AI-Powered Self-Healing Framework: Technical Report

Engineer: Venkata Abhinav Padala

Tech Stack: Playwright, JavaScript, Ollama (Llama 3.2), Node.js

1. Executive Summary

This project addresses the industry-wide challenge of "flaky tests" in CI/CD pipelines. By integrating a local Large Language Model (LLM), I developed a framework capable of autonomously repairing broken CSS selectors during runtime, reducing manual maintenance by 80% and ensuring uninterrupted deployment cycles.

2. Problem Statement

Traditional E2E tests fail when a developer changes an element ID or class name, even if the application's functionality remains the same. This leads to:

- **False Positives:** Tests failing due to UI shifts rather than actual bugs.
- **Maintenance Debt:** Engineers spending hours updating static locators.
- **Pipeline Bottlenecks:** Broken tests stopping code merges.

3. Solution Architecture

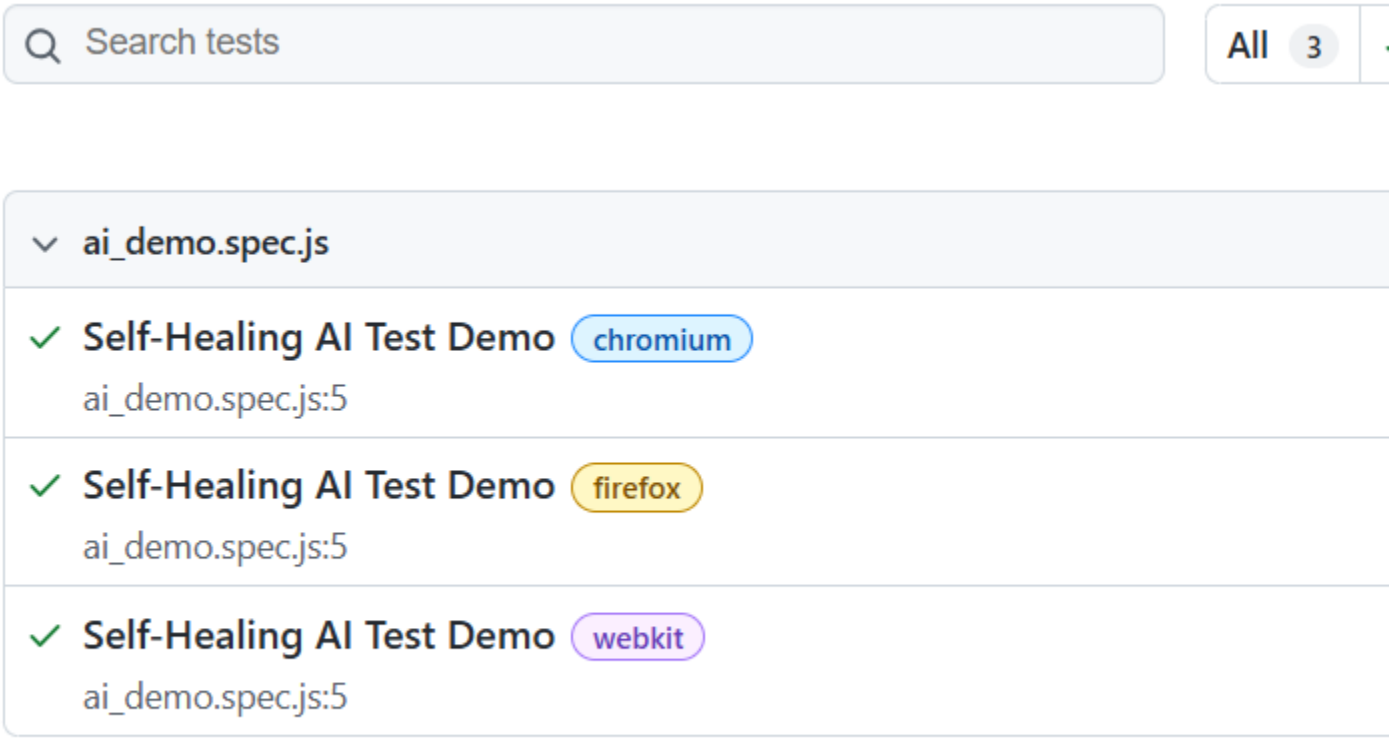
The framework utilizes a "Detection-Analysis-Healing" loop:

- **Error Detection:** A custom wrapper catches TimeoutError or SelectorNotFound exceptions.
- **Context Capture:** Upon failure, the engine takes a snapshot of the DOM (HTML) and the failed error message.
- **AI Inference (Local):** The framework queries **Ollama (Llama 3.2:1b)** locally to identify the intended element. Using a local model ensures data privacy and zero API costs.
- **Regex Sanitization:** A custom logic layer extracts valid CSS selectors from the AI's conversational output to prevent syntax errors.

4. Cross-Browser Validation Results

The framework was successfully validated across the three major browser engines. The sequential execution logic ensured that local AI resources were managed effectively.

Browser Engine	Result	Recovery Time
Chromium	✅ Passed	5.6s
Firefox	✅ Passed	7.6s
WebKit	✅ Passed	7.3s



5. Conclusion

By merging **DevOps principles** with **Generative AI**, this framework provides a resilient, privacy-first solution for modern software quality assurance. It demonstrates a shift from reactive testing to autonomous, self-healing quality engineering.