## **Real-Time Collaborative Document Editor with AI Assistance**

### **Overview**

A Google Docs–style platform that allows multiple users to edit the same document **simultaneously**, with integrated **AI-powered writing tools** such as summarization, grammar suggestions, and tone adjustments.  
The project aims to merge **collaborative editing** (powered by CRDTs or OT algorithms) with **real-time AI augmentation** for productivity.

### **Key Features (Planned & In Progress)**

* **Real-Time Editing** – Multi-user collaboration using WebSockets
* **Live Cursors & User Presence** – See other users’ selections and typing in real-time
* **Conflict-Free Synchronization** – CRDT or Operational Transform-based document sync
* **AI Tools**:
  + Summarize selected text
  + Grammar & spelling correction
  + Tone/style suggestions
* **Version History** – Track and revert document changes
* **Auth & Access Control** – Sign-in and document sharing with permissions

### **Tech Stack**

* **Frontend:** React.js + Tailwind CSS
* **Backend:** Node.js + Express + WebSockets
* **Database:** MongoDB (storing doc state, user info)
* **Collaboration Logic:**
  + **Option 1:** Yjs (CRDT-based)
  + **Option 2:** Custom OT implementation
* **AI Models:**
  + OpenAI API / Local LLM for summarization & grammar correction
* **Deployment:** Docker, Vercel (frontend), Railway/Render (backend)

### **Architecture Overview**

1. **Document State Server** – Maintains master copy & handles sync messages
2. **Collaboration Layer** – CRDT/OT logic ensures conflict-free merges
3. **AI Service Layer** – Sends selected text to AI endpoint and returns processed output
4. **Frontend Integration** – Toolbar buttons trigger AI actions

### **Roadmap**

**Phase 1:** Real-time editing with WebSocket sync  
**Phase 2:** Add user cursors & presence indicators  
**Phase 3:** Integrate AI summarization  
**Phase 4:** Add grammar/tone correction  
**Phase 5:** Version history + sharing permissions

### **Potential Innovative Leap**

* Integrate **real-time AI “ghost collaborator”** — an AI agent that can proactively suggest edits while multiple humans are editing
* Allow **multi-language collaborative translation mode**