Intelligent Research Discovery Assistant (IRDA)

1. Introduction

The Intelligent Research Discovery Assistant (IRDA) is an AI-driven system designed to help researchers analyze scientific documents more efficiently. The system uses Google Gemini AI to automate document understanding, extract insights, and generate new hypotheses. IRDA transforms research workflows by allowing users to upload papers, view summaries, explore knowledge graphs, and compare multiple documents.

2. Problem Statement

Researchers face three core challenges: the overwhelming volume of scientific literature, difficulty identifying relationships between concepts, and the lack of automated synthesis tools. These issues slow discovery and make research workflows inefficient. IRDA addresses these challenges by applying multimodal AI to extract structure, reveal connections, and propose new research directions.

3. Solution Overview

IRDA provides an end-to-end research analysis pipeline:

- Upload documents for automated extraction and summarization

- Visualize key relationships through knowledge graphs

- Compare multiple documents using AI-powered synthesis

- Use a context-aware chat assistant for explanations and queries

- Apply a role-based governance workflow for controlled access

4. Impact

IRDA significantly improves literature review speed, clarity, and depth. Automated summaries save time, knowledge graphs reveal hidden relationships, and synthesis generates new hypotheses. This makes research more accessible to students, supports

professionals in analyzing complex domains, and accelerates scientific discovery across disciplines.

5. Technical Execution

IRDA is fully functional and integrates Google Gemini models for real reasoning. Core technologies include:

Frontend: React 19, Tailwind CSS

Visualization: D3.js for interactive graphs

AI Engine: Gemini 2.5 Flash for fast parsing, Gemini 3 Pro for advanced reasoning

Governance: Simulated blockchain identity with role-based permissions

Gemini capabilities used:

- Structured extraction

- Hypothesis generation

- Multi-document synthesis

- Context-aware chat

- Advanced reasoning and conflict detection

6. Creativity

IRDA uniquely integrates AI reasoning with knowledge graphs, synthesis workflows, and governance tools. It goes beyond typical Q&A systems by combining multiple AI capabilities into a cohesive research assistant. The system demonstrates new ways to explore scientific literature by unifying structured extraction, visualization, and reasoning.

7. Conclusion

IRDA shows how AI can enhance and modernize research workflows. By automating analysis, enabling deeper insights, and generating new ideas, the system supports students, researchers, and institutions. With further development, IRDA can become a powerful research intelligence tool for the scientific community