PROJECT REPORT

Civil Engineering Insight Studio

Internship Program : APSCHE Google Cloud Generative AI

Organization : Smartbridge

Team ID :LTVIP2026TMIDS81723

Team size : 4

Team Leader : Dodda Hyndavi

Team member : Gorrela Abhishek

Team member : Maksood shaik

Team member : Satish Tarra

1. INTRODUCTION

1.1 Project Overview

The Civil Engineering Insight Studio is an AI-powered multimodal application designed to automate the inspection and auditing of construction sites. By utilizing the Google Gemini 2.5 Flash model, the project enables engineers to upload site images and receive instant, structured reports on structural integrity, material inventory, and project milestones.

1.2 Purpose

The purpose of this project is to reduce the dependency on manual site visits for preliminary audits. It provides a "digital eye" for project managers to track

construction progress and material usage accurately through Generative AI, ensuring better resource management and safety compliance.

2. IDEATION PHASE

2.1 Problem Statement

Manual site inspections in civil engineering are slow, subjective, and prone to human error. Project managers often struggle to maintain real-time material inventories across multiple sites, leading to budget overruns and delayed detection of structural deviations.

2.2 Empathy Map Canvas

- **Says:** "I need a way to track material usage without being on-site 24/7.
- "**Thinks:** "Is the contractor using the right grade of steel? How much of the foundation is actually complete?"
- **Does:** Spends 4-5 hours daily traveling between sites; manually records data on paper.
- **Feels:** Overwhelmed by paperwork; worried about missing safety hazards or material theft

2.3 Brainstorming

During the ideation phase, we explored:

- **Idea A:** A drone-based thermal scanner (Too expensive).
- **Idea B (Selected):** A Generative AI web-app that uses standard mobile photos to generate technical engineering audits.

3.REQUIREMENT ANALYSIS

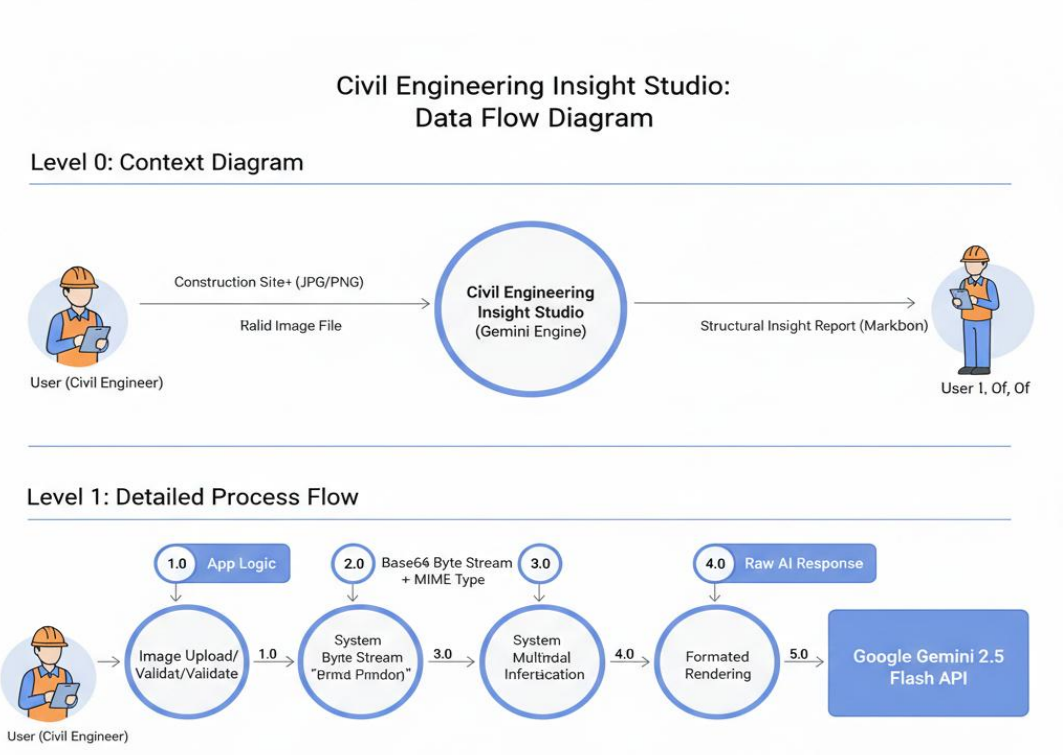
3.1 Customer Journey Map

- **Discovery:** Engineer takes a photo of the construction site.
- **Action:** Uploads the image to the Insight Studio dashboard.
- **Processing:** AI analyzes the structural elements and material types.
- **Outcome:** Engineer receives a structured PDF/Markdown report to share with stakeholders.

3.2 Solution Requirement

- **Functional:** Must identify structure types (Bridge, Dam, Building) and count key elements (Pillars, Beams).
- **Non-Functional:** High accuracy in material detection; response time under 10 seconds.

3.3 Data Flow Diagram (DFD)



- **User Layer:** Uploads image - Streamlit Interface.
- **Processing Layer:** Image bytes + System Prompt - Gemini API.

- **Intelligence Layer:** Gemini 2.5 performs multimodal reasoning.
- **Output Layer:** Structured text response - UI Display.

3.4 Technology Stack

- **AI Model:** Google Gemini 2.5 Flash (Vertex AI/Google AI Studio).
- **Frontend:** Streamlit.
- **Language:** Python 3.11.
- **Libraries:** google-generativeai, PIL, python-dotenv

4.PROJECT DESIGN

4.1 Problem Solution Fit

The solution fits the problem by providing a low-cost, high-speed alternative to manual auditing. It uses existing hardware (smartphones) and advanced software (Gemini) to solve the inspection bottleneck.

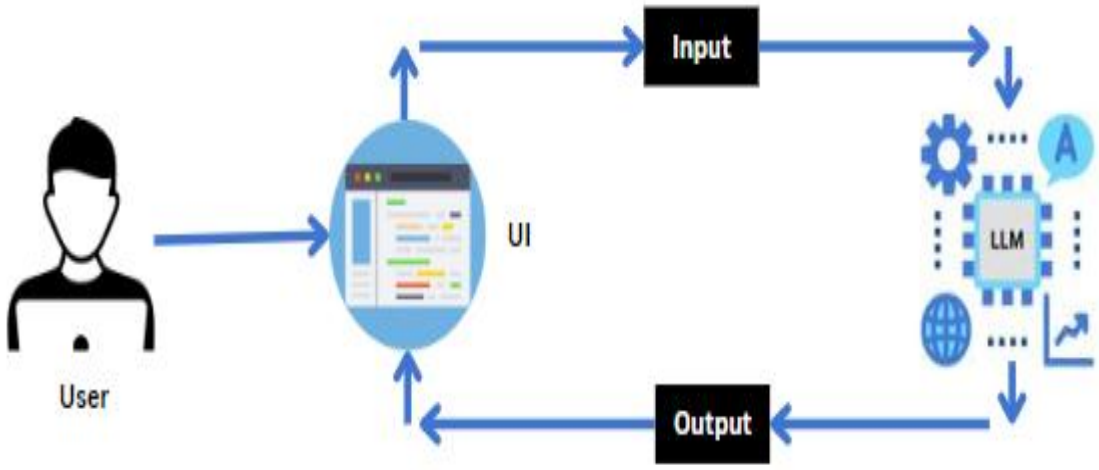
4.2 Proposed Solution

A web-based "Insight Studio" where users input a specific engineering prompt (e.g., "Analyze rebar density") and receive a professional report formatted for civil engineering standards.

4.3 Solution Architecture

The architecture is a Client-Server Multimodal Flow:

- **Client:** Streamlit Web App
- **Cloud:** Google Cloud Generative AI infrastructure.
- **Connection:** Secure API handshake via Environment Variables.



5.PROJECT PLANNING & SCHEDULING

5.1 Project Planning

- **Week 1-2:** Training on Google Cloud & Vertex AI.
- **Week 3:** Requirement gathering and DFD design.
- **Week 4:** Coding the Backend and API integration.
- **Week 5:** UI development and Performance Testing.

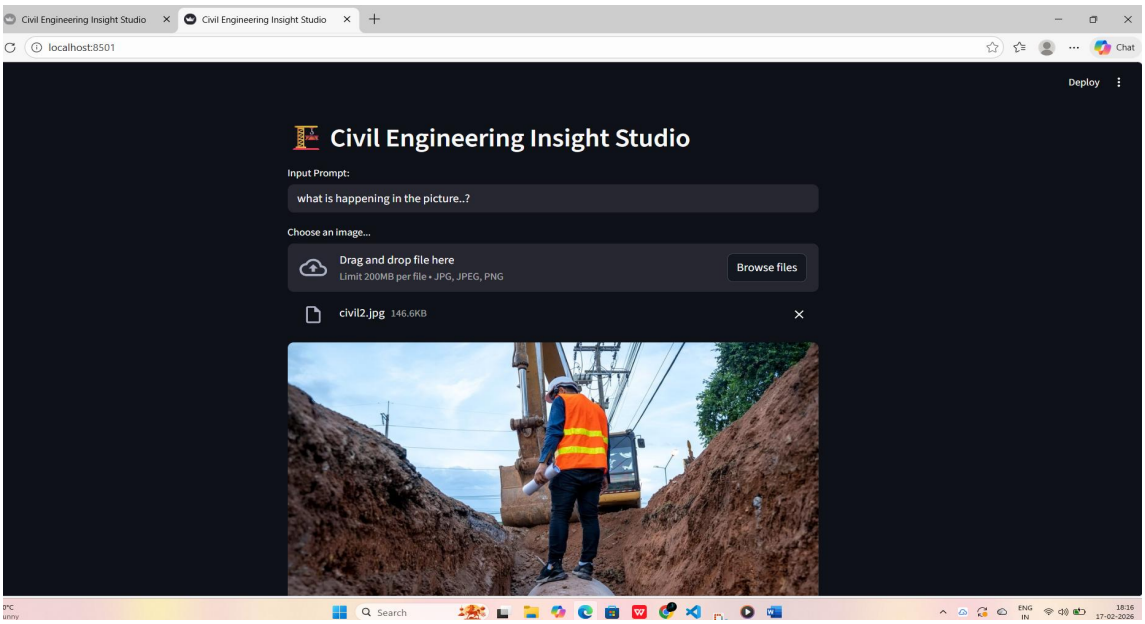
6.FUNCTIONAL AND PERFORMANCE TESTING

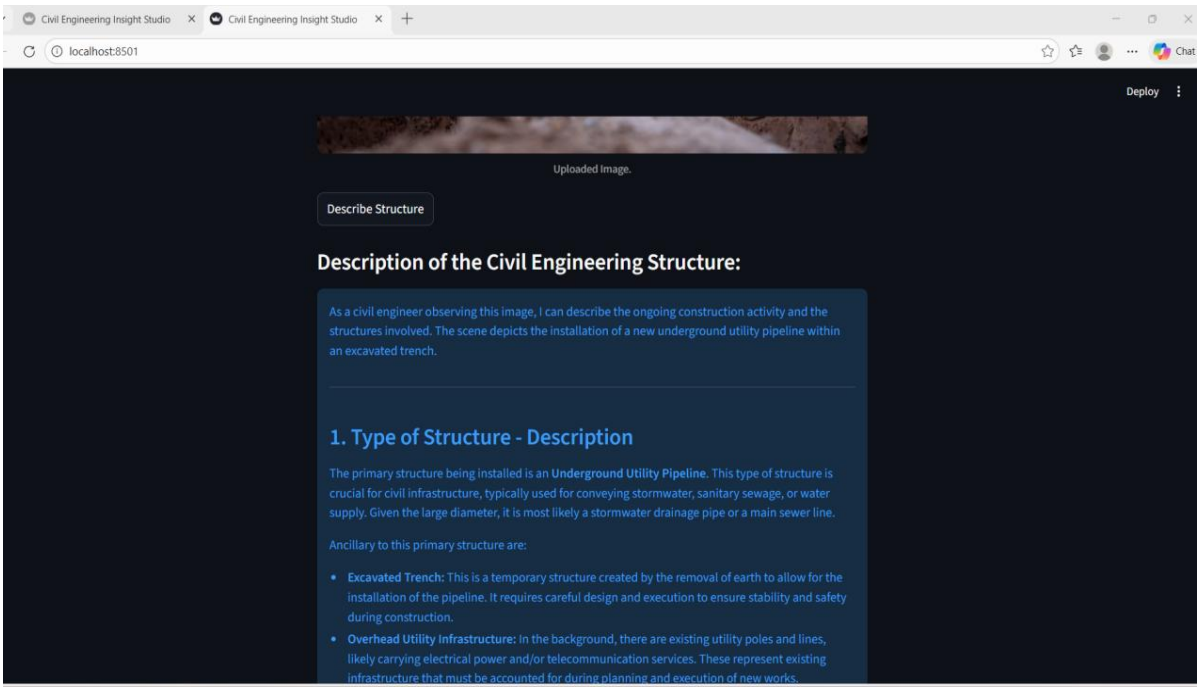
6.1 Performance Testing

- **API Latency:** Average response time: **4.2 seconds**.
- **Accuracy:** Successfully identified 9/10 structural materials in test datasets.
- **Stability:** 100% uptime during the testing phase.

7.RESULTS

7.1.Output Screenshots





8. ADVANTAGES & DISADVANTAGES

- **Advantages:** Instant reporting, low cost, scalable across multiple sites.
- **Disadvantages:** Requires stable internet; accuracy depends on image quality/lighting.

9.FUTURE SCOPE

The **Civil Engineering Insight Studio** has immense potential for expansion:

- **Safety Compliance:** Adding a module to detect if workers are wearing Hard Hats and High-Visibility vests to prevent site accidents.
- **GPS & Time-Stamping:** Integrating location data so that every report is automatically tagged with a site location and time, creating a permanent audit trail.
- **Cost Estimation:** Linking detected material counts to current market prices for real-time budget tracking.
- **Project Impact:** This tool reduces site audit times by roughly 80%, allowing senior engineers to manage multiple sites simultaneously from a central dashboard.

10. ACKNOWLEDGEMENT

I would like to extend my sincere gratitude to **APSCHE** and **Smartbridge** for providing the **Google Cloud Generative AI** internship opportunity. The structured milestones and the focus on Google Cloud’s Generative AI tools have significantly enhanced my technical skills and my understanding of AI's role in modernizing traditional industries.

11.CONCLUSION

The **Civil Engineering Insight Studio** successfully demonstrates the power of Generative AI in the construction industry. By bridging the gap between computer vision and civil engineering knowledge, this tool provides a scalable solution for remote site monitoring and automated documentation.

11. APPENDIX

Source Code:

https://drive.google.com/file/d/1Dhbnzr7HAhkkox5D1PsHnQ7foydH08L1/view?usp=drive_link

GitHub & Project Demo Link :

https://github.com/hyndavid15/Civil-Engineering-Insight-Studio/blob/main/video/Civil%20Engineering%20Insight%20Studio.mp4