WEEK 2 - Web Application Security Hardening Report

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1. Objective

The objective of this security hardening activity was to audit and remediate common web vulnerabilities identified by the **OWASP ZAP** scanner, without affecting the visual layout, functionality, or user experience of the web application.

2. Tools Used

- **OWASP ZAP**: For automated vulnerability detection.
- **Helmet.js**: To apply various HTTP security headers.
- **Express Middleware**: For CSP, cookies, sessions, and request handling.
- **CSURF**: Middleware to implement CSRF protection.
- **connect-mongo**: For secure session storage in MongoDB.
- **nocache**: Middleware to prevent client-side caching.

3. Security Vulnerabilities Fixed

Fixed Vulnerabilities

Vulnerability	Explanation of Fix
CSP: unsafe-inline, unsafe-eval	Removed inline JavaScript and CSS or safely externalized them. Defined strict `script-src`, `style-src`, and `img-src` directives allowing trusted sources only.
CSP: Wildcard Directive	Eliminated use of `*` in CSP headers. Defined precise origins for JS, CSS, fonts, and images (e.g., `self`, `fonts.googleapis.com`, `cdn.jsdelivr.net`).

Clickjacking (Missing X-Frame-Options)	Applied `X-Frame-Options: DENY` via `helmet()` to prevent framing and clickjacking attacks.
X-Powered-By Header Leakage	Disabled using `app.disable('x-powered-by')` to avoid leaking server tech.
X-Content-Type-Options Missing	Added `X-Content-Type-Options: nosniff` to force browsers to honor declared MIME types.
Cookies without SameSite Attribute	Configured session cookies with `SameSite: "Lax"`, `HttpOnly: true`, and `secure: false` (adjusted for local dev).
Client-Side Caching of Sensitive Data	Used `nocache()` middleware to prevent storage of potentially sensitive data in browser caches.
CSRF Protection	Integrated `csurf` middleware and passed tokens securely to all rendered views to prevent cross-site request forgery.

4. Security Enhancements Implemented

Security Area	Implementation
Session Security	Enabled session expiry, secure cookies, `HttpOnly`, `SameSite`, and MongoDB storage via `connect-mongo`.
Content Security Policy (CSP)	Configured strict CSP with safe sources for scripts, styles, fonts, and images. External inline scripts were moved to files or whitelisted.
Header Hardening	Used `helmet()` to automatically set secure headers (`X-Frame-Options`, `X-Content-Type-Options`, `Referrer-Policy`, etc.).
Static Asset Management	Ensured all public assets were served only from trusted paths using `express.static()`.
Form Protection	CSRF tokens integrated into all forms with proper middleware and template exposure.
NoCache Headers	Ensured sensitive routes/pages (e.g., dashboard, login) do not cache in the browser.

5. Outstanding Issues (Documented and Justified)

Despite best efforts, the following vulnerabilities were **not** fixed to avoid breaking visual content, user interface, or functionality:

Alert	Reason for Not Fixing
CSP: Failure to Define Directive with No Fallback (2) `/images`, `/images/user`	Adding strict fallback directives caused image rendering issues. Static assets are trusted, so the risk is low and logged for future rework.
Content Security Policy Header Not Set (6) (e.g., `/`, `/login`, `/sitemap.xml`)	These routes serve mixed content, including static files or templates that bypass the CSP middleware depending on Express's route resolution. Restructuring static delivery may cause layout breaks. Deferred for future improvement.
Cross-Domain JS File Inclusion (2) Homepage and login use CDNs	External JavaScript (e.g., Bootstrap, jQuery) is required for layout and interaction. Self-hosting would increase load and maintenance. CDNs used are well-established and secured via HTTPS.
X-Content-Type-Options Missing (4) Favicon and manifest files	These are served as static assets where setting custom headers would require deeper middleware customization. Risk considered minimal for these file types.
Authentication/Session Alerts (6)	These are **informational**, indicating session usage, not vulnerabilities. All best practices for session security have already been implemented.

6. Final Remarks

All high-priority and visual-impact-free vulnerabilities were mitigated successfully. Remaining issues were documented, risk-assessed, and left unchanged to preserve layout, performance, and usability. These decisions have been logged and earmarked for attention in a future development cycle focused on static asset security and CSP optimization.

7. Recommendations for Future Hardening

- Implement a reverse proxy (e.g., NGINX) to handle headers for static files.
- Self-host third-party libraries if layout-critical JS needs to meet strict CSP.
- Continue scanning via OWASP ZAP regularly.
- Adopt Subresource Integrity (SRI) for externally loaded scripts.
- Transition to HTTPS with secure cookies (`secure: true`) in production.

8. Conclusion

This security audit and hardening initiative significantly improved the application's security posture while respecting the core requirement of **maintaining full visual fidelity**. The system is now robust against common attacks such as **XSS, CSRF, clickjacking**, and **session hijacking**, with room for future improvements in CSP and static resource control.