Civil Engineering Insight Studio: AI-Based Structural Analysis Using Multimodal Generative Models

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Abstract— Civil engineering structures are essential components of modern infrastructure, requiring accurate analysis and documentation. This paper presents Civil Engineering Insight Studio, an artificial intelligence-based web application that analyzes images of civil engineering structures and generates detailed engineering descriptions. The system integrates Google's Gemini multimodal generative model with a Streamlit-based web interface to process both textual prompts and structural images. The application automatically identifies structure type, materials, construction methods, dimensions, and notable features. This tool serves as an educational and analytical aid for students, engineers, and researchers by providing rapid, automated insights into infrastructure components.

Keywords— Generative AI, Civil Engineering, Multimodal AI, Structure Analysis, Image Processing, Infrastructure, Streamlit, Gemini Model

I. INTRODUCTION

Civil engineering structures such as bridges, buildings, dams, and highways form the backbone of infrastructure development. Traditional analysis methods require expert knowledge and manual inspection. Recent advancements in artificial intelligence, particularly Generative AI, enable automated interpretation of visual data. Multimodal AI models can process both images and text, making them suitable for infrastructure analysis tasks.

II. METHODOLOGY

The system accepts a textual prompt and an image of a civil engineering structure. The image is processed into a suitable format and combined with the prompt. The Gemini 1.5 Flash multimodal model analyzes the input to generate detailed descriptions including structure type, materials used, construction methods, dimensions, engineering challenges, and notable features.

III. IMPLEMENTATION

The application is developed using Python and deployed with Streamlit. Google Generative AI SDK enables communication with the Gemini model. Pillow handles image processing, while python-dotenv manages secure API key storage. The system runs locally and is accessible through a web browser.

IV. APPLICATIONS

- Educational tool for civil engineering students
- Preliminary infrastructure analysis
- Technical documentation support
- AI demonstration for engineering domains

V. CONCLUSION

Civil Engineering Insight Studio demonstrates the potential of multimodal generative AI in infrastructure analysis. By combining computer vision and natural language processing, the system provides automated insights into civil engineering structures, assisting students and engineers in understanding complex structural information efficiently.

REFERENCES

[1] Google Generative AI Documentation — https://ai.google.dev
[2] Streamlit Documentation — https://streamlit.io
[3] Generative Artificial Intelligence — Wikipedia