# System Architecture

The **AI-Generated Recipe Assistant** is built using a **modular architecture** for scalability, speed, and maintainability.

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## 1. Frontend (React + Tailwind CSS)

- Handles **user input** (ingredient photos, dietary preferences, cuisine).

- Sends data to backend via **REST API**.

- Displays:

    - Detected ingredients

    - Generated recipes

    - Options to save, share, or regenerate recipes

- **Image:**
  *(Placeholder: Frontend interface mockup)*

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## 2. Backend (FastAPI / Flask)

- Handles core API endpoints:

    - `/generate-recipe` → Generates new recipes using ML model

    - `/save-recipe` → Stores user recipes

- Preprocesses input before sending to ML model

- Formats output before sending back to frontend

- **Image:**
  *(Placeholder: Backend API flow diagram)*

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# 3. Machine Learning Layer

- **Ingredient Detection:**

    - YOLOv8 / Detectron2 for object detection

    - Pre-trained or fine-tuned on **food datasets** (Food-101, IndianFood14)

- **Recipe Generation:**

    - LLM (GPT / Llama) generates creative, structured recipes based on detected ingredients

- **Image:**
  *(Placeholder: Diagram showing CV model → LLM pipeline)*

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# 4. Database (MongoDB / PostgreSQL)

- Stores:

    - User profiles and preferences

    - Saved/generated recipes

    - Feedback for model improvement

- **Image:**
  *(Placeholder: Database schema diagram)*

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# 5. Optional Integrations

- **Image Generation:** DALL·E / Stable Diffusion for realistic dish previews

- **Voice Input:** Users can speak ingredients to generate recipes faster

- **Image:**
  *(Placeholder: Integration diagram showing optional services)*

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# 🔁 Example System Flow

1. User uploads fridge/pantry photo → **Frontend**

2. Frontend sends data → **Backend API**

3. Backend calls **CV model** → detects ingredients

4. Detected ingredients → **LLM** → generates recipe

5. Formatted recipe → Backend → **Frontend** → displayed to user

- **Image:**
  *(Placeholder: End-to-end system flow diagram)*