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# UI Surgeon: Precision Web UI Manipulation and AI-Driven Styling

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A Technical White Paper on Real-Time DOM Surgery and Accessibility Compliance

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Chrome Extension Link:

https://chromewebstore.google.com/detail/peddiakhlgofpljhapajlnmeljamcgga?utm_sour ce=item-share-cb

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**ABSTRACT**

This paper explores the development and architecture of **UI Surgeon**, a professional-grade Chrome extension designed to eliminate technical friction in the UI/UX lifecycle. By leveraging the **Chrome Debugger API** for deep CSS inspection and **Gemini-powered GenAI** for context-aware styling, the platform enables Developers, Product Owners, and BAs to surgically audit and prototype live web interfaces. The following sections provide an end-to-end technical breakdown of its Manifest V3 architecture, accessibility auditing
methodology, and AI-assisted design optimization.

**Keywords:** Chrome Extension, CSS Inspection, Gemini AI, WCAG Compliance, DOM Manipulation

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## 1. INTRODUCTION

Modern web development often suffers from "DevTools fatigue," where finding specific CSS rules in deeply nested DOM trees delays rapid prototyping. UI Surgeon addresses this by providing a clean, persistent **Side Panel** interface that allows users to "operate" on live UI elements with 100% precision. This paper details how the system transforms natural
design intent into live, injectable code.

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## 2. THE CORE CHALLENGE

- **DOM Complexity:** Modern frameworks generate highly nested code, making manual CSS auditing time-consuming.
- **Static Prototyping:** Testing "copy-fit" or layout changes usually requires local environment setups or staging deployments.
- **Accessibility Afterthought:** WCAG compliance is often checked post-production rather than during the design audit phase.

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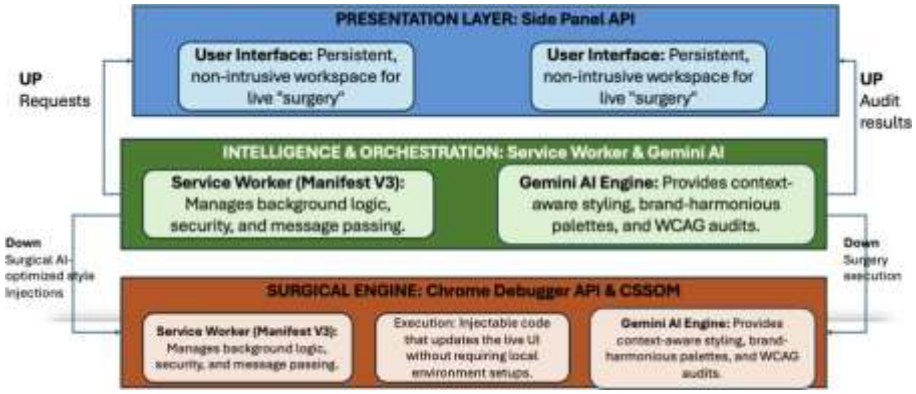
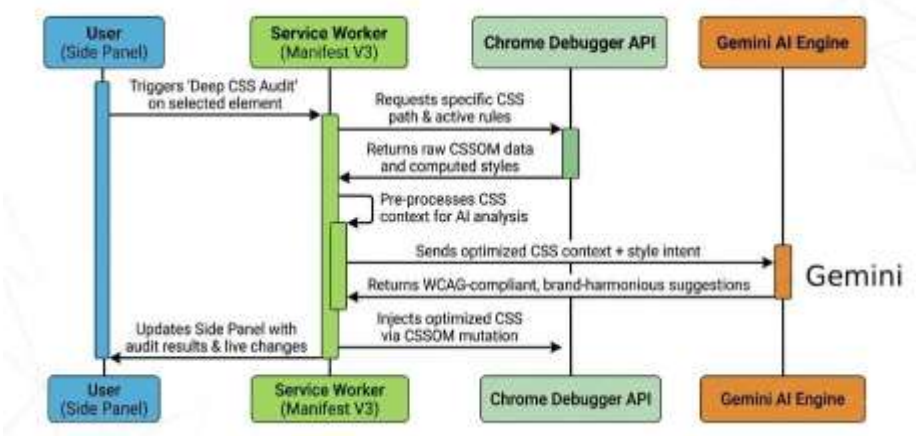
## 3. SYSTEM ARCHITECTURE

**The Stacked Architecture Diagram**




Sequential Diagram




### 3.1 Manifest V3 Framework

UI Surgeon is built on **Manifest V3**, ensuring high performance and security.

- **Service Worker:** Manages background logic and coordinates API calls between the UI and the browser.
- **Side Panel API:** Offers a non-intrusive workspace that remains open while the user navigates different tabs.

### 3.2 Precision Inspection Engine

The extension utilizes the **Chrome Debugger API** to fetch accurate computed styles. Unlike standard inspectors, this "surgical" approach identifies the exact CSS path and active rules, allowing for direct mutation of the CSSOM.

### 3.3 Intelligence Layer (Gemini AI)

The **Gemini AI Engine** is integrated to provide:

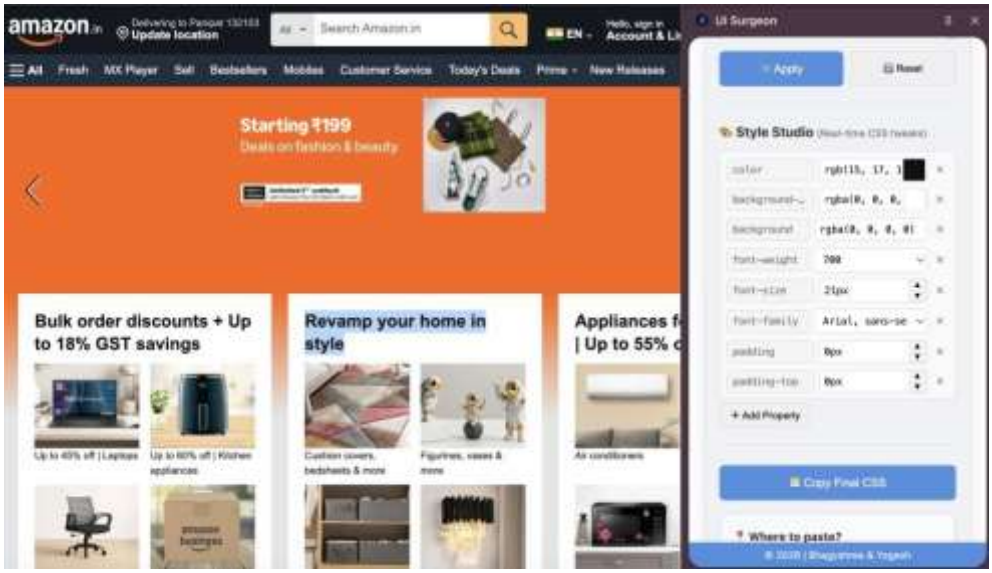
- **Style Suggestions:** Analysis of existing brand palettes to suggest harmonious, accessible alternatives.
- **Context-Aware Audits:** Identifying potential layout breaks or contrast issues before they hit production.

## 4. KEY FEATURES s IMPLEMENTATION

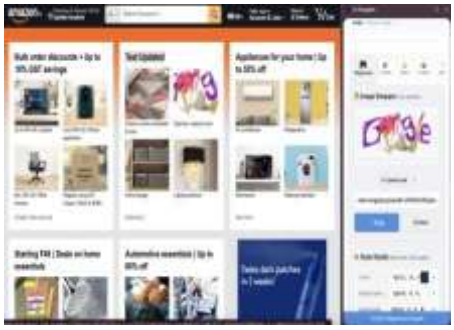
| Feature | Technical Implementation | Outcome |
|---|---|---|
| **Surgical CSS Inspection** | Debugger API + CSSOM Injection | 100% accurate rule identification and live editing. |
| **Smart Content Swapper** | DOM Text/Image Mutation | Instant "copy-fit" testing without staging builds. |
| **Accessibility Audit** | WCAG 2.1 Contrast Checker | Real-time AA/AAA compliance verification. |
| **Feature** | **Technical Implementation** | **Outcome** |
| **VS Code Integration** | Clipboard API + Query Generation | Seamless handoff from browser prototype to source code. |

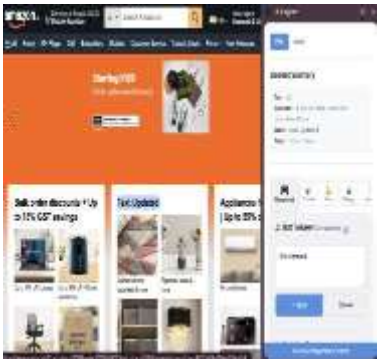
## 5. USE CASE VALIDATION

- **Developers:** Use the **Deep CSS Inspector** for rapid layout debugging and rapid prototyping of fixes.




- **Product Owners s BAs:** Use the **Content Swapper** to demonstrate new copy or images to stakeholders in seconds.





- **Designers:** Conduct **Accessibility Audits** on live builds to ensure brand inclusive standards are met.


## 6. CONCLUSION

UI Surgeon redefines the browser as a precision instrument for UI surgery. By combining low-level browser APIs with high-level AI intelligence, it significantly reduces the time from design audit to production-ready code. The POC confirms that AI-assisted styling and live DOM manipulation are essential for the next generation of developer productivity tools.