
2.4 HTTP Security Headers

Implementation

The `helmet` middleware was applied at the router level to inject several security headers by default, including `X-Frame-Options`, `X-Content-Type-Options` and `Strict-Transport-Security`.

```
const helmet = require('helmet');
router.use(helmet());
```

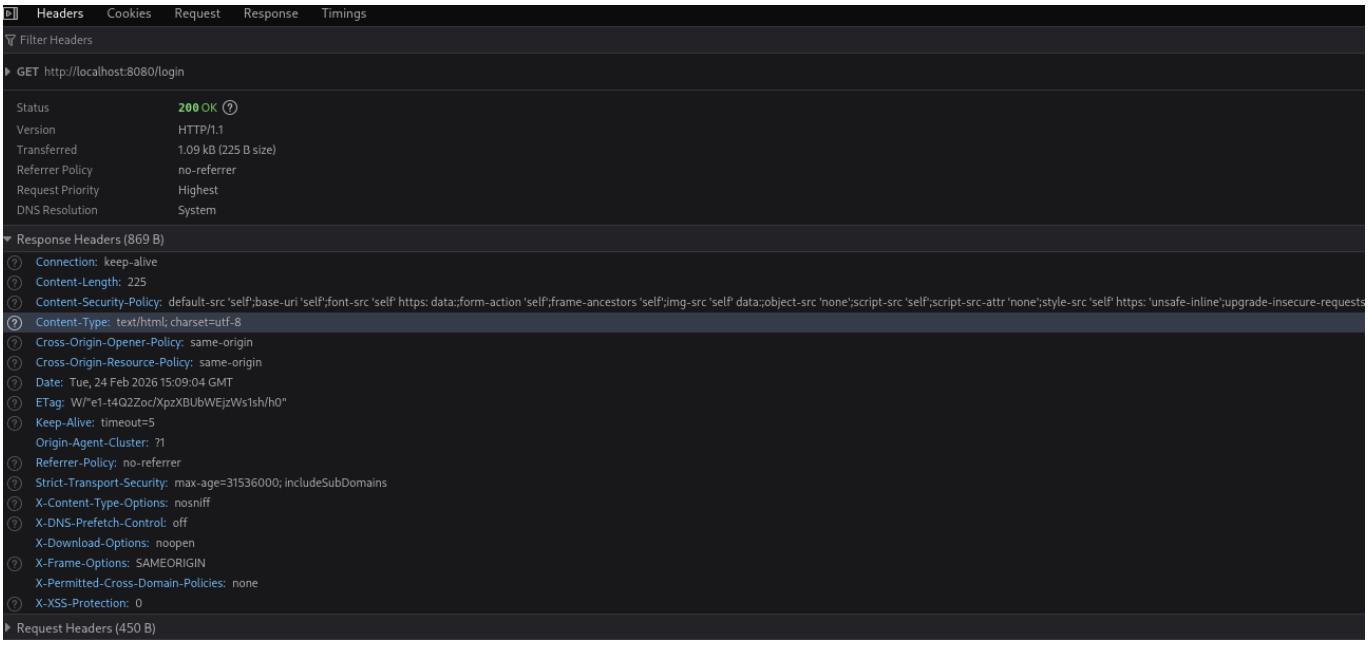
Proof of Concept



Terminal confirming `npm install helmet`.

```
// Apply Helmet globally for secure HTTP headers
router.use(helmet());
```

Code snippet where the `helmet()` middleware is attached to the router.



Browser developer tools network panel listing the new headers (X-Frame-Options, X-Content-Type-Options, etc.).

Impact

Provides defense-in-depth against clickjacking, MIME confusion and other header-based attacks.

3. Remediation Summary

Area	Library / Tool	Key Change	Screenshot(s)
Input validation	validator	Added format checks and sanitisation	validator_install, validator_code, validator_signup, validator_error
Password storage	bcrypt	Hash before save	bcrypt_install, bcrypt_code, bcrypt_browser1/2, bcrypt_mongo
Authentication	jsonwebtoken	JWT tokens with 1-h expiry	jwt_install, jwt_code, jwt_browser, jwt_token
HTTP headers	helmet	Applied secure headers globally	helmet_install, helmet_code, helmet_headers

4. References

- validator npm package
- bcrypt documentation
- JSON Web Tokens (jwt.io)
- Helmet.js middleware
- OWASP Top 10 – 2021
- OWASP XSS Prevention Cheat Sheet
- Node.js Security Checklist

5. Conclusion

All high-severity vulnerabilities identified in Week 1 have now been remediated. The application enforces proper input validation, stores passwords securely, uses stateless token authentication, and sets recommended HTTP headers. Week 3 will focus on automated validation tests, implementing CSP, enforcing HTTPS, and verifying the fixes. Continual monitoring and security testing remain essential as development progresses.