# Universal Software-Driven Constraint Tracking Form

Purpose:

- This document captures constraints that originate from software itself, including architectural decisions, performance targets, concurrency limits, interface restrictions, and memory behavior.  
- These constraints apply across various software domains (embedded, cloud, web, mobile, hybrid).

- Traceability to IEEE 29148 (SRS), ISO 26262 (safety), DO-178C (avionics), IEC 62304 (medical), and other domain-specific standards is enabled where required.

Constraint Tracking Table:

| **Constraint ID** | **Category** | **Constraint Description** | **Design Rationale** | **Owner** | **Impacted Requirements** | **Domain Application(s)** | **Impacted Components** | **Associated Standard(s)** | **Verification Method** | **Risk Impact** | **Status** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SWC-L-001** | Performance | Max API response time: 5 seconds for AI word definition generation | Maintain acceptable user experience during OpenAI API calls; typical response 2-4s + network latency | Ozan Bayer | FR-1, FR-2, NFR (Performance) | Web Application | AI Integration Module (ai\_handler.py), Backend API | IEEE 29148 (Performance Requirements), ISO/IEC 25010 (Time Behaviour) | Performance test with 100 word requests; measure avg & max response time | High | Active |
| **SWC-L-002** | Performance | Podcast generation time ≤ 40 seconds for 25-word groups | OpenAI TTS processes ~1.5s per word; 25 words = 37.5s + 2.5s overhead | Ozan Bayer | FR-7, FR-10, NFR (Performance) | Web Application | TTS Module (tts\_handler.py), Audio Generator | ISO/IEC 25010 (Performance Efficiency) | Load test with maximum word count (25 words); test both accents | Medium | Active |
| **SWC-L-003** | Resource | Daily podcast generation limit: 10 words maximum | Control OpenAI TTS API costs; 10 words/day × $0.0075 = $0.075/day keeps budget under $50 | Gülsüm Yıldırım | FR-12 | Web Application | Podcast Generator, Backend Limit Logic (limit\_checker.py) | IEEE 29148 (Resource Constraints) | Unit test: attempt 11-word podcast → expect warning; validate 24h reset | High | Active |
| **SWC-L-004** | Resource | Total API budget ceiling: $50 for entire project | Project financial constraint for OpenAI GPT-4o mini + TTS usage | All Team Members | FR-1, FR-2, FR-3, FR-7, Project Success Criteria | Web Application | AI Module, TTS Module, Usage Tracker | IEEE 29148 (Cost Constraints) | Weekly monitoring via OpenAI dashboard; automated usage logging; alert at 80% ($40) | Critical | Active |
| **SWC-L-005** | Storage | All vocabulary data stored in JSON format locally | Single-user app with no cloud sync; JSON is human-readable, parsable, no DB server needed | Gülsüm Yıldırım | FR-4, Scope (EX-3) | Web Application | Database Module (vocabulary.json), JSON Handler | IEEE 29148 (Data Format), RFC 8259 (JSON Spec) | Integration test: validate JSON schema integrity; test with malformed data | Medium | Active |
| **SWC-L-006** | Compatibility | Responsive design: desktop ≥1024px, mobile ≥375px screen width | Target users access from laptops, tablets, phones; ensure multi-device accessibility | Nurefşan Olfaz | NFR (Cross-Browser/Device), Key Feature 5 | Web Application | Frontend HTML/CSS (templates/, static/css/) | W3C Responsive Design, WCAG 2.1 (Accessibility) | Manual UI test on Chrome (1920×1080), Firefox (1366×768), iPad (768×1024), iPhone SE (375×667) | Medium | Active |
| **SWC-L-007** | Concurrency | Single-user operation only; no multi-user or authentication | Scope limitation to simplify architecture; aligns with 75 person-hour budget | All Team Members | Scope Definition (EX-1, EX-2), All FR/NFR | Web Application | All modules (no auth middleware) | IEEE 29148 (Scope Definition) | Code review: confirm no authentication logic implemented | Low | Active |
| **SWC-L-008** | Performance | Web page initial load ≤ 5 seconds on 10 Mbps broadband | User experience research: 5s max before abandonment; balances expectations with realistic network | Nurefşan Olfaz | NFR (Performance), NFR (Usability) | Web Application | Frontend (HTML/CSS), Static Assets | ISO/IEC 25010 (Performance Efficiency), W3C Web Performance | Network throttling test (10 Mbps simulation); Google Lighthouse audit | Medium | Active |
| **SWC-L-009** | Reliability | Zero data corruption during JSON write operations | File-based storage vulnerable to corruption if interrupted; ensure atomic writes with backup | Gülsüm Yıldırım | FR-4, FR-5, NFR (Reliability) | Web Application | Database Module (json\_handler.py) | ISO/IEC 25010 (Reliability, Data Integrity) | Stress test: 100 concurrent writes; simulate crash during write; verify recovery | High | Active |
| **SWC-L-010** | Security | No plaintext API key storage in source code or Git repository | Prevent exposure if repo becomes public; follow OWASP best practices; protect against unauthorized usage | All Team Members | FR-1, FR-7 (implicit security) | Web Application | Backend Config, AI Module, TTS Module | OWASP Top 10 (A02:2021), OWASP Secure Coding | Code review + static analysis (bandit/semgrep); verify .env in .gitignore; pre-commit hook | High | Active |
| **SWC-L-011** | Usability | Streak tracking: accurate 24-hour consecutive day counting | Motivational feature requires precise daily tracking; gap >24h resets streak to maintain trust | Ozan Bayer | FR-6, FR-9 | Web Application | Streak Tracker (streak\_tracker.py), Dashboard UI | ISO/IEC 25010 (Usability, User Error Protection) | Unit test: activity at 23h → continues; activity at 25h → resets; multi-day simulation | Medium | Active |
| **SWC-L-012** | Usability | TTS accent selection: British vs American English before audio synthesis | Learners have dialect preferences; OpenAI TTS supports multiple voices; enhances learning effectiveness | Ozan Bayer | FR-11 | Web Application | TTS Module (tts\_handler.py), Podcast UI | OpenAI TTS API Documentation | Integration test: generate with both accents; manual listening verification; UI dropdown test | Low | Active |
| **SWC-L-013** | Resource | JSON database file size limit: 10 MB maximum | Avg entry 2 KB → 10 MB = 5,000 words; file I/O degrades beyond 10 MB; typical usage 500-1,000 words | Gülsüm Yıldırım | FR-4 | Web Application | Database (vocabulary.json) | IEEE 29148 (Storage Limits) | Load test: add 5,000+ entries; measure read/write at 5 MB, 8 MB, 10 MB | Low | Proposed |
| **SWC-L-014** | Maintainability | Code documentation coverage ≥ 60%; docstrings for all functions | Ensure readability for team and future maintenance; facilitate knowledge transfer | All Team Members | Project Success Criteria (Technical Quality) | All modules | Entire codebase (backend/, frontend/) | ISO/IEC 25010 (Maintainability), PEP 257 (Docstrings) | Automated coverage tool (pydocstyle, interrogate); code review checklist | Medium | Active |
| **SWC-L-015** | Compatibility | Flask backend compatible with Python ≥ 3.8 | Stable Flask 2.x support; library compatibility (OpenAI SDK); balances modern features with deployment | Gülsüm Yıldırım | Technical Stack (Python Flask) | Web Application |  |  |  |  |  |

Approval & Control

|  |  |  |  |
| --- | --- | --- | --- |
| Role | Name | Signature | Date |
| Backend Lead | Gülsüm Yıldırım |  | Nov 15, 2025 |
| Frontend Lead | Nurefşan Olfaz |  | Nov 15, 2025 |
| AI Integration Lead | Ozan Bayer |  | Nov 15, 2025 |

**Notes**

**Total Constraints Identified:** 15  
**Critical Constraints:** 1 (SWC-L-004: Budget)  
**High Priority Constraints:** 5 (SWC-L-001, SWC-L-003, SWC-L-009, SWC-L-010, SWC-L-011)  
**Medium Priority Constraints:** 6  
**Low Priority Constraints:** 3

**Standards Referenced:**

* IEEE 29148 (Software Requirements Specification)
* ISO/IEC 25010 (Systems and Software Quality Models)
* OWASP Top 10 (Web Application Security)
* W3C Web Standards (Responsive Design, Performance)
* RFC 8259 (JSON Data Interchange Format)
* PEP 8, PEP 257 (Python Coding Standards)