# 🛠️ Architectural Alchemist: Engineering & Design Roadmap

## Week 1: Infrastructure & "Safety-First" Compliance

**Goal:** Establish the Google Cloud backbone and pass the AUP (Acceptable Use Policy) check.

* **Task 1.1: GCP Project Provisioning**
  + Create a new Google Cloud Project.
  + Enable APIs: Vertex AI, Gemini Multimodal Live API, Cloud Run, and Cloud Vision.
* **Task 1.2: The "Privacy Shield" (AUP Requirement)**
  + Develop a Cloud Run microservice using **Vertex AI Vision**.
  + Logic: Detect human presence in the stream. If a face is detected, apply a Gaussian blur filter before the frame reaches the Gemini reasoning engine.
* **Task 1.3: Authentication & Hosting**
  + Initialize **Firebase Hosting**.
  + Set up **Firebase Authentication** (Anonymous login) to satisfy the "Auth Before Queries" requirement for future storage needs.

## Week 2: Design Identity & SpaceX UI

**Goal:** Use AI to build a "Grade A" visual interface.

* **Task 2.1: Brand Synthesis**
  + Use AI logo tools to create the "Alchemist" vector mark.
  + Design a "SpaceX-Minimalist" dashboard: Deep charcoal (#121212), Electric Cyan (#00f3ff), and semi-transparent blur overlays.
* **Task 2.2: Dynamic Color Palette Engine**
  + Build a utility: Upload a room photo → Extract dominant colors → Generate a **Tailwind CSS configuration** that complements the existing physical space.
* **Task 2.3: Frontend Foundation**
  + Scaffold Next.js app with **Tailwind CSS**.
  + Implement "Glassmorphism" components (frosted glass panels for AI text output).

## Week 3: The Live Agent "Brain" (ADK & Live API)

**Goal:** Master the Multimodal Live API and Interruption logic.

* **Task 3.1: WebRTC Integration**
  + Use the **Google GenAI SDK** to establish a bidirectional stream for video/audio.
  + Implement **Exponential Backoff** for API connection retries (as per best practices).
* **Task 3.2: ADK State Management**
  + Implement the **Agent Development Kit (ADK)** to manage the "Designer State Machine."
  + States: IDLE -> LISTENING -> ANALYZING\_SPACE -> GENERATING\_PREVIEW.
* **Task 3.3: Interruption Handling**
  + Configure the Live API to allow the user to cut the agent off.
  + *Scenario:* User says "Replace this wall—", Agent starts describing marble, User interrupts: "No, make it glass!" Agent must pivot instantly.

## Week 4: Spatial Reasoning & Veo Generation

**Goal:** The "Wow Factor"—Digital Demolition.

* **Task 4.1: Spatial Pointing (Tools)**
  + Define a tool/function call: identify\_surface(coordinates, surface\_type).
  + Gemini uses the vision stream to return the specific 2D coordinates of the wall to be replaced.
* **Task 4.2: Veo Video Pipeline**
  + Connect to **Google Veo** via Vertex AI Model Garden.
  + Prompt Engineering: "Photorealistic [View Name] seen through a modern architectural window, cinematic lighting, 4k, moving clouds."
* **Task 4.3: The "Alchemical" Transition**
  + Use **Framer Motion** to create a CSS transition where the real-time video "dissolves" into the Veo-generated video.

## Week 5: Cloud Persistence (Firestore & Data)

**Goal:** Implement storage using the "Three Mandatory Rules" for the contest.

* **Task 5.1: Private Data Storage**
  + Implement **Firestore** using the mandatory path: /artifacts/{appId}/users/{userId}/designs.
  + Save "Snapshots" of remodeled rooms (metadata + image URI).
* **Task 5.2: Public Gallery**
  + Create a "Community Inspo" feed using the path: /artifacts/{appId}/public/data/showcase.
  + Ensure all queries are simple collection() calls (no complex orderBy or where to avoid index issues).

## Week 6: Showcase & Judge Preparation

**Goal:** Documentation and Demo.

* **Task 6.1: The "One-Take" Demo**
  + Record a walkthrough: "Point phone at wall → Voice command → Wall disappears into a space view → Walk closer."
* **Task 6.2: Technical Documentation (Portfolio)**
  + Translate technical jargon (e.g., "Multimodal Latency") into easy-to-understand descriptions.
  + Highlight the use of Google Cloud services to fulfill contest categories.
* **Task 6.3: Submission**
  + Finalize the Devpost/Contest entry with the Architecture Diagram and Video.