**Software Testing Document (STD)**

**Project:** BoardCast – Real-Time Whiteboard Transcription System

**1 Purpose**

This document defines the full automated test suite for BoardCast. It lists every test, its objective, and the expected result, verifying the functionality of the project.

**2. Scope**

* **Unit tests (UT-01 … UT-18)** – Validate individual functions in isolation.
* **Integration tests (IT-19 … IT-22)** – Verify interaction with live NVIDIA OCR and Gemini APIs.
* **Performance test (PT-23)** – Measure frame-processing speed.
* **Edge-case tests (EC-24 … EC-25)** – Confirm graceful handling of boundary conditions.

**3. Test Environment**

| **Component** | **Version / Requirement** |
| --- | --- |
| Python | 3.10+ |
| Flask | 2.0+ |
| FFmpeg | Installed and in PATH |
| APIs | NVIDIA\_API\_KEY, GEMINI\_API\_KEY\_API\_KEY (for integration) |
| Test runner | pytest |

**4. Test Summary**

| **Category** | **Tests** | **Pass Criterion** |
| --- | --- | --- |
| Unit | 18 | All assertions succeed, no exceptions raised |
| Integration | 4 | Live API calls return valid, non-error responses |
| Performance | 1 | 50 frames processed in < 5 s |
| Edge Case | 2 | Correct fallback or empty outputs |

**5. Detailed Test Cases**

**5.1 Unit Tests:**

| **ID** | **Test Name** | **Purpose** | **Expected Result** |
| --- | --- | --- | --- |
| **UT-01** | test\_check\_api\_keys\_valid | Confirm valid keys are accepted | (True, "") |
| **UT-02** | test\_check\_api\_keys\_invalid | Reject placeholder keys | (False, "...key not set") |
| **UT-03** | test\_get\_optimal\_workers\_low\_end | Worker count on 2-core host | 4 workers |
| **UT-04** | test\_get\_optimal\_workers\_high\_end | Worker cap on 16-core host | 20 workers |
| **UT-05** | test\_prepare\_image\_valid\_pil\_image | Base64 encode a PIL image | (True, <non-empty string>) |
| **UT-06** | test\_prepare\_image\_invalid\_input | Handle non-image input | (False, "Failed to process image") |
| **UT-07** | test\_nvidia\_transcribe\_image\_success | Mock successful OCR | Text “2x + 3 = 7 …” |
| **UT-08** | test\_nvidia\_transcribe\_image\_api\_failure | Mock request error | Message contains "API request failed" |
| **UT-09** | test\_nvidia\_transcribe\_image\_no\_api\_key | No key provided | Graceful error string |
| **UT-10** | test\_process\_frame\_with\_order | Maintain frame order | (frame\_no, "Test transcription") |
| **UT-11** | test\_process\_video\_frames\_parallel\_success | Parallel frame processing | Five identical "Test text" results |
| **UT-12** | test\_process\_frames\_with\_gemini\_success | Mock Gemini cleanup | "Cleaned and organized transcription text" |
| **UT-13** | test\_process\_frames\_with\_gemini\_no\_api\_key | Missing Gemini key | Raises ValueError |
| **UT-14** | test\_health\_check\_endpoint | /health status route | HTTP 200, JSON {status:"healthy", ...} |
| **UT-15** | test\_upload\_endpoint\_no\_file | /upload with no file | HTTP 400, JSON {error:"No file uploaded"} |
| **UT-16** | test\_check\_dependencies\_valid | FFmpeg present | No exception |
| **UT-17** | test\_check\_dependencies\_missing | FFmpeg absent | Raises DependencyError |
| **UT-18** | test\_make\_api\_request\_success | First-try API call | JSON {"choices":[{"message":{"content":"Success"}}]} |

**5.2 Integration Tests:**

| **ID** | **Test Name** | **Purpose** | **Expected Result** |
| --- | --- | --- | --- |
| **IT-19** | test\_nvidia\_real\_api\_integration | Real NVIDIA OCR call | Returns non-error string |
| **IT-20** | test\_gemini\_integration\_real\_api | Real Gemini cleanup | Returns non-empty string |
| **IT-21** | test\_empty\_input\_real\_api | Gemini with empty input | "No frame texts provided for processing" |
| **IT-22** | test\_full\_pipeline\_real\_apis | End-to-end OCR to Gemini | Final cleaned text string |

**5.3 Performance Test**

| **ID** | **Test Name** | **Purpose** | **Expected Result** |
| --- | --- | --- | --- |
| **PT-23** | test\_large\_frame\_processing\_performance | 50 frames, 4 workers | < 5 s total, 50 outputs |

**5.4 Edge-Case Tests**

| **ID** | **Test Name** | **Purpose** | **Expected Result** |
| --- | --- | --- | --- |
| **EC-24** | test\_empty\_frame\_list\_processing | No frames supplied | Returns [] |
| **EC-25** | test\_single\_frame\_processing | One frame supplied | ["Single frame text"] |