SmartSDLC – AI-Enhanced Software Development Lifecycle

Project Documentation

1. Introduction

- Project Title: SmartSDLC – AI-Enhanced Software Development LifecycleTeam Members:
    - **Member 1: Thapsira thamim nisha.H**
    - **Member 2: Durgadevi.M**
    - **Member 3: Ammu.J**
    - **Member 4: Vimanthani.S**

Introduction:

Software development is a multi-phase process that begins with requirements gathering and ends with deployment. A critical challenge faced by developers is accurately interpreting requirements and transforming them into functional code. Traditional methods involve manual documentation review and coding, which is time-consuming and error-prone.

The AI Code Analysis & Generator project aims to automate this process by combining Natural Language Processing (NLP) with Large Language Models (LLMs). The system accepts requirements (from PDFs or text), organizes them into structured categories, and generates corresponding source code in the desired programming language.

2. Project Overview

- Purpose:
  The primary purpose of this project is to create a smart AI assistant that:
    - Simplifies requirement analysis
    - Reduces manual effort in software documentation
    - Speeds up prototype development through code generation
- Objectives:
    - Provide an easy-to-use web interface for non-technical and technical users
    - Enhance requirement analysis with AI-based categorization
    - Support multiple programming languages for code generation
    - Encourage faster software prototyping in academic and professional settings
- Features:

1. **Requirement Analysis**
    - AI categorizes requirements into:
        - *Functional requirements* (features and behaviors)
        - *Non-functional requirements* (performance, usability, security, etc.)
        - *Technical specifications* (tools, technologies, standards)
2. **Code Generation**
    - AI converts requirement statements into working code snippets in multiple languages
    - Currently supports: Python, JavaScript, Java, C++, C#, PHP, Go, Rust
3. **PDF Document Processing**
    - Accepts uploaded PDFs
    - Extracts text automatically for further analysis
4. **Interactive Gradio Web UI**
    - Tab-based interface
    - *Code Analysis Tab* → Upload/enter requirements and get AI analysis
    - *Code Generation Tab* → Enter requirement + select language → Generate code

3. **Architecture**

The architecture follows a modular layered design:

- Frontend (Gradio):
    - Provides interactive, tabbed user interface
    - Built with gr.Blocks()
    - Handles file uploads, text inputs, and displays outputs
- Backend (Hugging Face Transformers + PyTorch):
    - Model: ibm-granite/granite-3.2-2b-instruct
    - Provides natural language understanding & code generation
    - Runs inference on GPU if available (for speed)
- PDF Processing (PyPDF2):

    - Reads PDF pages
    - Extracts plain text for NLP analysis
- Core Modules:
    - generate_response() → Model inference wrapper
    - extract_text_from_pdf() → PDF reader
    - requirement_analysis() → Requirement classification logic
    - code_generation() → Generates code snippets
- Data Flow:

1. Input (PDF/Text) →
2. Preprocessing (Tokenizer / PDF Reader) →
3. Model (LLM for analysis or code generation) →
4. Output (Textbox in Gradio UI)

4. Setup Instructions

Prerequisites:

- Platform: Google Colab (recommended) or local Python environment
- Python Version: 3.9+
- Libraries:
- pip install gradio torch transformers PyPDF2
- Internet: Required to download Hugging Face model

Installation Steps (Google Colab):

1. Open Colab notebook
2. Paste the project code into a new cell
3. Run the cell → Model + dependencies install automatically
4. Colab generates a public Gradio link → Open in browser

5. Folder Structure

```
project-root/
│── app.ipynb          # Colab notebook containing code
│── requirements.txt     # Optional dependency file
│── README.md            # Documentation
│── /data                # (Optional) Folder for storing PDFs
```

6. Running the Application

1. Start Colab runtime and run the notebook
2. Gradio launches and generates a public URL
3. Navigate to the link and use tabs:
    - Code Analysis Tab:
        - Upload a PDF or type requirements
        - Output: AI-generated categorized requirements
    - Code Generation Tab:
        - Enter requirement + select programming language
        - Output: AI-generated code snippet

7. API Documentation (Internal Functions)

- generate_response(prompt, max_length)
    - Input: Prompt string
    - Output: AI-generated text
- extract_text_from_pdf(pdf_file)
    - Input: PDF file
    - Output: Extracted plain text
- requirement_analysis(pdf_file, prompt_text)
    - Input: PDF or text
    - Output: Categorized requirements
- code_generation(prompt, language)
    - Input: Requirement + Language choice
    - Output: Code snippet in selected language

8. **Authentication**

- Current version is open-access for academic demo

- Future deployments may include:
  - JWT tokens for secure API usage
  - Role-based access (Admin, Developer, User)
  - API keys for Hugging Face model usage

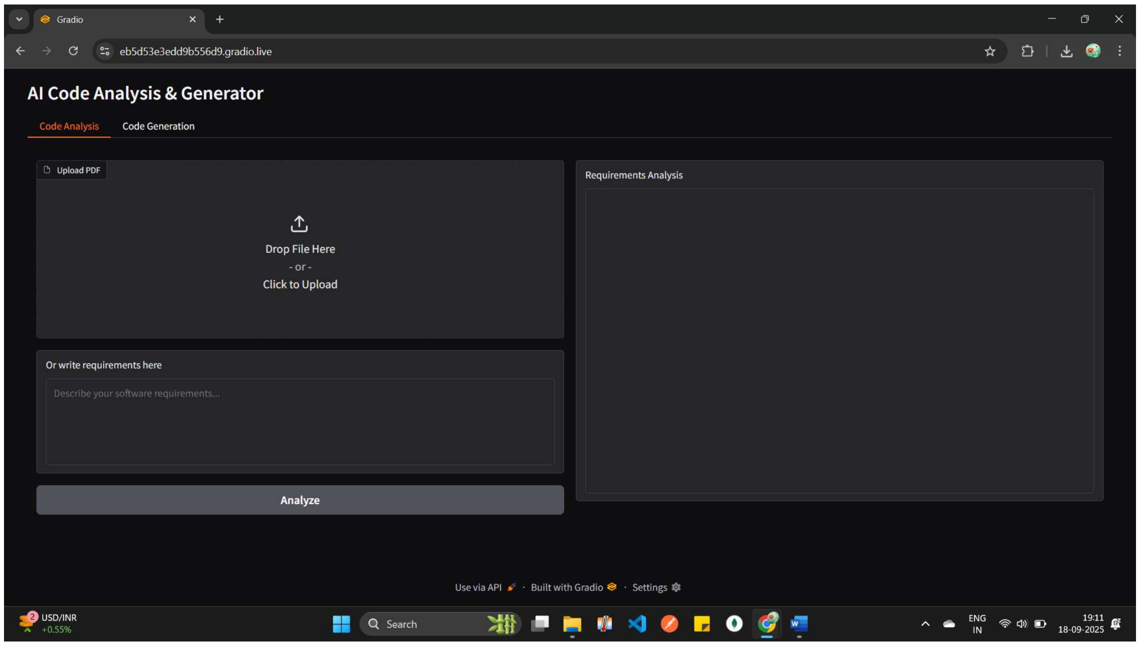
9. User Interface

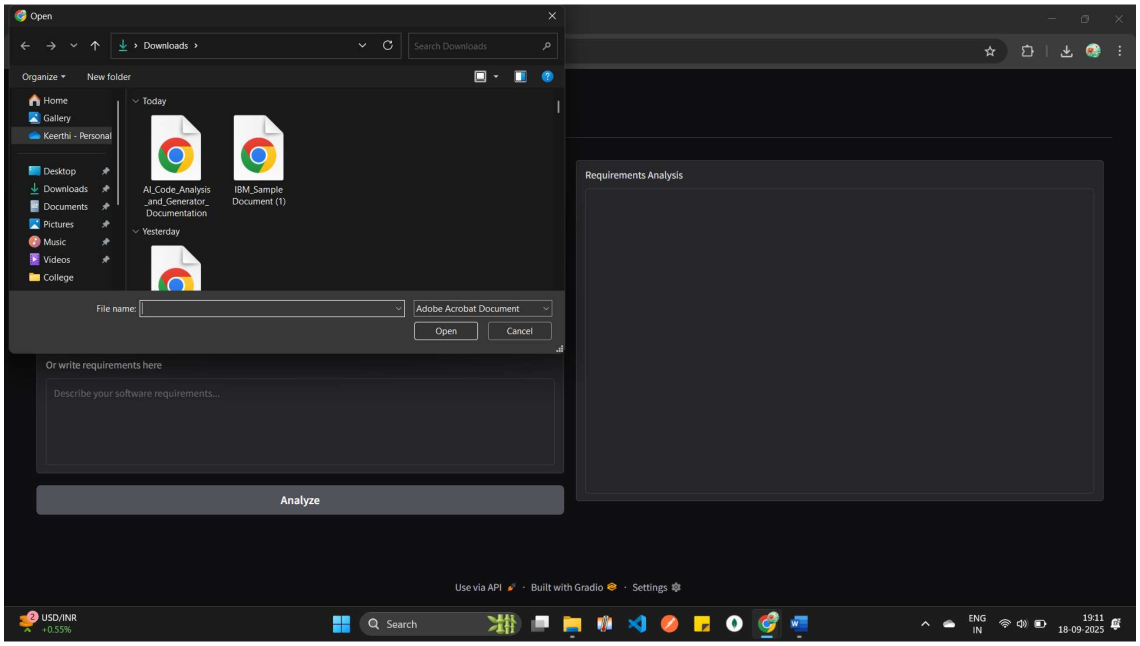
- Design Goals: Minimalist, tab-based, accessible for non-technical users
- Components:
  - Sidebar navigation (Gradio tabs)
  - File upload and text inputs
  - Drop-down menu for language selection
  - Real-time outputs for requirements and code

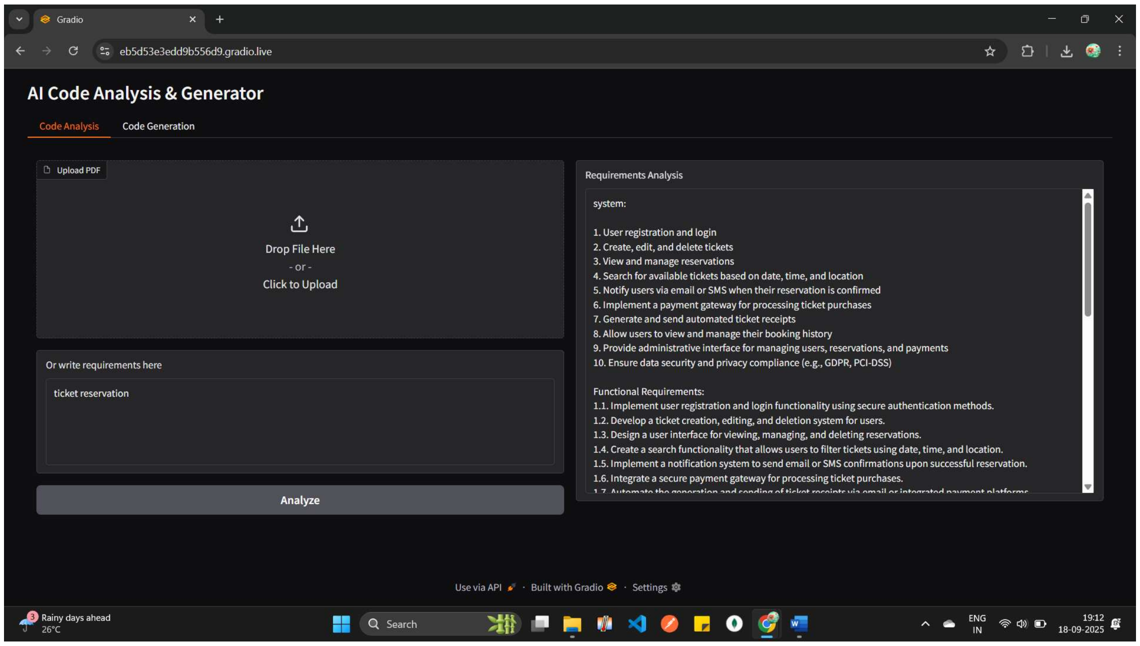
10. **Testing**

- Unit Testing:
  - PDF extraction functions
  - AI prompt generation
- API Testing:
  - Hugging Face model responses
  - Edge cases (long/empty input)
- Manual Testing:
  - File upload + text input in Gradio
  - Code generation correctness

11. Screenshots


Gradio
eb5d53e3edd9b556d9.gradio.live
AI Code Analysis & Generator
Code Analysis
Code Generation
Upload PDF
Drop File Here
- or -
Click to Upload
Requirements Analysis
Or write requirements here
Describe your software requirements...
Analyze
Use via API · Built with Gradio · Settings
USD/INR +0.55%
Search
ENG IN
19:11 18-09-2025





AI Code Analysis & Generator

Or write requirements here

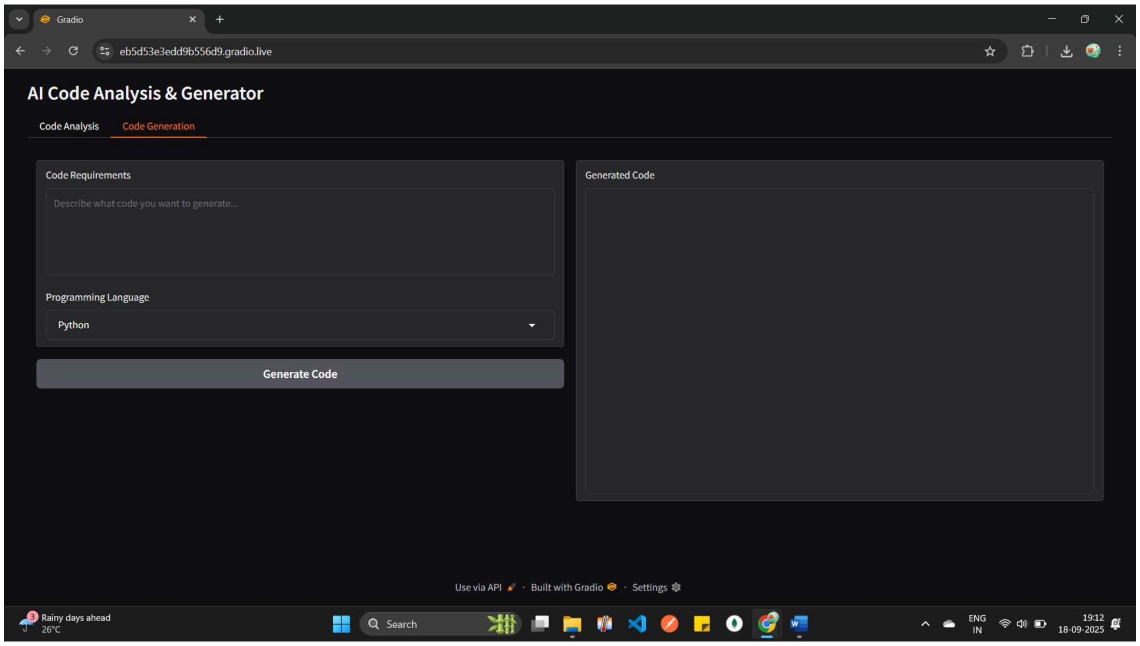
ticket reservation

Requirements Analysis

```
system:

1. User registration and login
2. Create, edit, and delete tickets
3. View and manage reservations
4. Search for available tickets based on date, time, and location
5. Notify users via email or SMS when their reservation is confirmed
6. Implement a payment gateway for processing ticket purchases
7. Generate and send automated ticket receipts
8. Allow users to view and manage their booking history
9. Provide administrative interface for managing users, reservations, and payments
10. Ensure data security and privacy compliance (e.g., GDPR, PCI-DSS)

Functional Requirements:
1.1. Implement user registration and login functionality using secure authentication methods.
1.2. Develop a ticket creation, editing, and deletion system for users.
1.3. Design a user interface for viewing, managing, and deleting reservations.
1.4. Create a search functionality that allows users to filter tickets using date, time, and location.
1.5. Implement a notification system to send email or SMS confirmations upon successful reservation.
1.6. Integrate a secure payment gateway for processing ticket purchases.
1.7. Automate the generation and sending of ticket receipts via email or integrated payment platforms
```



AI Code Analysis & Generator

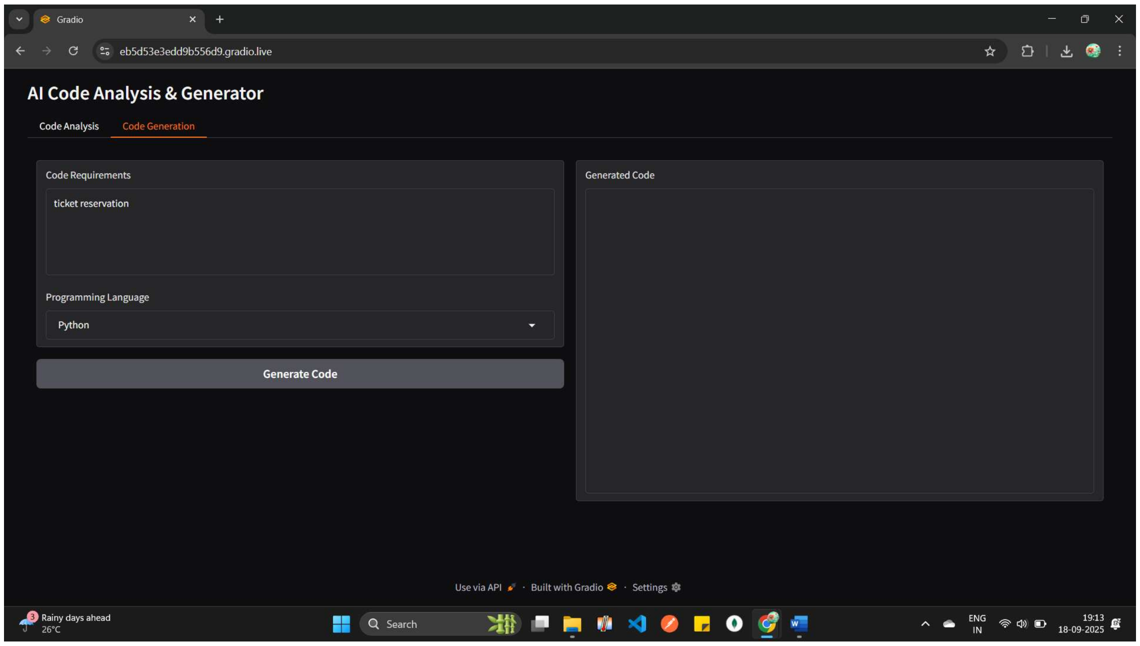
Code Requirements

Describe what code you want to generate...

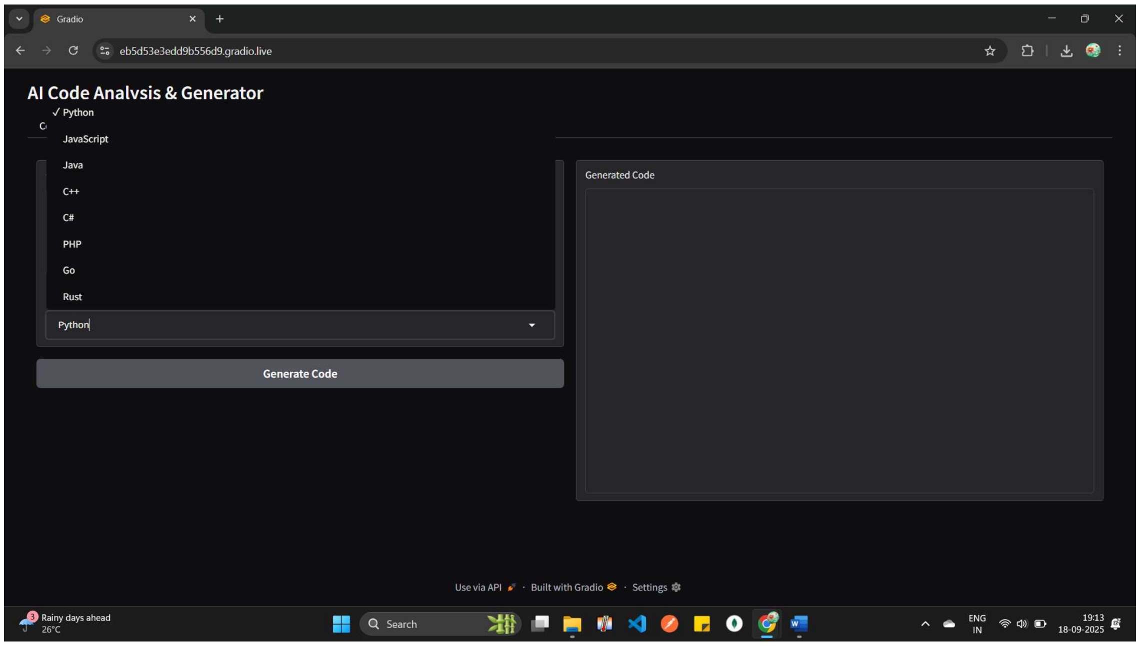
Programming Language

Python

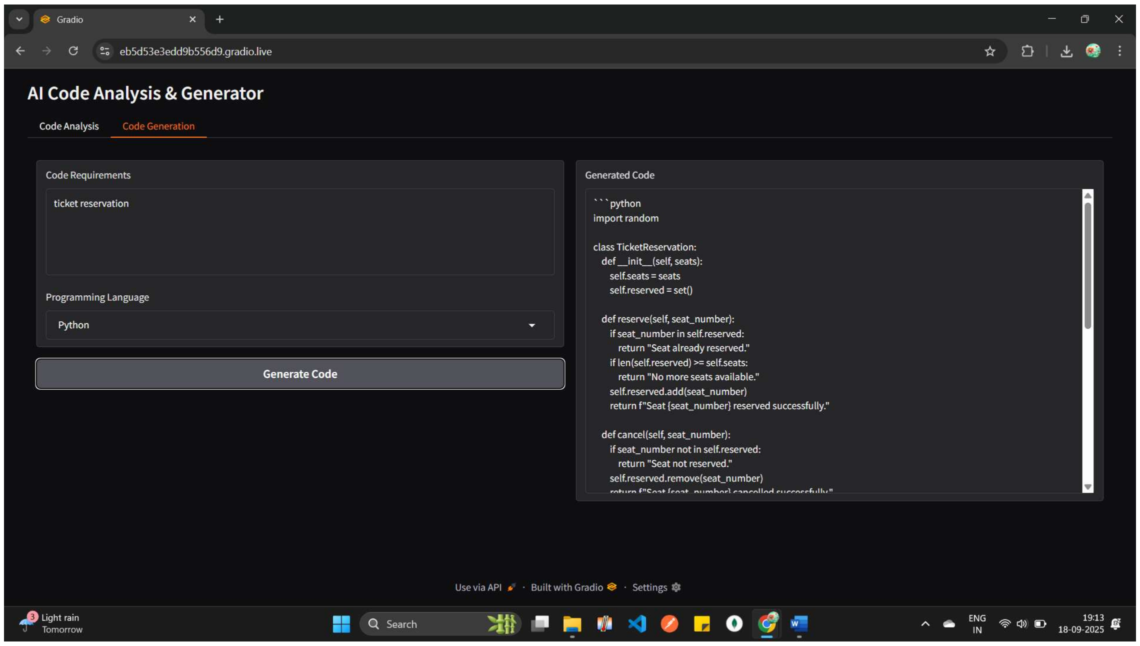
Generated Code



Gradio
eb5d53e3edd9b556d9.gradio.live
AI Code Analysis & Generator
Code Analysis
Code Generation
Code Requirements
ticket reservation
Programming Language
Python
Generate Code
Generated Code
Use via API · Built with Gradio · Settings
Rainy days ahead
26°C
Search
ENG
IN
19:13
18-09-2025



Gradio
eb5d53e3edd9b556d9.gradio.live
AI Code Analysis & Generator
✓ Python
JavaScript
Java
C++
C#
PHP
Go
Rust
Python
Generate Code
Generated Code
Use via API · Built with Gradio · Settings
Rainy days ahead
26°C
Search
ENG
IN
19:13
18-09-2025



Code Requirements: ticket reservation

~~~
```python
import random

class TicketReservation:
  def __init__(self, seats):
    self.seats = seats
    self.reserved = set()

  def reserve(self, seat_number):
    if seat_number in self.reserved:
      return "Seat already reserved."
    if len(self.reserved) >= self.seats:
      return "No more seats available."
    self.reserved.add(seat_number)
    return f"Seat {seat_number} reserved successfully."

  def cancel(self, seat_number):
    if seat_number not in self.reserved:
      return "Seat not reserved."
    self.reserved.remove(seat_number)
    return f"Seat {seat_number} cancelled successfully."
~~~

12. **Known Issues**

- Slow model loading (~500MB download on first run in Colab)
- Performance varies with document size
- Limited handling of complex/multi-page PDFs
- Generated code may require manual debugging

---

13. **Future Enhancements**

- Add database storage for past analysis results
- Extend support to Word (.docx) and Excel (.xlsx) documents
- Improve code generation with error handling and explanations
- Add multi-turn conversational capability (chatbot-style assistant)
- Integrate with project management tools like Jira or Trello