Project: ChemE Research Companion
Student: Shivanee Shrivas
Department: Chemical
Institute: IIT Kanpur
GitHub Repo: https://github.com/ShivaneeShrivas/Shivanee_iitk_sde

---

1. Introduction

The **ChemE Research Companion** is an intelligent agent designed to assist **Chemical Engineering students and researchers** in generating, structuring, and documenting experimental reports and literature reviews using AI.

This system leverages **LLM (Gemini API)** for natural language processing and provides:

- Automated formatting of lab notes into structured reports.
- Literature review generation.
- Sustainability and safety notes.
- Real-time chatbot guidance via **ChemBot**.

---

2. Problem Statement

Engineering students spend extensive time manually writing reports, summarizing experiments, and preparing documentation.
This project aims to:

- Reduce manual effort.
- Enhance documentation accuracy.
- Integrate sustainability and safety awareness into technical writing.
- Provide an interactive assistant for research-related queries.

---

3. Component Breakdown

index.html	Defines the web interface for report generation and chatbot
style.css	Handles responsive design and clean UI layout
script.js	Implements Ai interaction logic, handles user input, and updates UI
server.js	Backened server that connects to the Gemini API
.env	Stores API key securely
doc	Stores project documentation

---

4. Data Design

Input Data

- Raw lab notes or text data (temperature, time, materials, yields).
- Report type selection (daily, experimental, literature review).
- Optional flags for adding sustainability and safety notes.

Processing

- Data sent from frontend to backend.
- Backend packages data as prompt → Gemini API.
- Gemini returns structured report text.

Output Data

- AI-generated structured text.

- Downloadable PDF or copyable report.
- Interactive Q&A with ChemBot.

---

5. Technology Stack

- **Frontend**
    - **Technology:** HTML5, CSS3, JavaScript
    - **Purpose:** Build the user interface for report generation and chatbot interaction
- **Backend**
    - **Technology:** Node.js + Express
    - **Purpose:** Create a local API service that handles requests from the frontend and communicates with the AI model
- **AI Layer**
    - **Technology:** Gemini API (Google Generative Language)
    - **Purpose:** Generate intelligent, structured responses and reports based on user inputs
- **Environment Management**
    - **Technology:** dotenv
    - **Purpose:** Securely manage environment variables such as API keys
- **Version Control**
    - **Technology:** Git + GitHub
    - **Purpose:** Maintain version control, enable collaboration, and host project source code online

---

6. UI/UX Design

Design Goals

- Minimalist layout with a **scientific dashboard aesthetic**.
- Intuitive input areas and clearly labeled buttons.
- Floating **ChemBot** icon for conversation access.
- Dark/Light mode support.

Key Screens

1. **Main Dashboard**
    - Report Type Dropdown
    - Notes Input Area
    - Output Display
    - Sustainability / Safety options
2. **ChemBot Chat Panel**
    - Floating icon → Opens chat modal
    - Live conversation with memory

---

7. Chosen Technologies & Justification

Technology	Reason for Selection
Node.js	Lightweight and ideal for quick API setup
Express.js	Simplifies routing and API handling
Gemini API	Provides reliable and context-aware LLM output

HTML/CSS/JS	Ensures wide compatibility and quick testing
dotenv	Securely manages environment variables

---

8. Sequence of Operations

1. User enters experimental notes in frontend.
2. `script.js` sends request to backend via `/api/generate`.
3. Backend uses API key to query Gemini.
4. Gemini returns structured, formatted text.
5. Output displayed in the **Agent Output** box.
6. User can refine text or chat with **ChemBot**.

---

9. Security & Privacy

- API key hidden using `.env` (not uploaded to GitHub).
- No persistent data storage — user input stays local.
- All processing is stateless and secure.

---

10. Social Impact

- Saves 30–40% of researcher time in report writing.
- Encourages structured scientific thinking.
- Promotes sustainability and lab safety awareness.

- Supports education through accessible AI tools.
- Reduces documentation burnout for students.

---

11. Future Improvements

- Integration with Google Scholar APIs for citation automation.
- Cloud-based data storage for experiment logs.
- Voice interface and text-to-speech for accessibility.
- Collaborative report editing.

User Interface Overview

Below is a screenshot of the **ChemE Research Companion** main interface, providing a visual representation of its intuitive design and key functionalities.