



Ministry of Higher Education and Scientific Research  
University of Jendouba  
Higher Institute of Applied Languages and Computer Science of Béja



Réf : LA-GLSI...../2025

## **Final Year Project Report**

For the obtainment of the

**BACHELOR'S DEGREE IN COMPUTER SCIENCE**

### **Subject:**

**Development of a Diagram Generation Platform**

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Academic Year: 2024–2025

# Dedication

**To my dear parents,** No words of gratitude can truly do you justice. You have always been my support, my strength, and my first source of encouragement and generosity. Your efforts, sacrifices, and boundless love have been a guiding light that helped me overcome every challenge. I dedicate this work to you as a token of appreciation and gratitude for the values and principles you have instilled in me.

**To my sisters, friends, and loved ones,** Thank you for standing by me and for your encouraging words in every moment of weakness. You have always been and continue to be a part of this success. You have all my appreciation and love.

# Acknowledgments

This project would not have been possible without the support and assistance of several individuals to whom we extend our deepest gratitude. We dedicate this work to them with great appreciation.

We sincerely thank Professor Mohamed Naija, our supervisor, who spared no effort in guiding and advising us throughout the course of this project, offering invaluable support from beginning to end.

We also express our gratitude to Mrs. Ines Askri for his insightful guidance and helpful remarks during the internship period.

Our thanks also go to all our esteemed professors, especially the members of the examination committee who kindly agreed to evaluate our humble work.

Finally, we extend our heartfelt thanks to everyone who contributed, directly or indirectly, to the completion of this project. May Allah bless everyone with success and barakah.

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# Chapter 1

## Overview of the Project

### 1.1 Introduction

The evolution of software development has increased the demand for efficient design tools. UML diagrams play a vital role by bridging conceptual design and implementation, improving stakeholder communication and offering standardized documentation.

Traditional approaches to diagramming face challenges due to manual effort and technical complexity. With the rise of AI and LLM technologies, automating diagram generation is now feasible.

This project proposes a platform combining natural language accessibility with the precision of textual UML generation, democratizing the process while maintaining professional standards.

### 1.2 Presentation of the Project Context

#### 1.2.1 Problem Statement

UML creation using GUI and textual tools presents several challenges:

**GUI-Based Tools:** Difficult to master, time-consuming, limited collaboration, and weak version control integration.

**Textual Tools:** Require syntax knowledge (e.g., PlantUML, Mermaid), lack real-time feedback, and pose debugging difficulties.

**Integration Issues:** Poor workflow integration and limited automation.

#### 1.2.2 Existing Solutions

**AI-Based Tools:** Use LLM to generate diagrams from user input, but often lack accuracy.

**Conversational Tools:** Tools like ChatUML[1] and DiagrammingAi[2] provide fast feedback but lack support for complex cases.

**Limitations:** Existing tools lack full AI integration, offer inconsistent quality, and miss collaborative/community features.

### 1.2.3 Proposed Solution

**Core Idea:** The platform combines LLM with PlantUML to interpret natural language and generate accurate diagrams.

**Key Features:** Real-time validation, collaborative editing, version control support, and a marketplace for sharing templates.

**Architecture:** Microservices separate LLM, generation, and UI layers for scalability.

**Advantages:** Professional-quality output, community-oriented design, and user-friendly interfaces.

## 1.3 Methodology Agile and Scrum Framework

Agile promotes iterative development and adaptability, ideal for evolving AI projects. Scrum enhances Agile through defined roles (Product Owner, Scrum Master, Development Team), events (Planning, Daily, Review, Retrospective), and artifacts (Product Backlog, Sprint Backlog, Increment).

This framework ensures regular inspection, collaboration, and adaptation, supporting continuous improvement throughout the development process.

## 1.4 Modeling Language

Modeling languages like UML provide standard notations for representing system structure and behavior.



Figure 1.1: UML Official Logo

UML is widely adopted due to its standardization, tooling support, and flexibility across domains, unlike domain-specific languages like BPMN or SysML.

## 1.5 Conclusion

This project addresses key limitations in UML generation by integrating LLM with PlantUML. The proposed platform enhances usability, collaboration, and automation through a scalable architecture. By leveraging AI, it democratizes diagramming while maintaining professional quality and precision.

# Chapter 2

## Project Initiation

### 2.1 Introduction

This project develops a comprehensive PlantUML-based diagramming platform combining individual productivity tools with community collaboration features. The web-based solution enables creating, editing, and sharing PlantUML diagrams while fostering collaborative learning environments.

The platform targets developers, software architects, system designers, and educational institutions requiring efficient technical diagram creation and visual documentation tools.

The project follows agile development using Scrum framework for iterative development and continuous feedback integration.

### 2.2 Requirements Analysis

#### 2.2.1 System Actors

##### Primary Actors:

- **User:** Authenticated individuals with full platform access including workspace management and community interaction

##### Secondary Actors:

- **AI System:** Intelligent assistant providing code editing assistance
- **PlantUML Server:** External service for diagram rendering

#### 2.2.2 Core Requirements

##### 2.2.2.1 Functional Requirements

- **Authentication:** OAuth via Google/GitHub with cross-device persistence

- **Project Management:** Complete CRUD operations, sharing, and bulk export
- **Workspace:** Interactive editor with real-time rendering and AI assistance
- **Community:** Project exploration, commenting, liking, and forking
- **Profile:** User management and public portfolio display

### 2.2.2.2 Non-Functional Requirements

- **Performance:** Page loads <3s, diagram rendering <5s, real-time syntax highlighting, autocomplete response <200ms, support for 1000 concurrent users
- **Security:** HTTPS/TLS encryption, OAuth 2.0 authentication, input validation, XSS/CSRF protection, secure code execution sandboxing
- **Usability:** Responsive design across devices, WCAG 2.1 Level AA accessibility compliance, intuitive visual interface design
- **Editor Experience:** Syntax highlighting for multiple languages, intelligent autocomplete with context awareness, real-time error detection, code folding, and multi-cursor editing support
- **SEO & Discoverability:** Server-side rendering (SSR) for search engine optimization, semantic HTML structure

## 2.3 Project Management

### 2.3.1 Scrum Rol

| Role             | Member(s)                   |
|------------------|-----------------------------|
| Product Owner    | Issam Mekni                 |
| Scrum Master     | Issam Mekni                 |
| Development Team | Issam Mekni, Souhaieb Askri |

Table 2.1: Scrum team roles

### 2.3.2 Product Backlog

The product backlog represents a prioritized list of features and requirements derived from stakeholder needs and market analysis. Each backlog item follows the user story format and includes priority classification using MoSCoW method (Must have, Should have, Could have, Won't have this time).

Table 2.2: Product Backlog with User Stories

| ID                     | Feature              | Sub-ID | User Story  | Priority |
|------------------------|----------------------|--------|---|----------|
| 1                      | Authentication       | 1.1    | As a user; I want to authenticate using my Google account so that I can log in easily.                            | M        |
|                        |                      | 1.2    | As a user; I want to authenticate using my GitHub account so that I can log in with my developer profile.         | M        |
|                        |                      | 1.3    | As a user; I want to stay authenticated across multiple devices so that I can access my account anywhere.         | S        |
|                        |                      | 1.4    | As a user; I want to log out from my account so that my information is secure when I finish.                      | M        |
| 2                      | Explore Landing Page | 2.1    | As a user; I want to explore the landing page so that I can understand the platform’s features and benefits.      | M        |
| 3                      | Manage Projects      | 3.1    | As a user; I want to create a new project so that I can organize my diagrams.                                     | M        |
|                        |                      | 3.2    | As a user; I want to view my project details so that I can track my work.   | M        |
|                        |                      | 3.3    | As a user; I want to update project details so that I can keep information current.                               | M        |
|                        |                      | 3.4    | As a user; I want to delete a project so that I can remove unwanted content.                                      | M        |
|                        |                      | 3.5    | As a user; I want to download project diagrams as images in a compressed ZIP file so that I can use them offline. | S        |
|                        |                      | 3.6    | As a user; I want to share my project with others so that I can collaborate or showcase my work.                  | S        |
| 4                      | Manage Diagrams      | 4.1    | As a user; I want to create a new diagram so that I can visualize my ideas.                                       | M        |
|                        |                      | 4.2    | As a user; I want to view my diagram so that I can review my work.  | M        |
|                        |                      | 4.3    | As a user; I want to update diagram details so that I can improve my designs.                                     | M        |
|                        |                      | 4.4    | As a user; I want to delete a diagram so that I can remove unwanted content.                                      | M        |
| Continued on next page |                      |        |   |          |

Table 2.2 – continued from previous page

| ID | Feature               | Sub-ID | User Story   | Priority |
|----|-----------------------|--------|--|----------|
| 5  | Manage Workspace      | 5.1    | As a user; I want to edit diagram code in an interactive editor so that I can create diagrams efficiently.               | M        |
|    |                       | 5.2    | As a user; I want to chat with an AI model to edit diagram code so that I can get assistance with complex diagrams.      | C        |
|    |                       | 5.3    | As an AI system; I need to respond to user requests and help edit diagram code so that users can create better diagrams. | C        |
|    |                       | 5.4    | As a PlantUML Server; I need to render diagram code into diagram images so that users can visualize their work.          | M        |
| 6  | Community Interaction | 6.1    | As a user; I want to explore the community so that I can discover interesting projects.                                  | S        |
|    |                       | 6.2    | As a user; I want to comment on projects so that I can provide feedback to other users.                                  | C        |
|    |                       | 6.3    | As a user; I want to like/unlike projects so that I can show appreciation for good work.                                 | C        |
|    |                       | 6.4    | As a user; I want to share projects so that I can promote interesting content.   | C        |
|    |                       | 6.5    | As a user; I want to update my comments so that I can correct or improve my feedback.                                    | C        |
|    |                       | 6.6    | As a user; I want to delete my comments so that I can remove inappropriate or outdated feedback.                         | C        |
|    |                       | 6.7    | As a user; I want to like/unlike comments so that I can engage in community discussions.                                 | C        |
|    |                       | 6.8    | As a user; I want to copy community projects to my workspace so that I can learn from and build upon others' work.       | S        |
| 7  | Profile Management    | 7.1    | As a user; I want to edit my profile so that I can keep my information current.  | S        |
|    |                       | 7.2    | As a user; I want to view public projects on profiles so that I can see others' work.                                    | S        |



### 2.3.3 Global Use Case Diagram

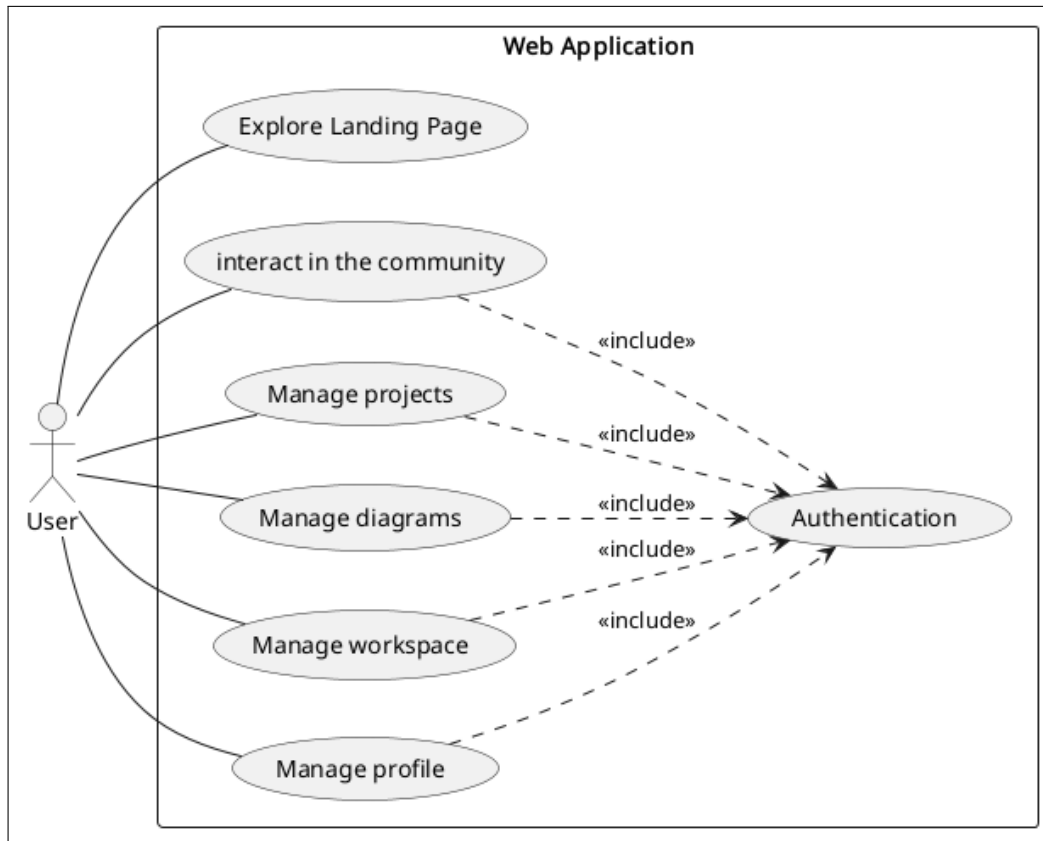


Figure 2.1: Global Use Case Diagram

### 2.3.4 Sprint Planning

The project is organized into six strategic sprints, each focusing on specific functional areas and building upon previous deliverables. The total project duration is designed to fit within 3.5 months (14 weeks) with efficient resource allocation and parallel development activities.

| Sprint | Focus Area                         | Backlog Features | Weeks |
|--------|------------------------------------|------------------|-------|
| I      | Infrastructure Setup               | N/A              | 2     |
| II     | Authentication and Landing Page    | 1,2              | 3     |
| III    | Project Management                 | 3                | 3     |
| IV     | Diagram and Project Management     | 4,5              | 3     |
| V      | Community Interaction and Profiles | 6 ,7             | 3     |

Table 2.3: Scrum Sprint Planning with Estimated Durations

## 2.4 System Architecture

### 2.4.1 Deployment Overview

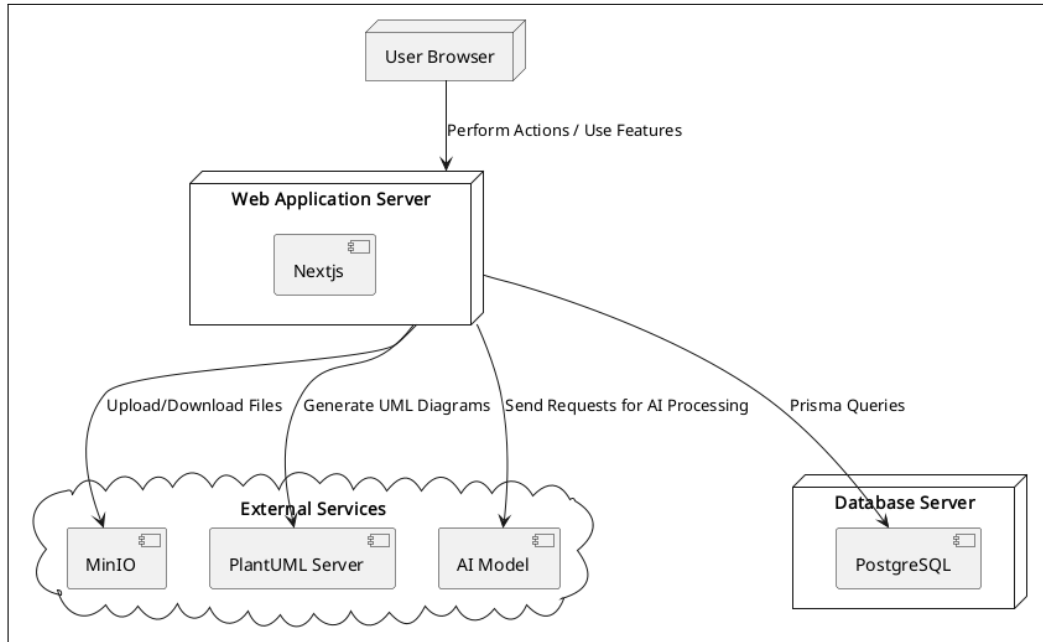


Figure 2.2: Deployment Architecture

### 2.4.2 Technology Stack
















| Category       | Technologies  |
|----------------|---|
| Frontend       |  Next.js,  React,  TypeScript,  Tailwind CSS |
| Backend        |  Node.js,  NextAuth.js,  Prisma ORM  |
| Database       |  PostgreSQL  |
| AI Integration |  LangChain   |
| Deployment     |  Docker,  MinIO   |
| Development    |  Git,  GitHub,  VSCodium,  Linux              |

Table 2.4: Core technology stack with icons

### 2.5 Conclusion

The project initiation phase successfully established a comprehensive foundation through systematic requirement analysis, stakeholder identification, and strategic Scrum-based planning. The structured approach ensures focused development on core functionality while maintaining flexibility for future enhancements.

Key achievements include clear actor identification, comprehensive requirement specification, prioritized product backlog, realistic sprint planning, and established project management framework. This foundation positions the project for successful progression through technical architecture design and implementation phases.

# Chapter 3

## Study and Implementation of Sprint I: Infrastructure Setup

### 3.1 Introduction

Sprint I establishes a robust, scalable infrastructure foundation using Docker containerization. This sprint creates the development environment and core services supporting the entire application ecosystem, ensuring consistency across environments and facilitating deployment.

### 3.2 Sprint Planning and Objectives

#### 3.2.1 Sprint Backlog

1. Database Setup (PostgreSQL with persistent storage)
2. Object Storage (MinIO S3-compatible service)
3. Diagram Service (PlantUML server)
4. Web Application (Next.js with TypeScript/Tailwind CSS)
5. ORM Configuration (Prisma with PostgreSQL)
6. Environment Configuration and Integration Testing

## 3.3 Technology Stack Implementation

### 3.3.1 Core Services Overview







| Service          | Technology  | Purpose  |
|------------------|---|--|
| Database         |  PostgreSQL 16   | ACID-compliant relational database with persistent storage |
| Object Storage   |  MinIO           | S3-compatible file storage with web management interface   |
| Diagram Service  |  PlantUML Server | Automated diagram generation from markup                   |
| Web Framework    |  Next.js 15      | Full-stack React framework with TypeScript support         |
| ORM              |  Prisma          | Type-safe database access layer                            |
| Containerization |  Docker Compose | Service orchestration and environment consistency          |

Table 3.1: Infrastructure services and technologies

## 3.4 Infrastructure Deliverables

### 3.4.1 Docker Compose Configuration

The complete infrastructure is orchestrated through Docker Compose:

Listing 3.1: Docker Compose Services Configuration

```
services:
  postgres:
    image: postgres:16
    container_name: my_postgres
    environment:
      POSTGRES_USER: user
      POSTGRES_PASSWORD: password
      POSTGRES_DB: database
    ports:
      - "5432:5432"
    volumes:
      - postgres_data:/var/lib/postgresql/data

  minio:
    image: minio/minio
    container_name: minio
```

```
ports:
  - "9000:9000"    # API
  - "9001:9001"    # Web UI
volumes:
  - ./minio-data:/data
environment:
  MINIO_ROOT_USER: minioadmin
  MINIO_ROOT_PASSWORD: minioadmin
command: server /data --console-address ":9001"

plantuml:
  image: plantuml/plantuml-server
  container_name: plantuml_server
  ports:
    - "3030:8080"
  restart: unless-stopped

web-app:
  build: .
  container_name: nextjs_app
  ports:
    - "3000:3000"
  depends_on:
    - postgres
    - minio
    - plantuml
  environment:
    - DATABASE_URL=postgresql://user:password@postgres:5432/database
    - PLANTUML_SERVER=http://plantuml:8080
```

### 3.4.2 Application Container Configuration

Listing 3.2: Next.js Application Dockerfile

```
FROM node:20-alpine

WORKDIR /app

COPY package*.json ./
COPY prisma ./prisma/

RUN npm install
RUN npx prisma generate

COPY . .
```

EXPOSE 3000

CMD ["npm", "run", "dev"]

## 3.4.3 Database Schema Design

The database implements a normalized schema supporting core application functionality:

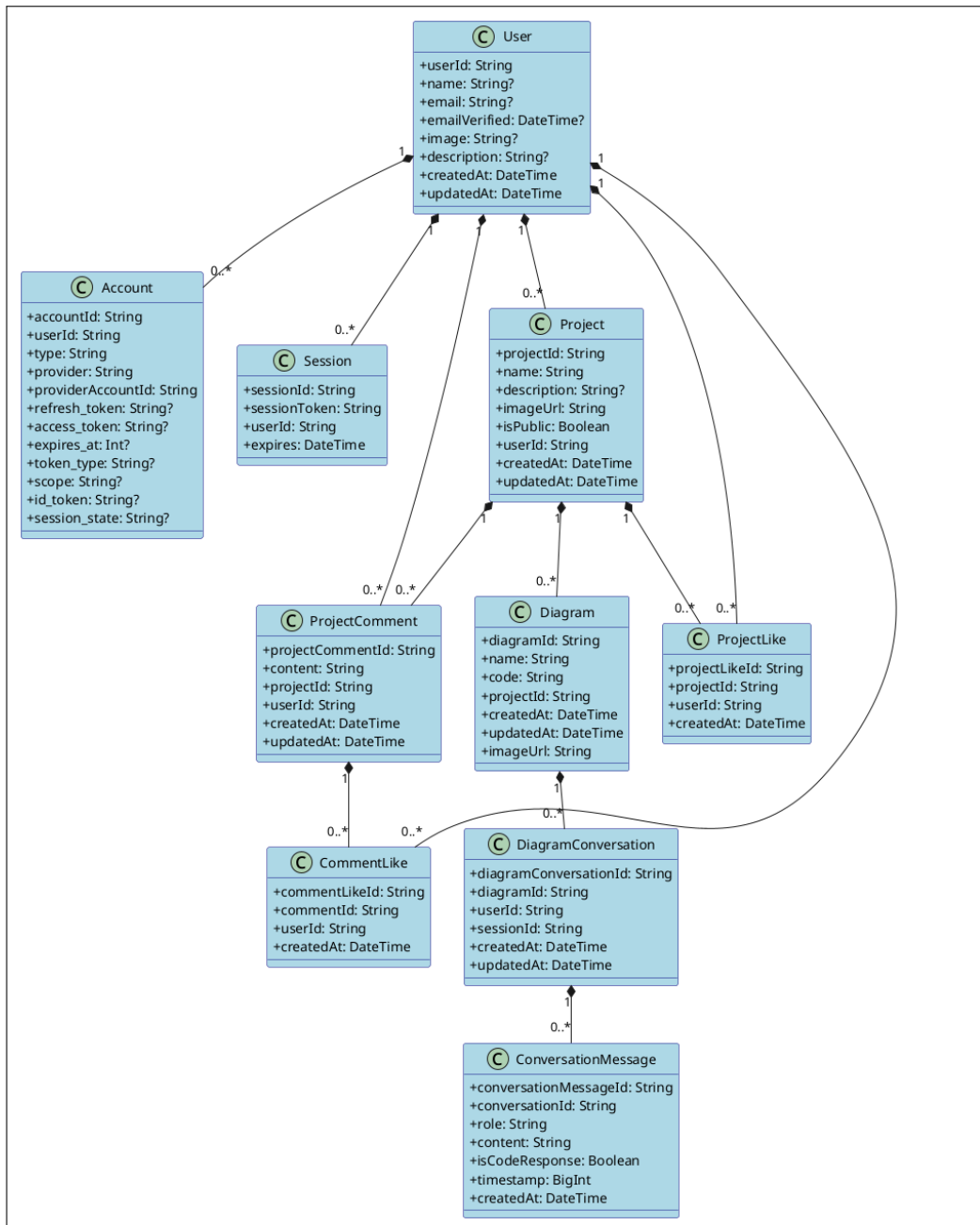


Figure 3.1: Database Entity Relationship Diagram

### 3.4.4 Environment Configuration

Essential environment variables for secure operation:

Listing 3.3: Environment Variables

```
GOOGLE_CLIENT_SECRET=*****
GOOGLE_CLIENT_ID=*****
NEXTAUTH_URL=http://localhost:3000
NEXTAUTH_SECRET="*****"
DATABASE_URL=postgresql://user:password@postgres:5432/database
PLANTUML_SERVER=http://localhost:3030
GEMINI_API_KEY=*****
```

## 3.5 Sprint Retrospective

### 3.5.1 Key Achievements

- Complete containerized infrastructure with service integration
- Database schema design and Prisma ORM integration
- Secure environment configuration and networking

### 3.5.2 Challenges Resolved

- **Security Management:** Implemented secure environment variable handling
- **Schema Synchronization:** Coordinated Prisma migrations in containers

### 3.5.3 Future Enhancements

- Health checks implementation for all services
- Logging and monitoring solutions integration
- Automated backup systems for database
- CI/CD pipeline preparation

## 3.6 Conclusion

Sprint I successfully established a comprehensive, production-ready development infrastructure using containerization best practices. The integration of PostgreSQL, MinIO, PlantUML, and Next.js creates a robust foundation supporting all planned application features.



# Chapter 4

## Study and Implementation of Sprint II: Authentication & Landing Page

### 4.1 Introduction

Sprint II focuses on developing the authentication system and landing page using NextAuth.js and Prisma ORM. This sprint establishes essential user management capabilities and creates an intuitive entry point for the application, building upon the foundation from previous iterations.

### 4.2 Sprint Planning

#### 4.2.1 Objectives

- Implement secure OAuth authentication (Google, GitHub)
- Develop cross-device session management
- Create responsive landing page

#### 4.2.2 Backlog Items

The MoSCoW prioritization method categorizes requirements into four levels: **Must have** (critical features essential for project success), **Should have** (important features that add significant value but aren't critical), **Could have** (nice-to-have features that can be included if time and resources allow), and **Won't have** (features explicitly excluded from current scope).

This method helps teams focus on delivering the most valuable features first while maintaining clear expectations about what will and won't be included in each release.

| ID | Feature              | Sub-ID | User Story   | Priority |
|----|----------------------|--------|--|----------|
| 1  | Authentication       | 1.1    | As a user; I want to authenticate using my Google account so that I can log in easily.                       | M        |
| 1  | Authentication       | 1.2    | As a user; I want to authenticate using my GitHub account so that I can log in with my developer profile.    | M        |
| 1  | Authentication       | 1.3    | As a user; I want to stay authenticated across multiple devices so that I can access my account anywhere.    | S        |
| 1  | Authentication       | 1.4    | As a user; I want to log out from my account so that my information is secure when I finish.                 | M        |
| 2  | Explore Landing Page | 2.1    | As a user; I want to explore the landing page so that I can understand the platform's features and benefits. | M        |

Table 4.1: User Stories Requirements Table

## 4.3 System Analysis

### 4.3.1 Use Case Overview

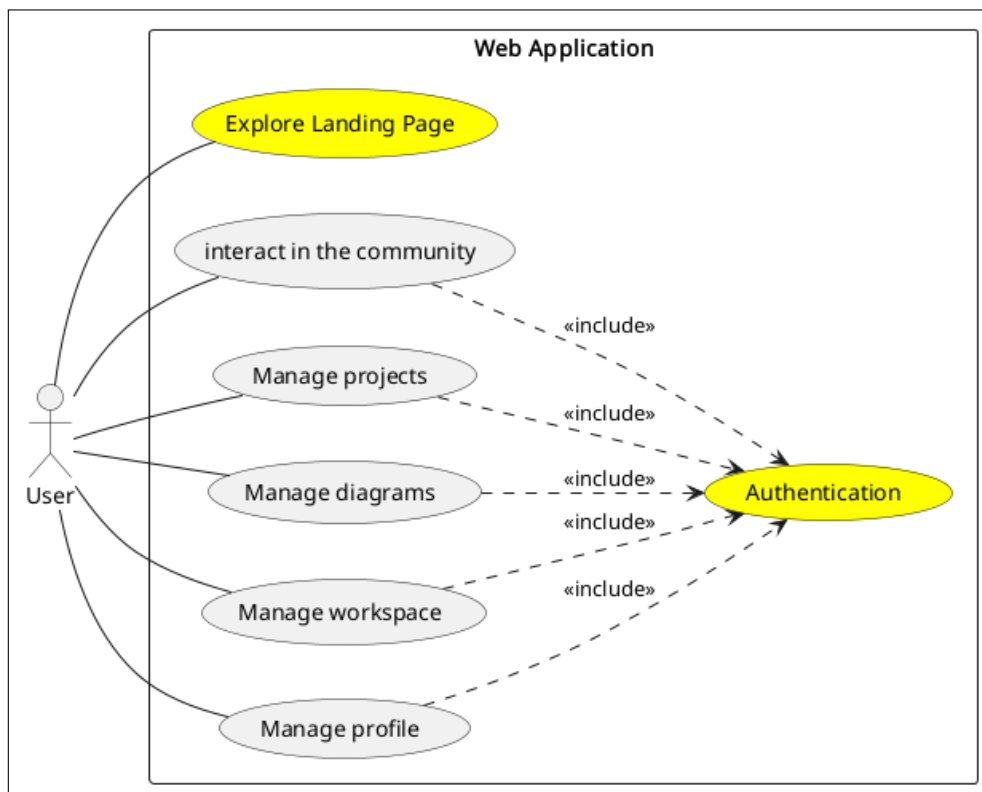


Figure 4.1: Sprint II Use Case Diagram

### 4.3.2 Authentication Use Cases

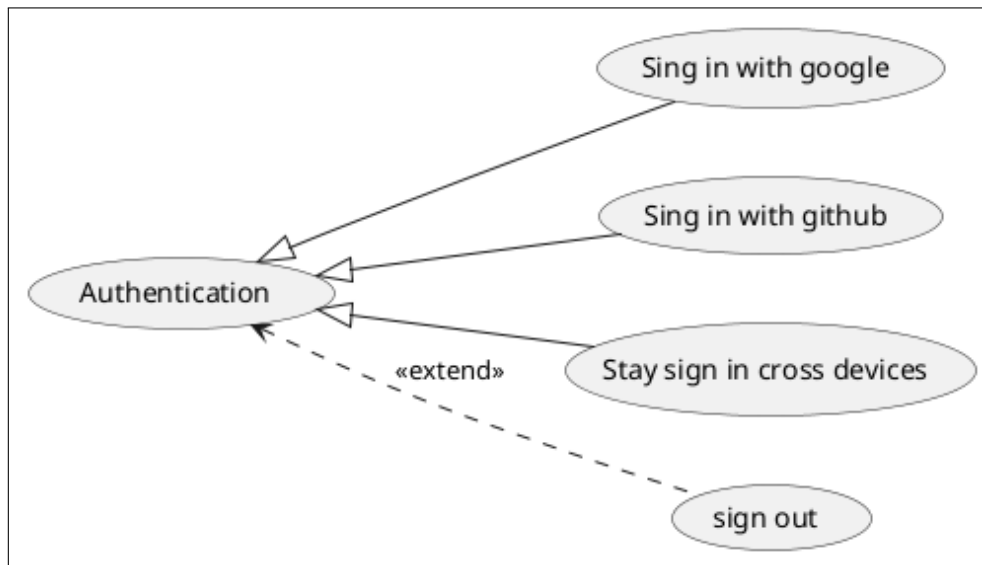


Figure 4.2: Refined Authentication Use Case

#### 4.3.2.1 Core Authentication Scenarios

##### OAuth Sign-In Process:

1. User clicks OAuth provider button (Google/GitHub)
2. System redirects to provider's authorization page
3. User authorizes application access
4. Provider returns authorization code
5. System validates and creates user session
6. User is redirected to dashboard

**Cross-Device Authentication:** Session persistence is maintained through secure tokens allowing users to access the application across multiple devices without re-authentication, with automatic session validation and expiration handling.

**Secure Sign-Out:** Session termination involves token invalidation, cookie clearing, and secure redirection to the landing page.

## 4.4 System Design

### 4.4.1 Authentication Flow

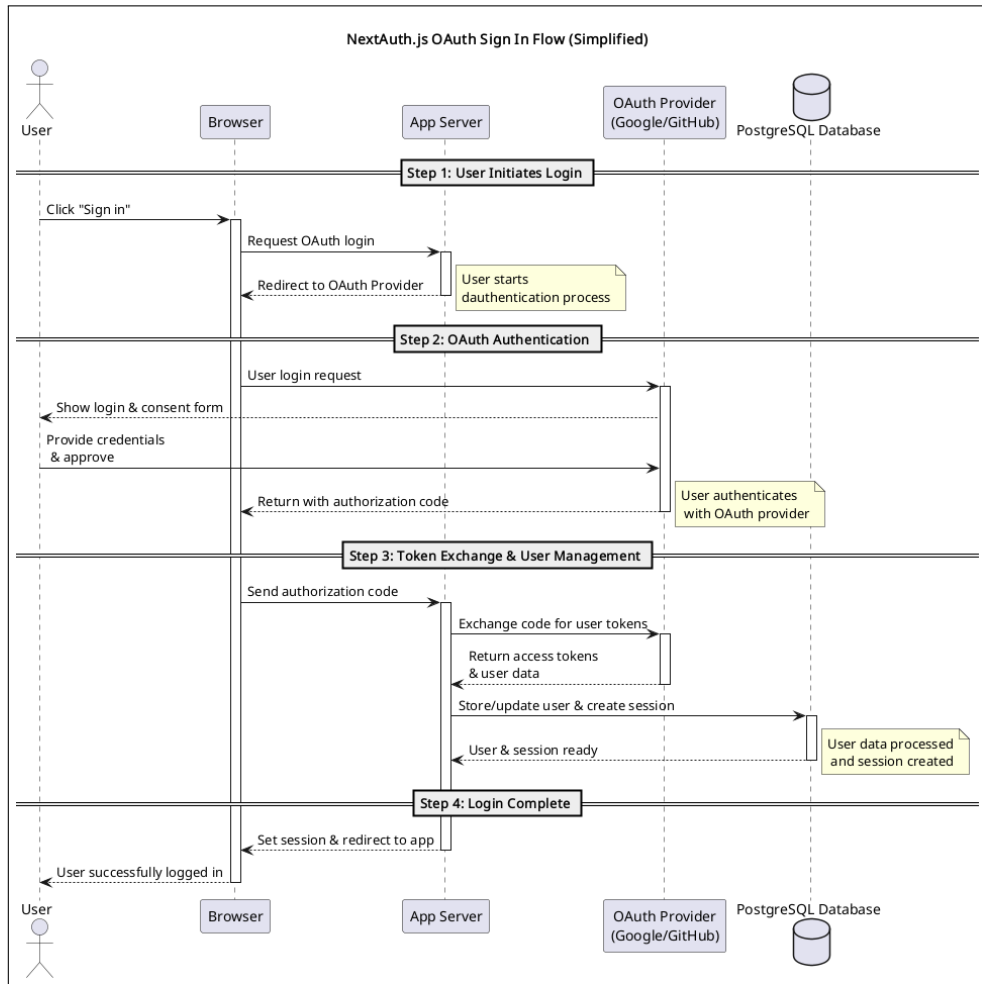


Figure 4.3: OAuth Authentication Sequence

### 4.5 Implementation Results

#### 4.5.1 Landing Page

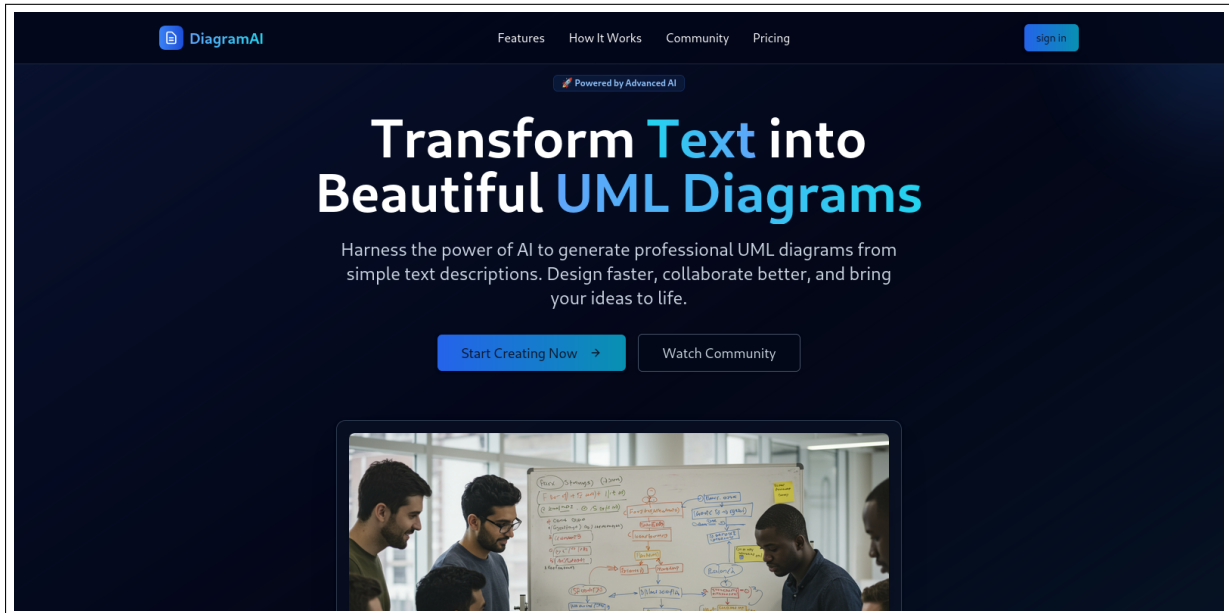


Figure 4.4: Responsive Landing Page

Modern design featuring clear value proposition, feature highlights, and prominent call-to-action elements optimized for user engagement and conversion.

#### 4.5.2 Authentication Interface

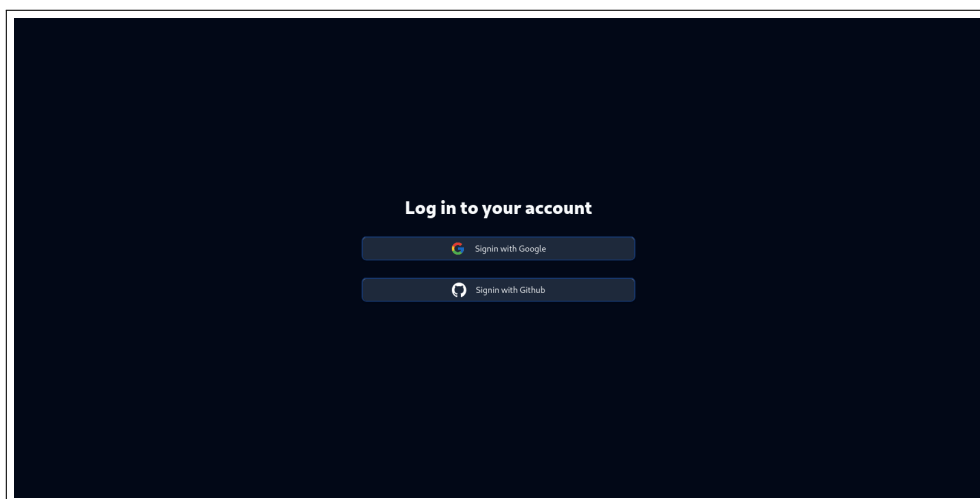


Figure 4.5: OAuth Sign-In Interface

Clean, user-friendly authentication interface supporting multiple OAuth providers with consistent branding and accessibility standards.

### 4.6 Sprint Retrospective

#### **Achievements:**

- Successful OAuth integration with Google and GitHub
- Robust cross-device session management
- Responsive landing page with high conversion potential
- Secure authentication flow with proper error handling

#### **Challenges Resolved:**

- OAuth configuration complexities across environments
- Session persistence optimization
- Cross-browser compatibility testing

### 4.7 Conclusion

Sprint II successfully established the authentication infrastructure and user entry point. The implementation of NextAuth.js with OAuth providers and Prisma database management provides a secure, scalable foundation for user management. The responsive landing page effectively communicates value while guiding user engagement. These achievements create a solid foundation for subsequent development phases, with robust security and optimal user experience.

# Chapter 5

## Sprint III: Project Management Implementation

### 5.1 Introduction

Sprint III implements comprehensive project management functionality within the UML diagram platform. This sprint introduces essential features enabling users to organize, manage, and maintain UML projects effectively, serving as the foundation for user workflow organization with capabilities for project creation, modification, visualization, and data export.

### 5.2 Sprint Planning

#### 5.2.1 Objectives

Sprint III aims to implement a complete project management system allowing users to efficiently organize UML diagram projects through:

- Project creation with customizable parameters
- Intuitive project browsing and viewing capabilities
- Secure project modification features
- Safe project deletion with confirmations
- Robust export system for compressed project diagrams

#### 5.2.2 Sprint Backlog

Table 5.1: Manage Projects User Stories Requirements  
Table

| ID | Feature         | Sub-ID | User Story  | Priority |
|----|-----------------|--------|---|----------|
| 3  | Manage Projects | 3.1    | As a user; I want to create a new project so that I can organize my diagrams.                                     | M        |
|    |                 | 3.2    | As a user; I want to view my project details so that I can track my work.   | M        |
|    |                 | 3.3    | As a user; I want to update project details so that I can keep information current.                               | M        |
|    |                 | 3.4    | As a user; I want to delete a project so that I can remove unwanted content.                                      | M        |
|    |                 | 3.5    | As a user; I want to download project diagrams as images in a compressed ZIP file so that I can use them offline. | S        |
|    |                 | 3.6    | As a user; I want to share my project with others so that I can collaborate or showcase my work.                  | S        |

## 5.3 Analysis and Design

### 5.3.1 Use Case Analysis

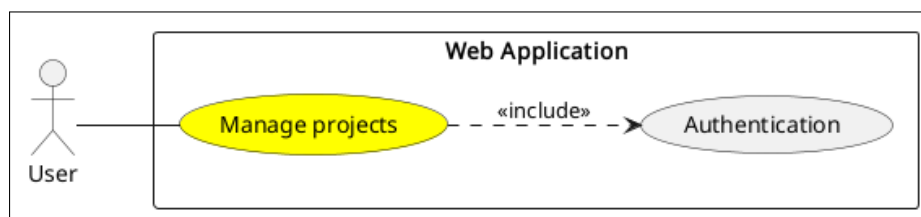


Figure 5.1: Sprint III Use Case Diagram



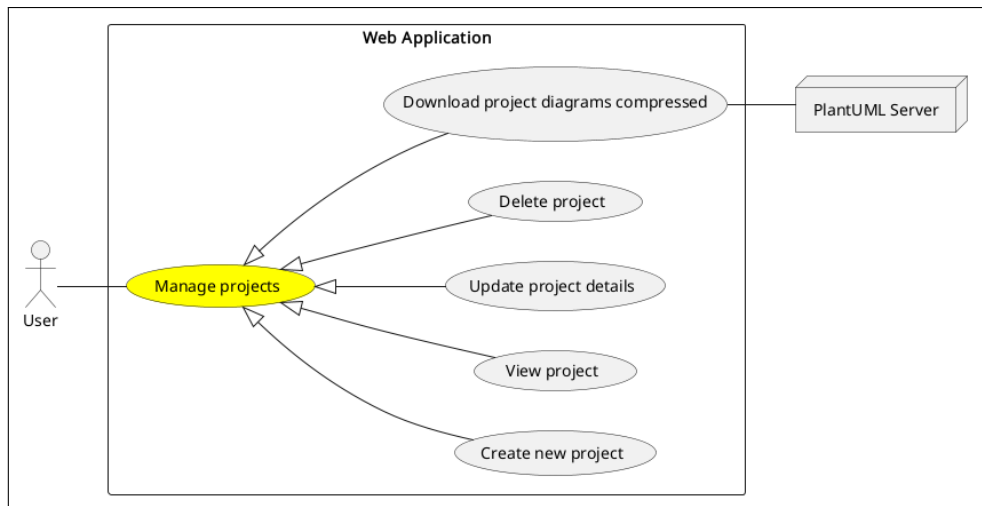


Figure 5.2: Refined Project Management Use Cases

## 5.3.2 Key Use Case Specifications

### 5.3.2.1 Create New Project (UC-3.1)

**Main Flow:** User accesses creation form → enters project details → selects type/settings → system validates → creates project → displays confirmation → redirects to dashboard.

**Alternative Flows:** Invalid input triggers validation errors; system errors maintain form data.

### 5.3.2.2 View Project (UC-3.2)

**Main Flow:** User accesses project list → selects project → system retrieves details → displays organized layout → enables diagram navigation.

**Alternative Flows:** Empty projects show appropriate messages; access errors redirect or show permissions.

### 5.3.2.3 Update Project (UC-3.3)

**Main Flow:** User accesses edit interface → modifies fields → submits changes → system validates → saves to database → confirms success.

**Alternative Flows:** No changes or validation errors handled appropriately.

### 5.3.2.4 Delete Project (UC-3.4)

**Main Flow:** User selects deletion → system shows confirmation → user confirms → system removes data → cleans resources → confirms deletion.

**Alternative Flows:** Cancellation or shared project warnings handled safely.

## 5.3.2.5 Download Compressed (UC-3.5)

**Main Flow:** User accesses export → selects formats → initiates download → system generates diagrams → creates zip → downloads file.

**Alternative Flows:** Large projects show progress; selective export options available.

## 5.4 System Design

### 5.4.1 Sequence Diagrams

The following diagrams illustrate system component interactions:

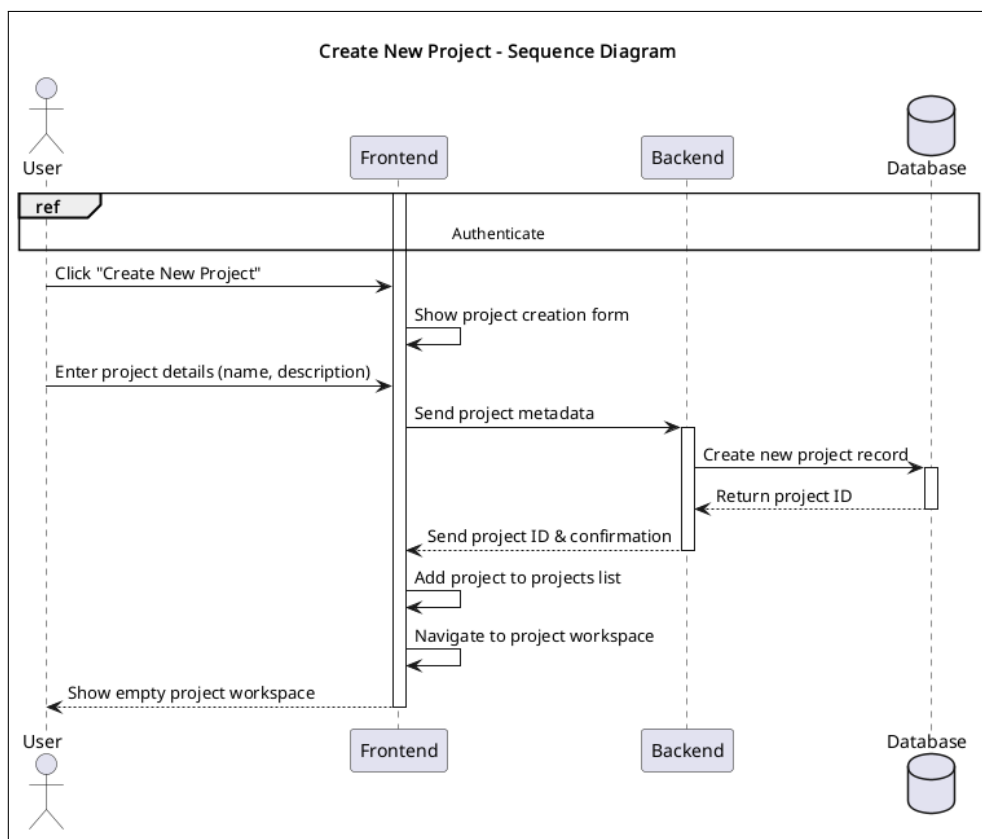


Figure 5.3: Create Project Sequence

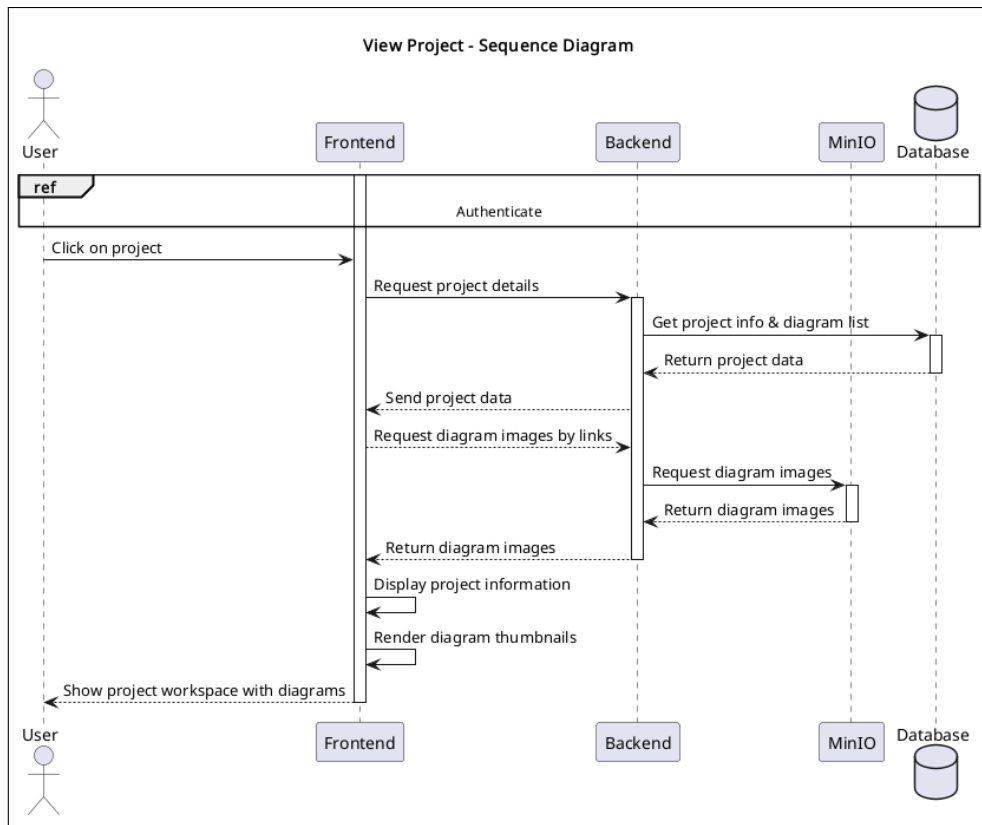


Figure 5.4: View Project Sequence

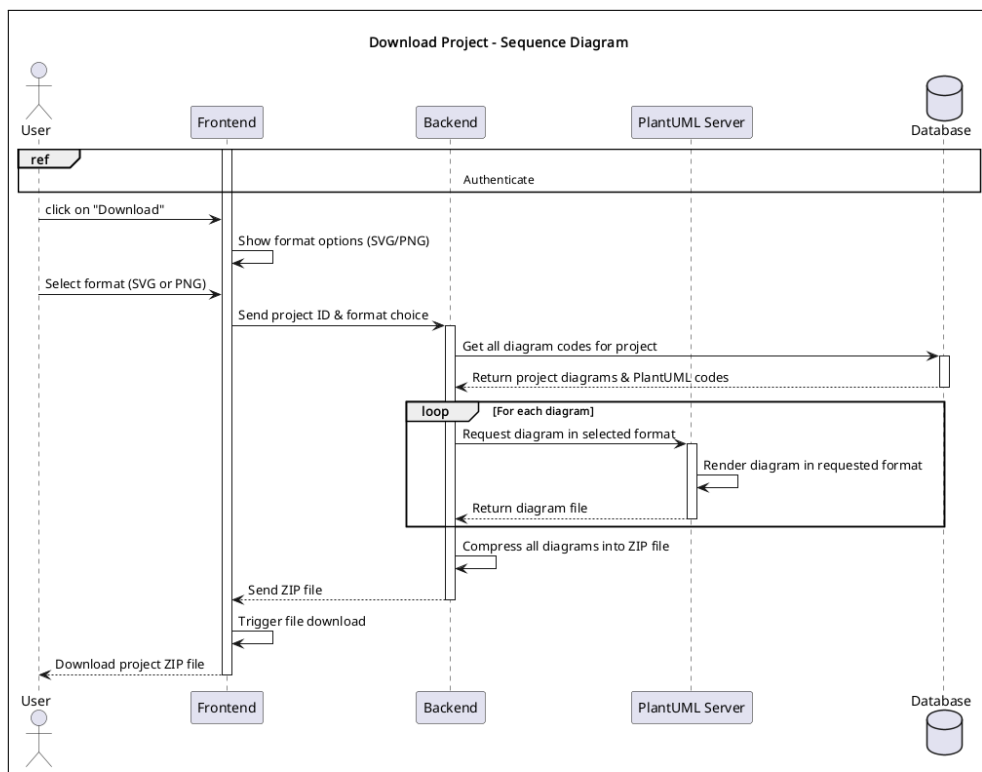


Figure 5.5: Download Project Diagrams Sequence

### 5.5 Implementation Results

#### 5.5.1 User Interface Screenshots

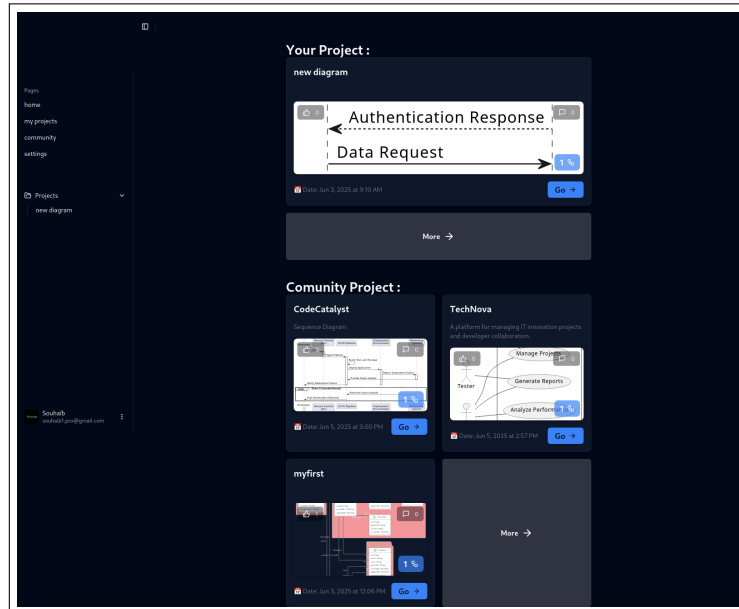


Figure 5.6: Home page with project overview

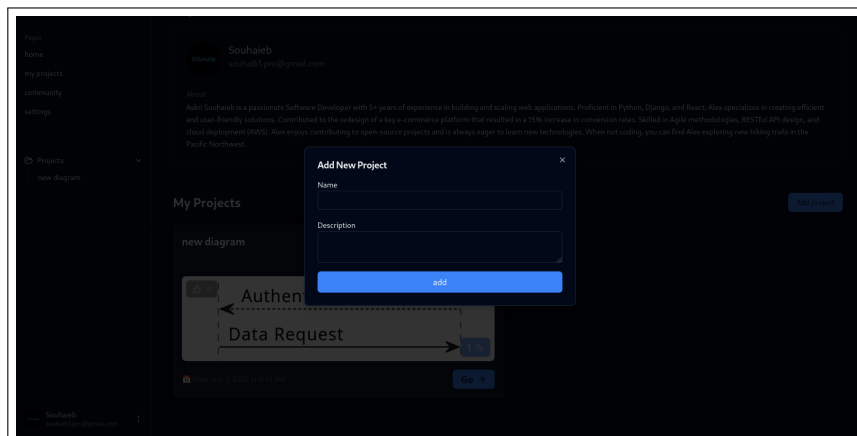


Figure 5.7: Project creation interface

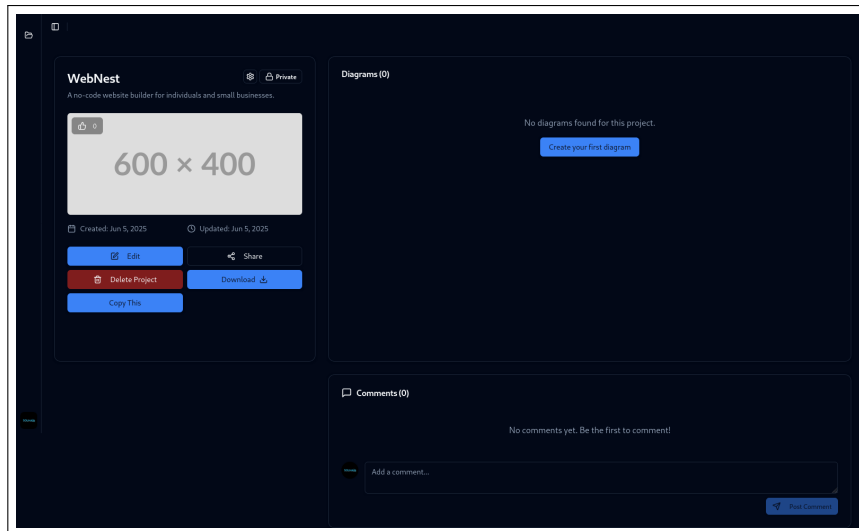


Figure 5.8: Project details and management

## 5.6 Sprint Retrospective

### 5.6.1 Achievements

- Complete CRUD operations implementation
- Robust export functionality with multiple formats
- Intuitive user interfaces with validation
- Strong technical execution and requirement analysis

### 5.6.2 Areas for Improvement

- Enhanced error handling mechanisms
- Performance optimization for large projects
- Extended sharing capabilities

## 5.7 Conclusion

Sprint III established a robust project management foundation providing users with comprehensive tools for organizing and managing UML projects effectively. The implemented features deliver significant value through intuitive interfaces, reliable functionality, and scalable architecture. This sprint positions the platform for continued growth and enhanced collaboration capabilities, demonstrating the team's ability to deliver complex functionality while maintaining high quality standards.

# Chapter 6

## Sprint IV: Diagram & Workspace Management

### 6.1 Introduction

Sprint IV focuses on implementing core diagram and workspace management functionality, representing a significant milestone in developing a comprehensive diagramming tool. This sprint delivers diagram lifecycle management and advanced workspace features including AI-assisted editing and interactive code editing capabilities.

### 6.2 Sprint Planning

#### 6.2.1 Objectives

Primary objectives include implementing comprehensive diagram CRUD operations, establishing robust workspace environment with split-view functionality, integrating AI assistance for diagram editing, and ensuring seamless PlantUML server integration for rendering.

| ID | Feature          | Sub-ID | User Story   | Priority |
|----|------------------|--------|--|----------|
| 4  | Manage Diagrams  | 4.1    | As a user; I want to create a new diagram so that I can visualize my ideas.  | M        |
|    |                  | 4.2    | As a user; I want to view my diagram so that I can review my work.   | M        |
|    |                  | 4.3    | As a user; I want to update diagram details so that I can improve my designs.  | M        |
|    |                  | 4.4    | As a user; I want to delete a diagram so that I can remove unwanted content.   | M        |
| 5  | Manage Workspace | 5.1    | As a user; I want to edit diagram code in an interactive editor so that I can create diagrams efficiently.               | M        |
|    |                  | 5.2    | As a user; I want to chat with an AI model to edit diagram code so that I can get assistance with complex diagrams.      | C        |
|    |                  | 5.3    | As an AI system; I need to respond to user requests and help edit diagram code so that users can create better diagrams. | C        |
|    |                  | 5.4    | As a PlantUML Server; I need to render diagram code into diagram images so that users can visualize their work.          | M        |

Table 6.1: Manage Diagrams and Workspace User Stories Requirements Table

## 6.2.2 Sprint Backlog

## 6.3 System Analysis

### 6.3.1 Use Case Overview

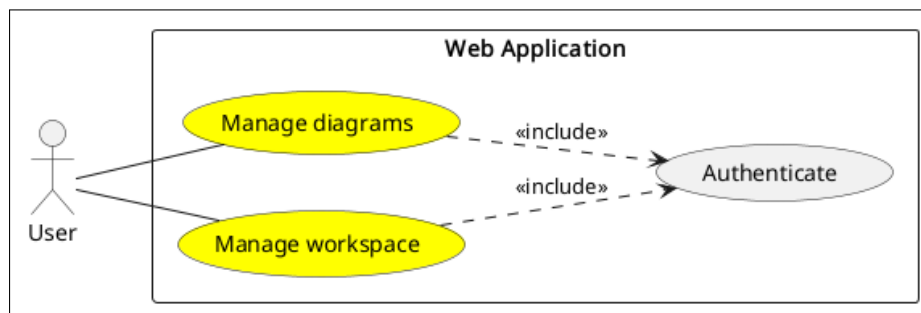


Figure 6.1: Sprint IV Use Case Diagram

## 6.3.2 Core Features

### 6.3.2.1 Diagram Management

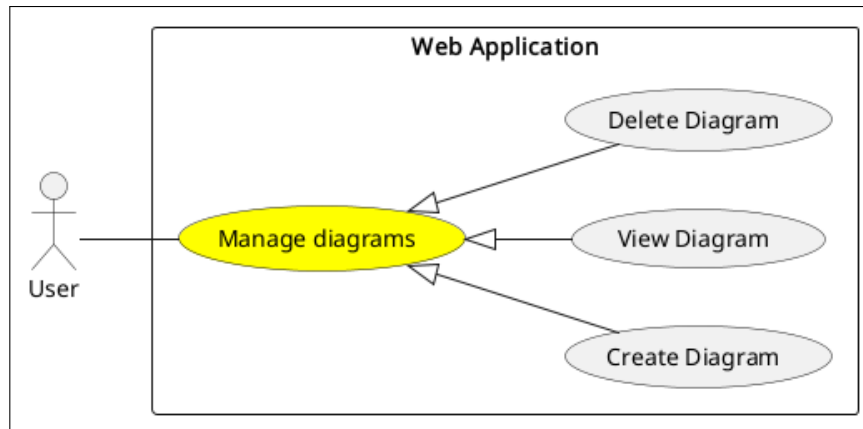


Figure 6.2: Diagram Management Use Cases

Key operations include:

- **Create Diagram:** User initiates new diagram creation with name and type selection
- **View Diagram:** Interactive editor with real-time preview and validation
- **Delete Diagram:** Secure deletion with confirmation dialog

### 6.3.2.2 Workspace Management

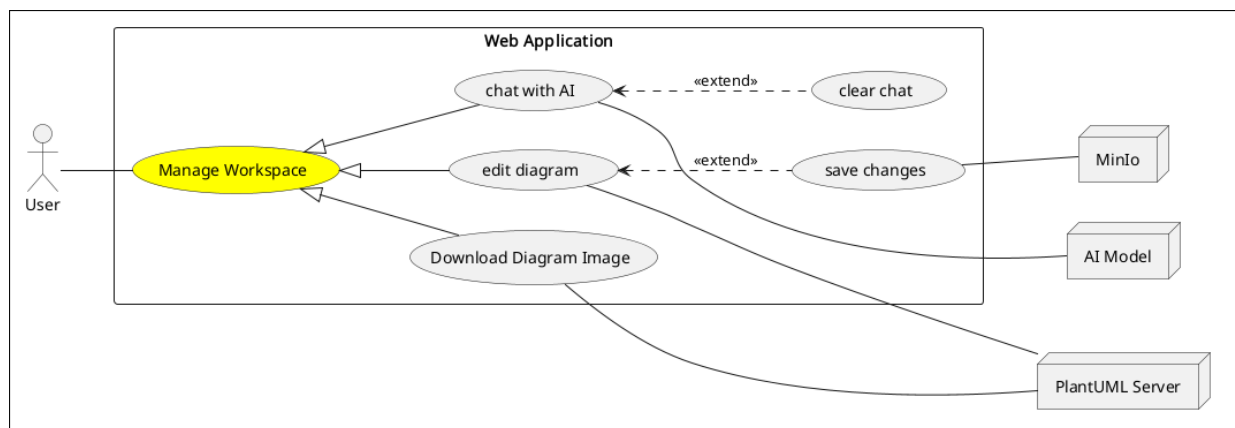


Figure 6.3: Workspace Management Use Cases

Core workspace features:

- **Edit Diagram:** Interactive code editor with syntax highlighting



- **AI Chat:** Natural language assistance for diagram creation and troubleshooting
- **Save Changes:** Persistent storage with validation and error handling

## 6.4 System Design

### 6.4.1 Key Sequence Diagrams

#### 6.4.1.1 Diagram Creation Process

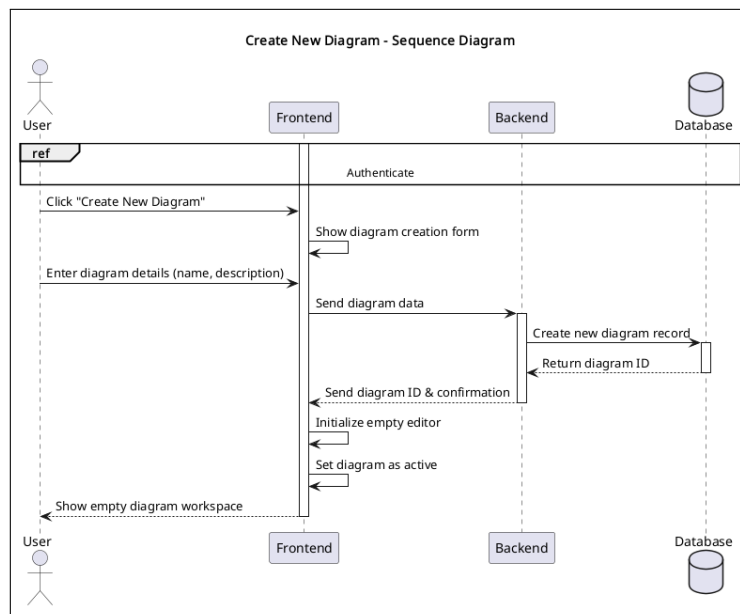


Figure 6.4: Create New Diagram Sequence

## 6.4.1.2 AI-Assisted Editing

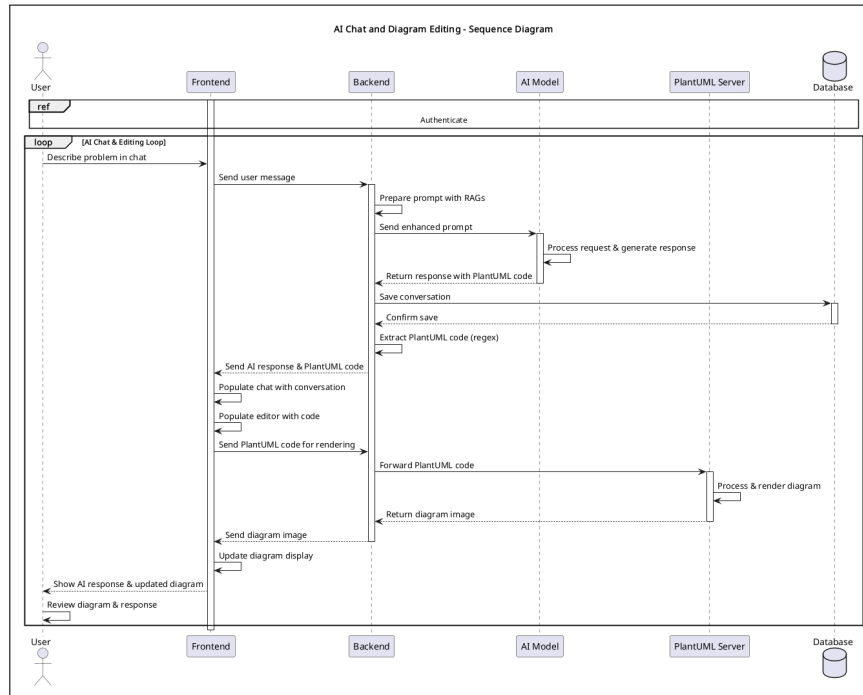


Figure 6.5: AI Chat Integration Sequence

## 6.5 Implementation Results

### 6.5.1 Core Interfaces

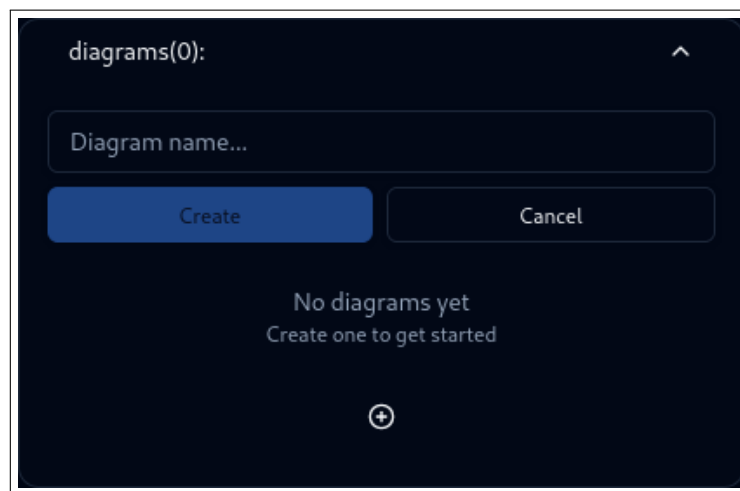


Figure 6.6: Diagram Creation Interface

The diagram creation interface provides intuitive name specification, type selection, and project initialization capabilities.

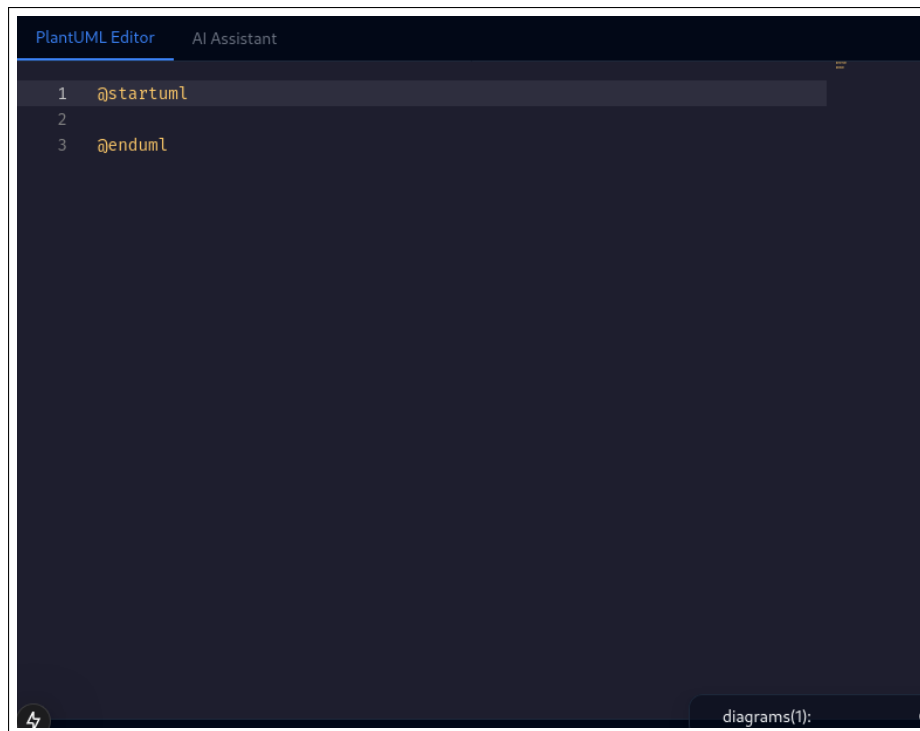


Figure 6.7: Interactive Code Editor with Real-time Preview

The interactive workspace features syntax highlighting, real-time validation, and seamless preview integration for enhanced productivity.

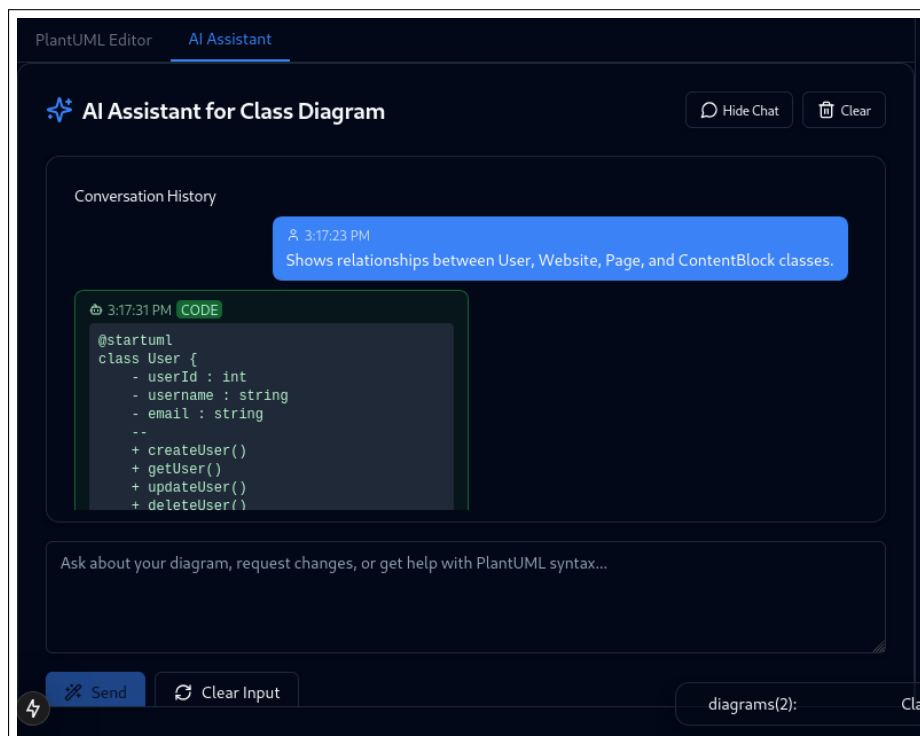


Figure 6.8: AI Assistant Integration

AI assistant provides intelligent support through natural language interaction for

diagram creation, code improvement, and troubleshooting assistance.

### 6.5.2 Workspace Environment

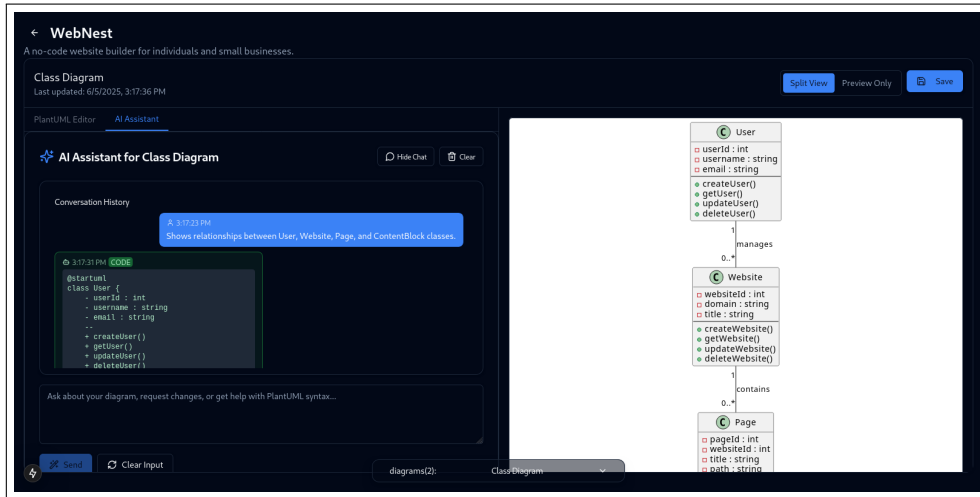


Figure 6.9: Split-View Workspace - Secondary View

The dual-pane workspace enables simultaneous code editing and diagram preview, providing immediate visual feedback and significantly improving user productivity.

## 6.6 Sprint Retrospective

### 6.6.1 Achievements

- Successfully implemented complete diagram CRUD operations
- Effective AI assistant integration with natural language processing
- Smooth PlantUML server integration for high-quality rendering
- Real-time editing with immediate visual feedback

### 6.6.2 Challenges & Solutions

- **Challenge:** AI service integration complexity
- **Solution:** Implemented robust error handling and fallback mechanisms
- **Challenge:** Performance optimization for large diagrams
- **Solution:** Added caching and progressive rendering
- **Challenge:** Browser compatibility for download features
- **Solution:** Implemented cross-browser compatibility layer

### 6.7 Conclusion

Sprint IV successfully delivered comprehensive diagram and workspace management capabilities that form the application's core foundation. The implementation combines efficient CRUD operations with intelligent AI assistance and interactive editing features, providing users with a powerful and intuitive diagramming platform. The integration of PlantUML server ensures high-quality rendering, while the AI assistant adds significant value for complex diagramming tasks. These achievements establish a solid foundation for future enhancements and advanced features in subsequent development cycles.

# Chapter 7

## Study and Implementation of Sprint V: Community Interaction & Profile Management

### 7.1 Introduction

Sprint V focuses on building a vibrant community ecosystem and profile management capabilities. This sprint introduces community interaction features enabling users to engage through comments, likes, and collaborative copying mechanisms, alongside robust profile management functionality for showcasing work effectively.

The community features transform the platform from a diagramming tool into a collaborative workspace where users discover, learn from, and build upon each other's work.

### 7.2 Sprint Planning

#### 7.2.1 Objectives and Backlog

Sprint V objectives include developing community exploration, project interaction features, comment management, project copying functionality, and comprehensive profile management.

| ID | Feature               | Sub-ID | User Story   | Priority |
|----|-----------------------|--------|--|----------|
| 6  | Community Interaction | 6.1    | As a user; I want to explore the community so that I can discover interesting projects.                            | S        |
|    |                       | 6.2    | As a user; I want to comment on projects so that I can provide feedback to other users.                            | C        |
|    |                       | 6.3    | As a user; I want to like/unlike projects so that I can show appreciation for good work.                           | C        |
|    |                       | 6.4    | As a user; I want to share projects so that I can promote interesting content.                                     | C        |
|    |                       | 6.5    | As a user; I want to update my comments so that I can correct or improve my feedback.                              | C        |
|    |                       | 6.6    | As a user; I want to delete my comments so that I can remove inappropriate or outdated feedback.                   | C        |
|    |                       | 6.7    | As a user; I want to like/unlike comments so that I can engage in community discussions.                           | C        |
|    |                       | 6.8    | As a user; I want to copy community projects to my workspace so that I can learn from and build upon others' work. | S        |
| 7  | Profile Management    | 7.1    | As a user; I want to edit my profile so that I can keep my information current.                                    | S        |
|    |                       | 7.2    | As a user; I want to view public projects on profiles so that I can see others' work.                              | S        |

Table 7.1: Community Interaction and Profile Management User Stories Requirements Table

## 7.3 System Analysis

### 7.3.1 Use Case Overview

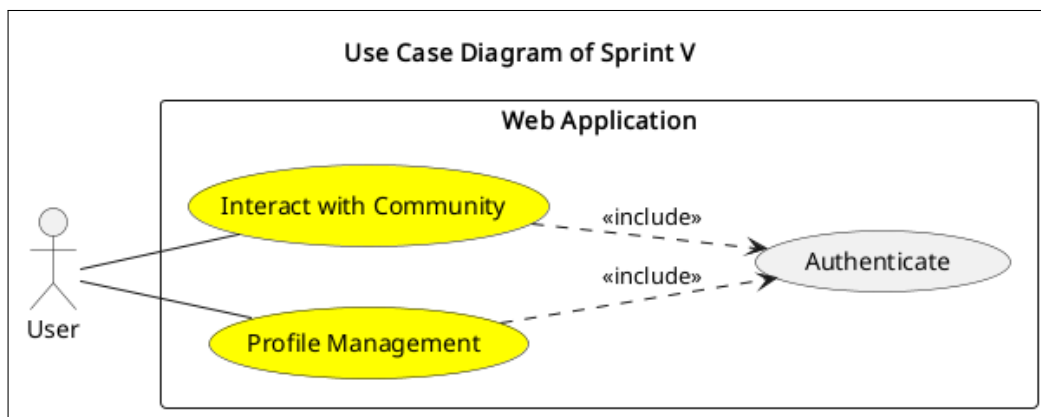


Figure 7.1: Use Case Diagram for Sprint V

### 7.3.2 Community Interaction Features

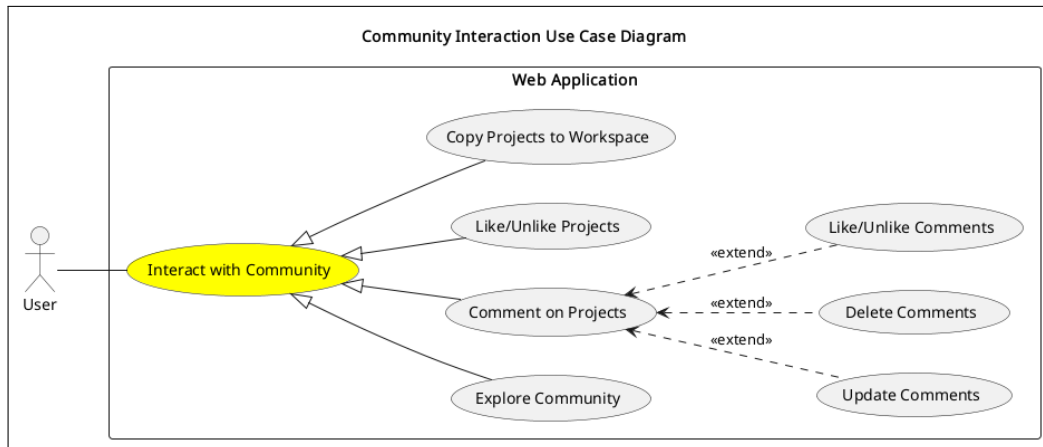


Figure 7.2: Community Interaction Use Cases

#### 7.3.2.1 Key Use Cases Description

**Explore Community:** Users and visitors browse public projects with filtering and search capabilities to discover interesting content and platform offerings.

**Comment Management:** Authenticated users can create, update, and delete comments on projects, providing feedback and engaging in community discussions with full CRUD operations.

**Project Interactions:** Users can like/unlike projects and comments to show appreciation and engage with community content, with real-time UI updates.

**Project Copying:** Users can copy community projects to their workspace for learning and building upon others' work, with proper attribution and workspace integration.

### 7.3.3 Profile Management Features

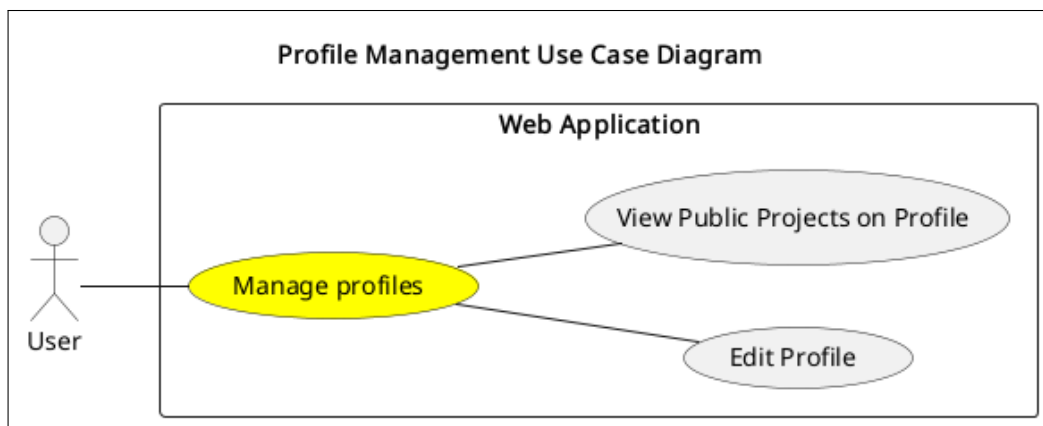


Figure 7.3: Profile Management Use Cases



**Edit Profile:** Users can update personal information, maintain account details, and manage their public presence with validation and confirmation feedback.

**View Public Projects:** Users and visitors can explore public projects on user profiles, showcasing portfolios and enabling project discovery through user-centric browsing.

## 7.4 System Design

### 7.4.1 Key Sequence Diagrams

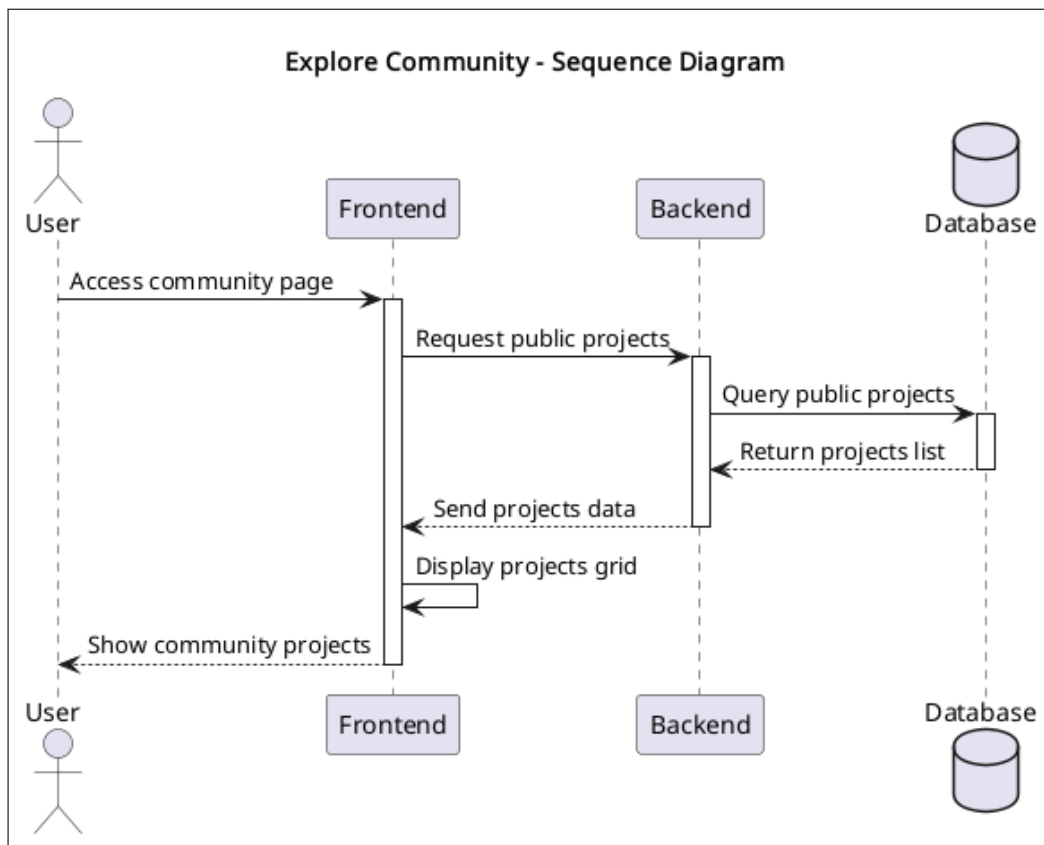


Figure 7.4: Community Exploration Flow

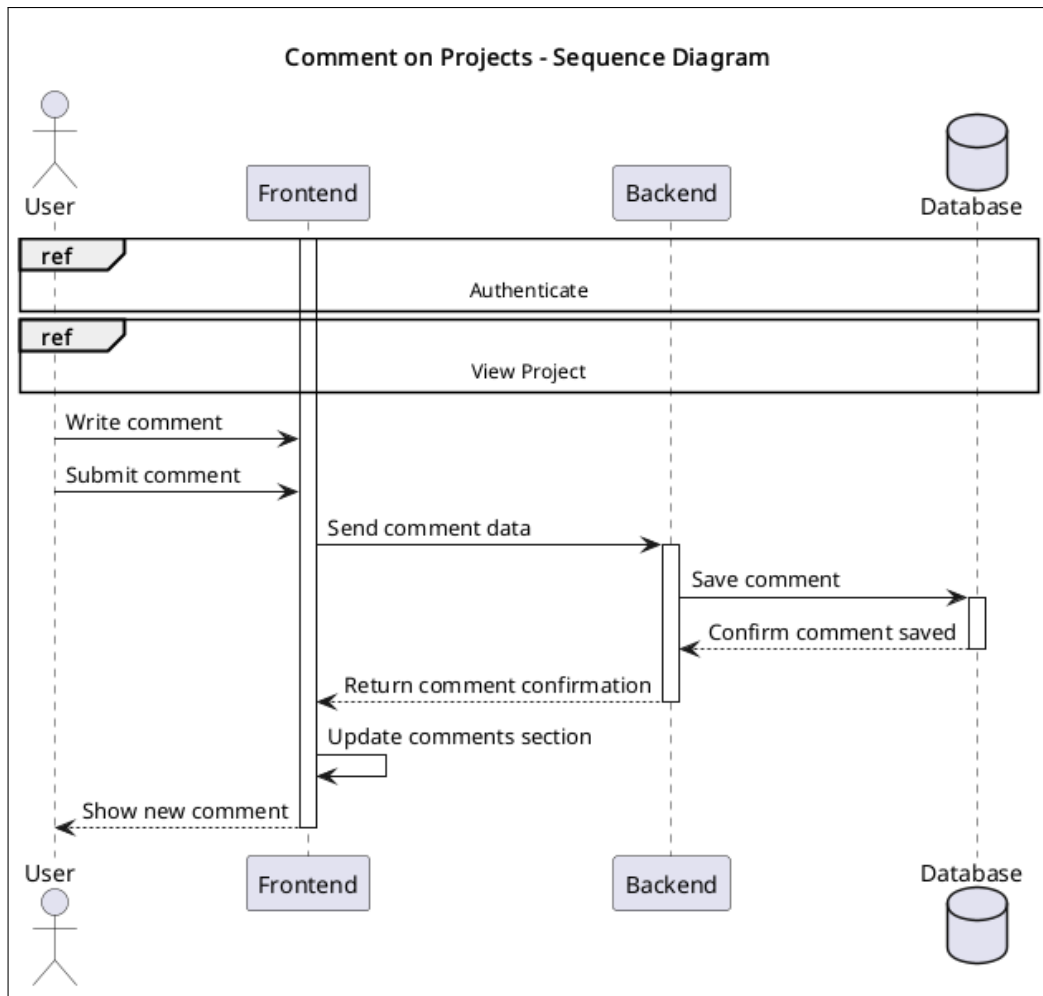


Figure 7.5: Project Commenting Flow

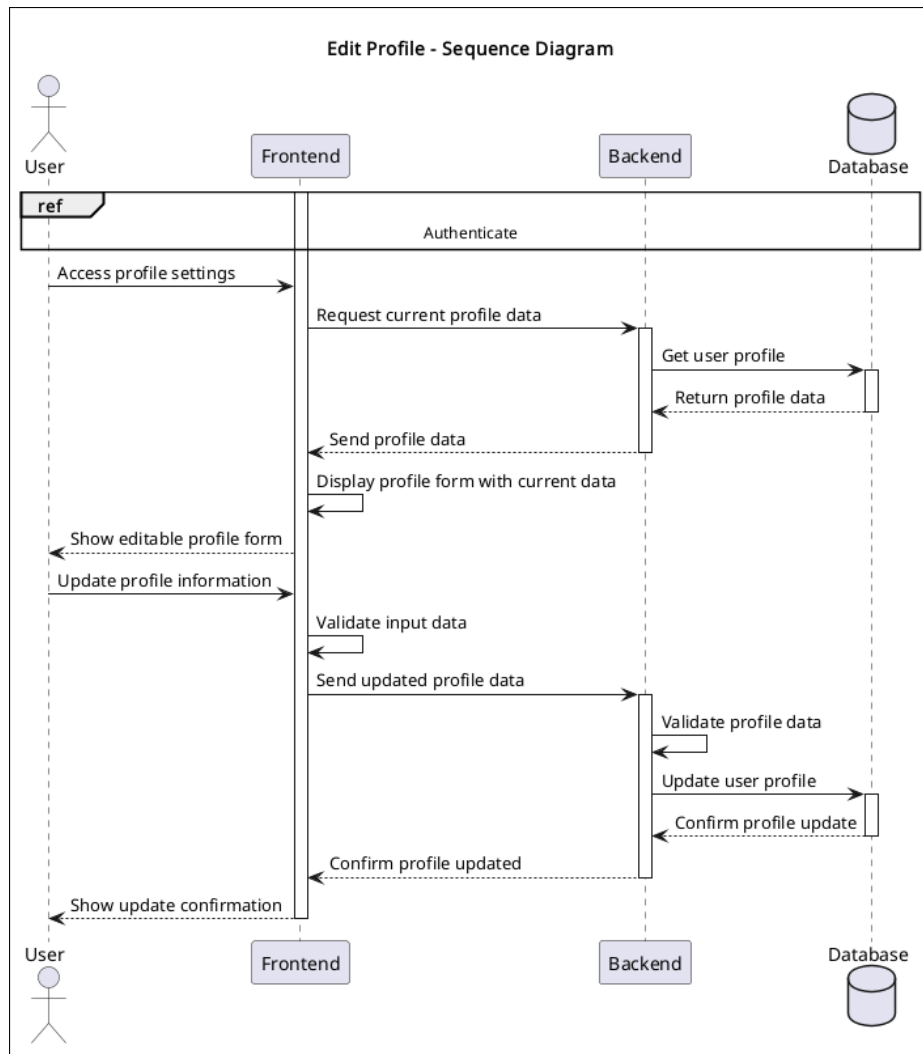


Figure 7.6: Profile Editing Flow

## 7.5 Implementation Results

### 7.5.1 Community Features

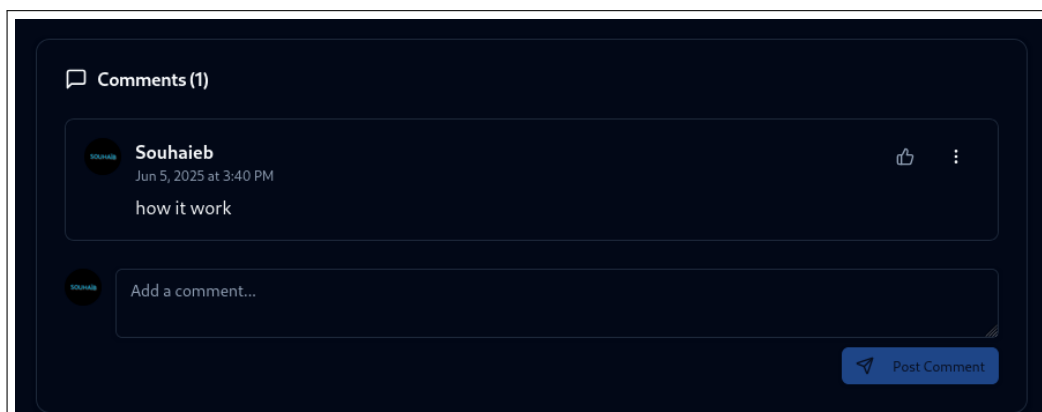


Figure 7.7: Comment System Implementation

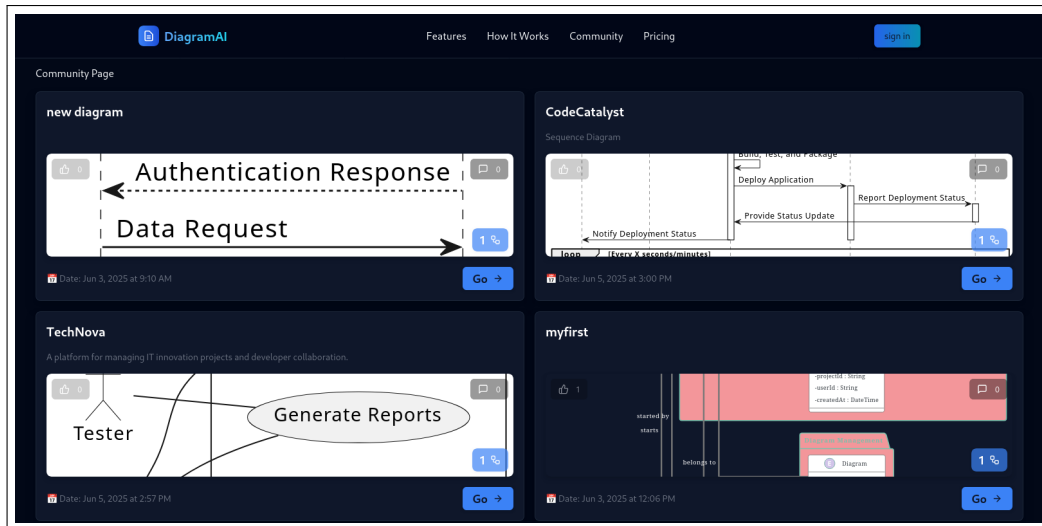


Figure 7.8: Community Exploration Interface

The comment system demonstrates comprehensive management including creation, editing, deletion, and interaction features for meaningful project discussions.

The profile interface enables users to maintain account information, update personal details, and manage their public platform presence with validation feedback.

## 7.6 Sprint Retrospective

### 7.6.1 Achievements

- Successfully implemented comprehensive community interaction features
- Smooth integration of profile management features

### 7.6.2 Future Actions

- Implement real-time notifications for community engagement
- Enhance mobile user experience across all features

## 7.7 Conclusion

Sprint V successfully transformed the platform into a collaborative community-driven ecosystem through comprehensive interaction features and robust profile management. The implementation of community exploration, project commenting, liking mechanisms, and profile editing establishes a solid foundation for user engagement and knowledge sharing.

# Chapter 8

## General Conclusion

### 8.1 Summary of Achievements

This project successfully delivered a comprehensive intelligent UML diagram generation platform that transforms traditional software modeling approaches. Through five systematic sprints using Scrum methodology, we created an AI-driven solution that bridges the gap between GUI-based tools and complex textual specifications.

Technical achievements include robust containerized infrastructure using PostgreSQL, MinIO, PlantUML, and Next.js, providing scalable foundation with DevOps best practices. OAuth-based authentication through NextAuth.js and Prisma database management ensure secure user management.

The platform delivers comprehensive project management capabilities, enabling users to organize and share UML projects efficiently. Core diagramming features include CRUD operations, intelligent workspace with AI assistance, and high-quality PlantUML rendering integration.

The final sprint transformed the platform into a collaborative community-driven ecosystem with interaction features, project commenting, and profile management, creating a knowledge-sharing environment beyond individual diagramming.

### 8.2 Challenges Faced

Development encountered significant technical challenges requiring innovative solutions. Technical architecture complexity arose from integrating AI services, PlantUML rendering, and authentication while maintaining performance standards. AI integration presented challenges in context management and ensuring contextually relevant suggestions.

User experience design proved challenging when balancing feature richness with interface simplicity. Performance optimization required sophisticated strategies for handling complex diagram rendering and AI interactions while maintaining browser responsiveness.

### 8.3 Future Perspectives

The platform establishes excellent foundation for continued innovation in intelligent diagramming tools. Future development will focus on advanced AI capabilities including natural language diagram generation and automated layout optimization.

Enhanced collaboration features will include real-time multi-user editing and integration with development tools. The platform will expand beyond UML to support additional modeling languages with pluggable architecture.

Enterprise features will include advanced user management and role-based access control. Mobile applications will extend accessibility while comprehensive API development will enable third-party integrations and community-driven feature development.

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