CHEMVR: AN INTERACTIVE 3D PLATFORM FOR GAMIFIED CHEMISTRY EDUCATION

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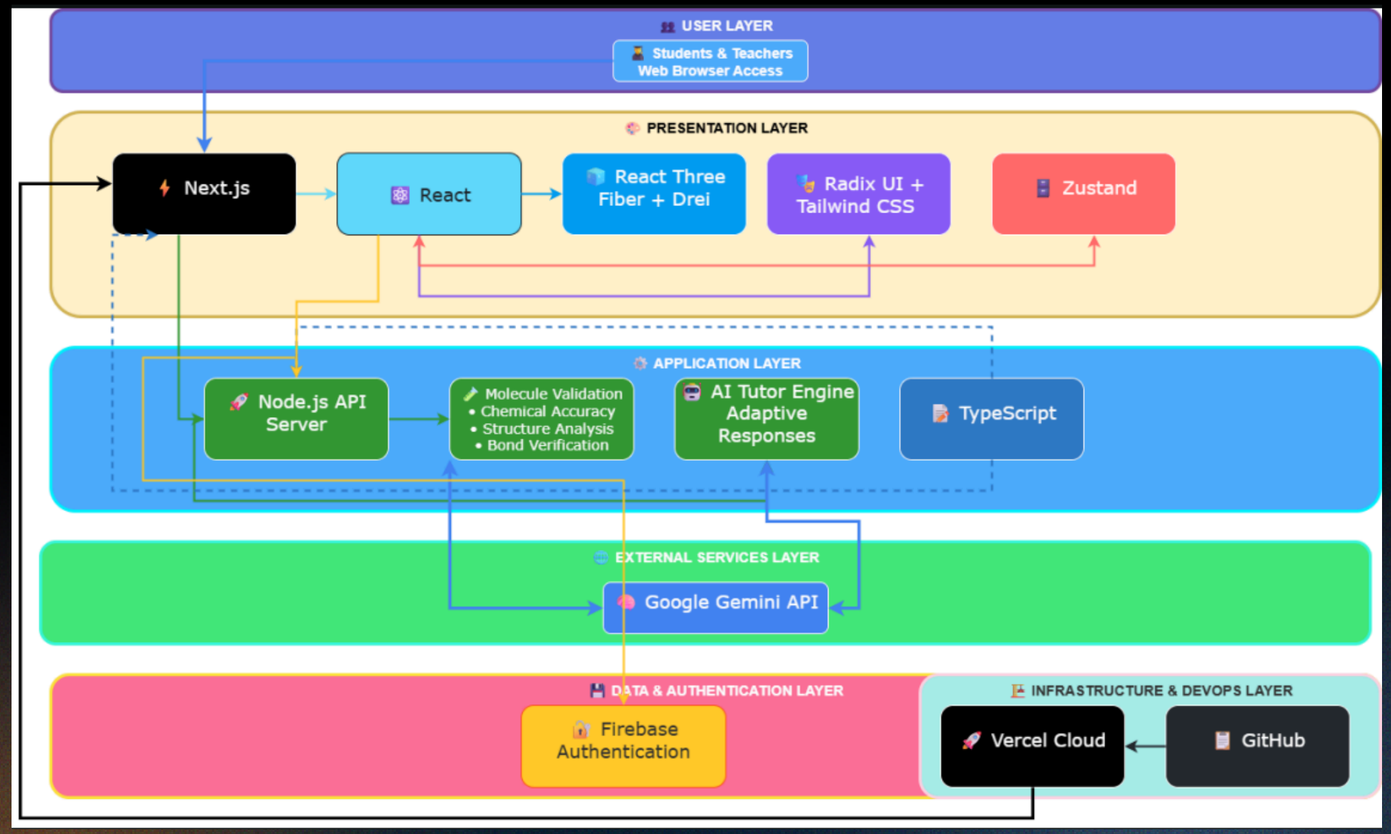
01 ARCHITECTURE DIAGRAM



- Frontend: Next.js, React, React Three Fiber (for 3D), and Tailwind CSS.
- Backend: Node.js server (Next.js API routes) for application logic.
- AI & Validation: Business logic for molecule validation and AI tutor powered by the Google Gemini API.
- Authentication: Firebase for secure user login and management.
- Infrastructure: Hosted on Vercel, with the CI/CD pipeline managed by GitHub Actions.

02 PIPELINE FLOW

← CI/CD

Adding grafana and Prometheus for monitoring #17

Re-run all jobs

Summary

Jobs

Build and Deploy

Run details

Usage

Workflow file

Build and Deploy

succeeded 7 hours ago in 1m 51s

Search logs

Set up job	2s
Checkout repository	0s
Setup Node.js	3s
Setup pnpm	2s
Install dependencies	9s
Build	31s
Run tests (if you add them later)	0s
Deploy to Vercel	1m 2s
Post Setup pnpm	0s
Post Setup Node.js	0s
Post Checkout repository	1s
Complete job	0s

03 CHALLENGES

- Effective AI Prompt Engineering Crafting prompts to make the AI a true tutor was a major challenge. We had to iterate extensively to guide the AI to provide insightful hints based on the user's actions, rather than just giving away the correct answer, ensuring it facilitated learning.
- Real-Time Performance Optimization The application performs real-time chemical validation as users build molecules. Optimizing these complex calculations to run instantly was crucial to prevent UI lag and maintain a fluid, responsive interface for the user.
- Seamless DevOps Tool Integration Building a fully automated CI/CD pipeline required integrating multiple platforms like GitHub Actions, Docker, and Kubernetes. The challenge was scripting a seamless workflow to ensure that a code push would automatically and reliably trigger the entire deployment process.

04 LESSON LEARNED

- A Modular Architecture is Essential A clean, modular architecture was non-negotiable for managing the project's complexity. Separating concerns allowed our team to work in parallel and made the entire application more scalable, maintainable, and resilient.

- Automation is a Development Accelerator Investing in a solid CI/CD pipeline paid off immensely by accelerating our development cycle. Automating deployments reduced human error, allowed for faster iteration, and freed up our team to focus on building features rather than managing infrastructure.

- AI Should Guide, Not Just Answer We learned that the AI's greatest value in an educational tool is its ability to guide discovery. By framing the AI as a Socratic tutor that asks questions, we empowered users to think critically and solve problems on their own.

THANK YOU