

# RecipeAssist

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A personalized chatbot that recommends recipes based on your dietary preferences, ingredients, and cuisine choices

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# 1. Project Goal

The goal of this project is to develop **RecipeAssist**, a chatbot that uses a **Large Language Model (LLM) API** to recommend personalized recipes based on user preferences, ingredients, and dietary needs. The project will involve integrating **function calling** to query a recipe database and provide relevant suggestions.

## 2. Features

- 2.1. **Personalized Recipe Recommendations:** Suggests recipes tailored to user preferences such as dietary needs, cuisine types, and nutritional goals.
- 2.2. **Dietary Preference Parsing:** Understands specific dietary requirements like Vegan, Vegetarian, Keto, Gluten-Free, or No Preference.
- 2.3. **Nutritional Analysis:** Filters recipes based on macronutrient levels (Carb, Protein, Fat) categorized as High, Medium, or Low.
- 2.4. **Time-Conscious Options:** Recommends recipes based on prep time preferences for users seeking quick meals.
- 2.5. **Interactive Clarifications:** Asks follow-up questions to capture missing details and refine recommendations.
- 2.6. **Content Moderation:** Includes input moderation to ensure safe and relevant interactions.
- 2.7. **Recipe Filtering:** Validates and recommends recipes from a database, prioritizing highly rated options.
- 2.8. **Flexible Query Handling:** Handles vague or open-ended user inputs with clarifying questions and step-by-step refinements.
- 2.9. **Preloaded Catalog:** Summarizes available recipes in a catalog format with key details like nutritional values and prep times.

### 3. Data Sources

For this project, we will assume a small set of recipes. Here is a sample extract from the list of 40 recipes that we will use in this project.

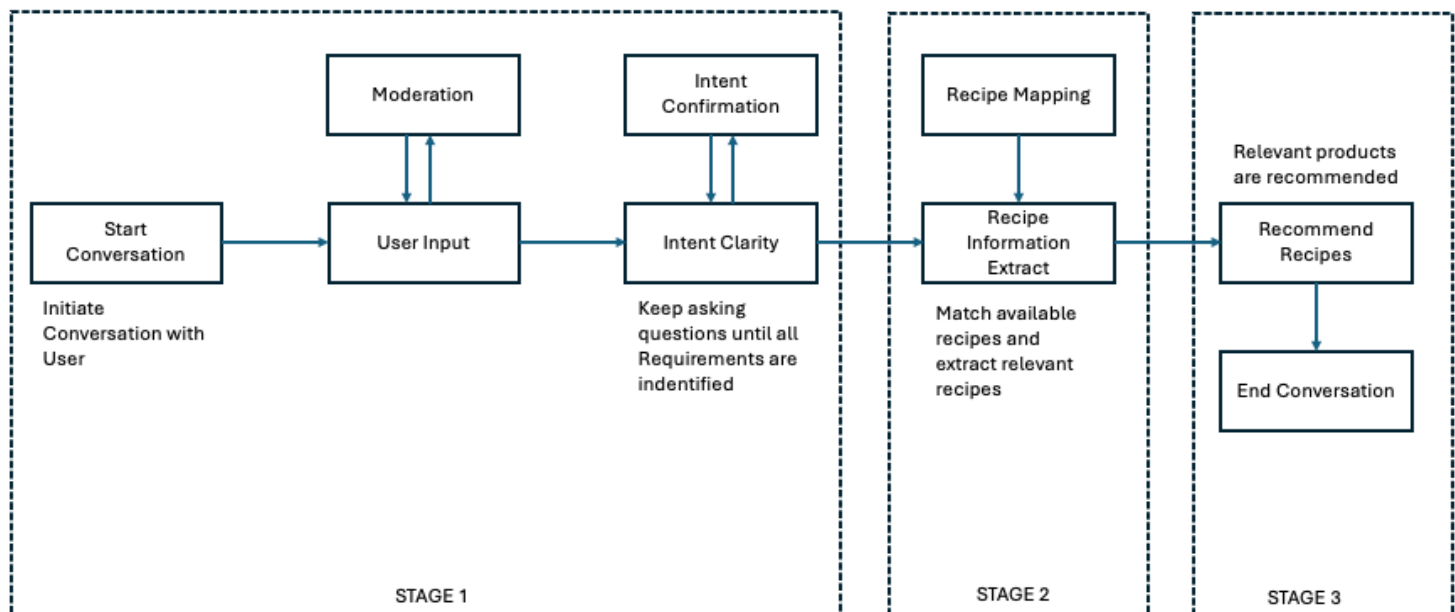
Recipe Name	Dietary Preference	Cuisine	Main Ingredients	Prep Time (Minutes)	Description
Vegan Tacos	Vegan, Gluten-Free	Mexican	Corn tortillas, black beans, avocado, tomato, cilantro, lime, chili powder, garlic	20	Soft corn tortillas filled with seasoned black beans, fresh avocado, diced tomatoes, and cilantro.
Chicken Caesar Salad	Gluten-Free	American	Grilled chicken breast, Romaine lettuce, Caesar dressing, Parmesan	15	Classic Caesar salad topped with grilled chicken, crispy lettuce, and creamy Caesar dressing.
Vegetarian Stir-Fry	Vegetarian, Gluten-Free	Asian	Tofu, bell peppers, broccoli, snap peas, soy sauce, sesame oil, garlic, ginger	25	Stir-fried tofu with fresh vegetables in soy sauce based dressing, topped with sesame seeds.
Spaghetti Aglio e Olio	Vegetarian	Italian	Spaghetti, garlic, olive oil, red chili flakes, parsley, Parmesan (optional)	20	Simple pasta with garlic, olive oil, and chili flakes, topped with parsley and optional Parmesan.
Grilled Salmon with Asparagus	Gluten-Free, Keto	American	Salmon fillets, asparagus, olive oil, lemon, garlic, dill	25	Grilled salmon with lemon and garlic, served with tender asparagus spears.
Vegetable Soup	Vegan, Gluten-Free	Mediterranean	Carrots, celery, zucchini, tomatoes, vegetable broth, onion, garlic, bay leaves	40	A comforting soup with carrots, zucchini, and tomatoes in a savory vegetable broth.
Chicken Curry	Gluten-Free	Indian	Chicken thighs, onions, garlic, ginger, curry powder, coconut milk, tomatoes, cilantro	45	Aromatic chicken curry cooked with coconut milk and Indian spices.
Sweet Potato & Black Bean Chili	Vegan, Gluten-Free	American	Sweet potatoes, black beans, tomatoes, onions, chili powder, cumin, garlic, broth	40	A hearty chili made with sweet potatoes and black beans, perfect for a warming meal.
Quinoa Salad with Roasted Vegetables	Vegan, Gluten-Free	Mediterranean	Quinoa, zucchini, bell peppers, cherry tomatoes, olive oil, lemon juice, parsley	30	A refreshing quinoa salad with roasted vegetables and a lemon dressing.
Chicken Tacos	Gluten-Free	Mexican	Ground chicken, corn tortillas, lettuce, tomato, onion, cheddar cheese, taco seasoning	20	Ground beef tacos seasoned with taco spices, served in corn tortillas with fresh toppings.

## 4. System Design

### 4.1. Without Function Calling

The system design for the project is illustrated in the diagram below. For ease, the system design has been grouped into three stages.

- Stage 1: Intent Clarity and Intent Confirmation
- Stage 2: Recipe Extraction and Recipe Mapping
- Stage 3: Recipe Recommendation



#### Stage 1: Intent Clarity and Intent Confirmation

1. **Start Conversation:**
  - Description: RecipeAssist initiates a conversation with the user.
  - Example Text: "Hi! I'm RecipeAssist. Let me help you find the perfect recipe. What are you looking for today?"
2. **User Input:**
  - Description: The user provides details such as dietary preferences, cuisine type, or specific ingredients.
  - Example Input: "I want a vegetarian dish with tomatoes and basil."
3. **Intent Clarity:**
  - Description: RecipeAssist asks clarifying questions to better understand user requirements.
  - Example Question: "Do you prefer Italian cuisine, or should I include other options?"

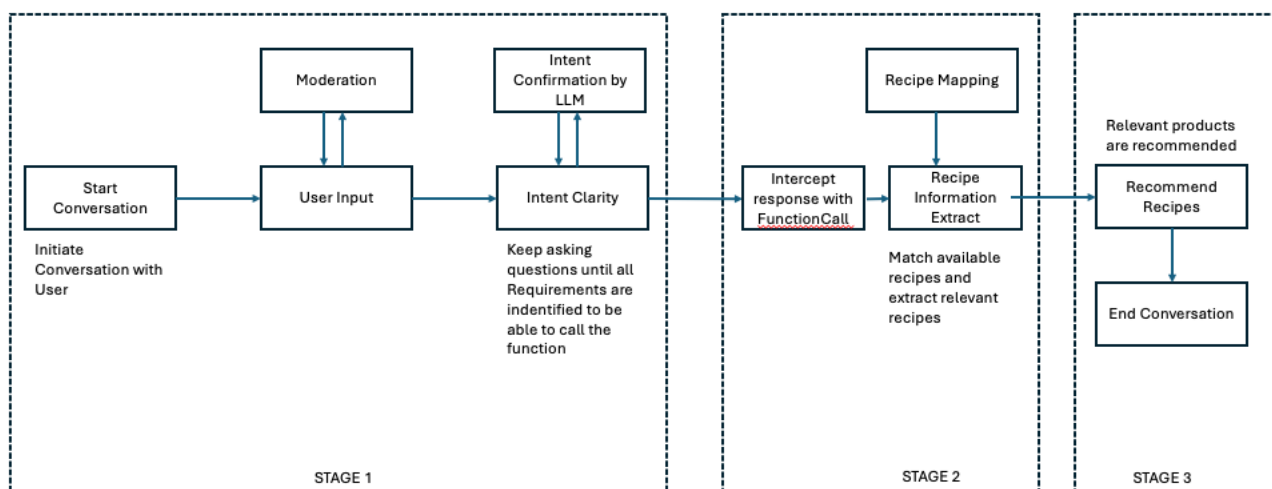
## Stage 2: Recipe Extraction and Recipe Mapping

4. Recipe Mapping:
  - Description: The chatbot matches the user's preferences with its database of recipes.
  - Example Process: Matches "vegetarian" and "tomatoes, basil" to pasta, pizza, and soup options.
5. Recipe Information Extraction:
  - Description: The chatbot filters relevant recipes and extracts the most suitable options.
  - Example Output: A list of recipes like "Margherita Pizza," "Tomato Basil Soup," or "Caprese Salad."

## Stage 3: Recipe Recommendation

6. Recipe Recommendation:
  - Description: RecipeAssist recommends relevant recipes to the user.
  - Example Output: "Based on your preferences, I recommend these recipes: 1. Margherita Pizza, 2. Tomato Basil Soup. Would you like to explore one?"
7. End Conversation:
  - Description: The chatbot ends the conversation once the user confirms satisfaction or presses 'exit.'
  - Example Text: "Great! Enjoy cooking. If you need more help, just ask. Bye!"

## 4.2. With Function Calling



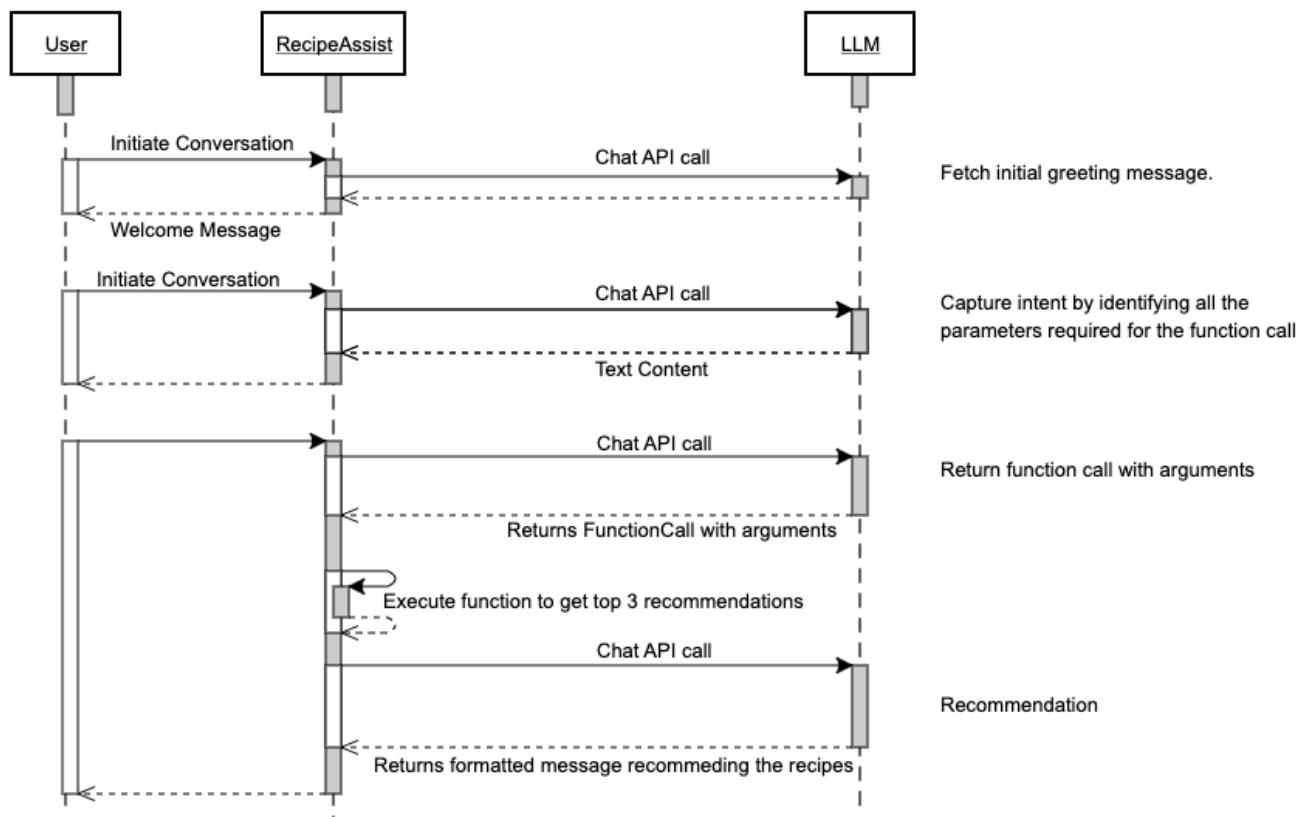
### The three layers remain pretty much same except for the below mentioned changes:

Stage 1: Intent Clarity and Intent Confirmation- In this stage, the Intent Confirmation is offloaded to LLM. Open AI API would continue asking questions until all the conditions required to call the function are met.

Stage 2: Recipe Extraction and Recipe Mapping – Once all the requirements are captured, LLM response would have the function\_call parameter set indicating that we are ready to call the function to get recommended recipes. App would call the function with the arguments provided by LLM and then process it via the validation layer to get the final recommended recipes.

**Note:** I have not attached the response to the same conversation chain, simply to keep the next LLM API call lighter. This works for my case since the only step after identifying recipes, was to present it to the user. However in cases where the history is necessary, we can add the response back to the same conversation history and subsequent responses from LLM would have better context in responding to user queries.

Stage 3: Recipe Recommendation – App would make another LLM call to recommend the recipes identified in a meaningful and presentable message.



Sequence Diagram of the workflow

## 5. User Experience Evaluation

### Evaluation Criteria:

- User friendliness
- Seamless interaction with the chatbot
- Clarity of response

### Evaluation Summary:

- The responses were very user friendly and the integration was seamless. The clarity of the response was also very good as illustrated in the examples below.
- However, there were a few instances where the LLM model would hallucinate and keep asking the same question again and again. This indicates that there is a large scope of improvement of the prompts.
- Will experiment further with better prompting techniques.

## 5.1. Example 1

RecipeAssist

Hello! I'm here to help you find the perfect recipe. To get started, could you let me know if you have any specific dietary preferences or if you're open to anything? Also, how much time do you have for preparation?

Hi, I am in the mood for some Mexican

That's fantastic! Mexican cuisine is full of vibrant flavors. Do you have any specific dietary preferences, such as vegan, vegetarian, gluten-free, or anything else? Also, how quick are you looking to prepare this meal?

I am advised to avoid gluten

Got it! So you're looking for Mexican cuisine and need

Type your message here...

End Conversation

RecipeAssist

I am advised to avoid gluten

Got it! So you're looking for Mexican cuisine and need gluten-free options. Do you have any specific dietary preferences like vegan or vegetarian, or are you open to other options? Also, how much prep time do you prefer for your meals?

No other preference, I would like to make it under 30 mins

Great! So you're looking for gluten-free Mexican recipes that can be prepared in under 30 minutes. To better refine my recommendations, how do you feel about the levels of carbs, protein, and fat in your meals? Would you like them to be low, medium, or high? And what about the spice level—do you prefer something mild, or are you open to a bit of heat?

Type your message here...

End Conversation

RecipeAssist

Hello! I'm here to help you find the perfect recipe. To get started, could you let me know if you have any specific dietary preferences or if you're open to anything? Also, how much time do you have for preparation?

Hi, I am in the mood for some Mexican

That's fantastic! Mexican cuisine is full of vibrant flavors. Do you have any specific dietary preferences, such as vegan, vegetarian, gluten-free, or anything else? Also, how quick are you looking to prepare this meal?

I am advised to avoid gluten

Got it! So you're looking for Mexican cuisine and need

Type your message here...

End Conversation

RecipeAssist

Got it! So you're looking for Mexican cuisine and need gluten-free options. Do you have any specific dietary preferences like vegan or vegetarian, or are you open to other options? Also, how much prep time do you prefer for your meals?

Yes please

Here are the three recipe options available: 1. Vegan Tacos: Soft corn tortillas filled with seasoned black beans, fresh avocado, diced tomatoes, and cilantro, Nutritional Value: Medium Carb, Medium Protein, Medium Fat, Spice Level: Medium, Prep Time: 20 minutes. 2. Chicken Tacos: Ground chicken tacos seasoned with taco spices, served in corn tortillas with fresh toppings, Nutritional Value: Medium Carb, High Protein, Medium Fat, Spice Level: Medium, Prep Time: 20 minutes. 3. Fish Tacos: Crispy fish tacos with tangy cabbage slaw and creamy avocado sauce, Nutritional Value: Medium Carb, High Protein, Medium Fat, Spice Level: Medium, Prep Time: 20 minutes. If you have any specific questions about these recipes or need further assistance, feel free to ask!

Type your message here...

End Conversation



## 5.2. Example 2

### RecipeAssist

Hello! I'm here to help you find the perfect recipe. Could you share any specific dietary preferences you have, like vegan, vegetarian, gluten-free, or keto? Also, do you have a favorite cuisine in mind?

Indian, Spicy low carb, high protein, 30 mins

Thank you for sharing your preferences! Just to confirm, are you looking for vegan, vegetarian, gluten-free options, or do you have any specific dietary preferences?

I dont mind anything

Great! Thank you for sharing your preferences. Since you prefer Indian cuisine, enjoy spicy dishes, and are looking for low-carb and high-protein options with a

Type your message here...

End Conversation

### RecipeAssist

I dont mind anything

Great! Thank you for sharing your preferences. Since you prefer Indian cuisine, enjoy spicy dishes, and are looking for low-carb and high-protein options with a preparation time of 30 minutes, I'll also set the remaining preferences to 'NoPreference' since you don't mind about them. Just to confirm, would you like to proceed with Indian spicy recipes that are low in carbs and high in protein, taking no more than 30 minutes to prepare?

Yes, thats good

Here's a brief summary of each recipe from the catalogue: 1. Rasam : Spicy and tangy South Indian soup made with tamarind and spices., Nutritional Value - Carb: Low, Protein: Low, Fat: Low, spiceLevel: High, score: 4, prepTime: 20 minutes 2. Chana Masala : Hearty chickpea curry in a flavorful tomato-based

Type your message here...

End Conversation

### RecipeAssist

to proceed with Indian spicy recipes that are low in carbs and high in protein, taking no more than 30 minutes to prepare?

Yes, thats good

Here's a brief summary of each recipe from the catalogue: 1. Rasam : Spicy and tangy South Indian soup made with tamarind and spices., Nutritional Value - Carb: Low, Protein: Low, Fat: Low, spiceLevel: High, score: 4, prepTime: 20 minutes 2. Chana Masala : Hearty chickpea curry in a flavorful tomato-based sauce., Nutritional Value - Carb: Medium, Protein: Medium, Fat: Low, spiceLevel: High, score: 3, prepTime: 30 minutes 3. Aloo Gobi : Spiced potato and cauliflower curry cooked with onions and tomatoes., Nutritional Value - Carb: Medium, Protein: Low, Fat: Low, spiceLevel: Medium, score: 2, prepTime: 30 minutes Feel free to ask if you have any specific queries about any of these recipes!

Type your message here...

End Conversation

## 5.3. Example 3

RecipeAssist

Hello! I'm here to help you find the perfect recipes tailored to your needs. Could you please share more about your dietary preferences, any specific cuisines you enjoy, how much time you have to prepare a meal, and what you're looking for in terms of carbs, protein, fat, and spice level? Your insights will really help me recommend the best meal options for you!

I am in the mood for Asian

That's wonderful! Asian cuisine offers so many delicious options. Do you have any specific dietary preferences, such as vegan, vegetarian, gluten-free, or anything else? This will help me narrow down the best meal options for you.

No dietary restrictions

Type your message here...

End Conversation

RecipeAssist

Thanks for sharing your preferences! Since you're open on dietary restrictions, could you let me know how much time you have for preparation? Also, do you have any preferences regarding the levels of carbs, protein, fat, or spice in your meals?

I have about an hour

That's great! Since you mentioned you're in the mood for Asian cuisine and have no dietary restrictions, let's talk about your preferences regarding the nutritional aspects. How do you feel about carbohydrates? Would you like them to be low, medium, or high? And what about protein and fat levels? Lastly, do you prefer your meals to be low, medium, or high in spice?

No preference for any of these

Type your message here...

End Conversation

RecipeAssist

Great! Since you're in the mood for Asian cuisine and have no dietary restrictions, I'm considering a broad range of options for you. It seems you want meals with no specific preferences for carb, protein, fat, or spice level. To clarify, just to summarize: - Cuisine: Asian - Dietary Preference: NoPreference - Prep Time: about 60 minutes - Carb: NoPreference - Protein: NoPreference - Fat: NoPreference - Spice Level: NoPreference Does that sound correct? If yes, I'll go ahead and find the top 3 recipes for you!

Yes please

Here is the recipe option available in the catalogue: 1. Vegetarian Stir-Fry: Stir-fried tofu with fresh vegetables in soy sauce-based dressing, topped with sesame seeds. Nutritional Value: Medium Carb, Medium Protein, Medium Fat, Low spice level. Prep Time: 25 minutes. If you have any questions about this recipe or need further assistance, feel free to ask!

Type your message here...

End Conversation

## 6. Challenges Faced

- **Prompt Engineering** – Initially writing the prompts was a bit of a challenge. Though the initial responses were good, sometimes the response from LLM was unexpected. It was a great learning experience in terms of writing a good prompt. I now understand the importance of Prompt engineering much better.
- **Function Calling** – Exploring the documentation from openAI, I was trying to understand how function calling works. The key takeaway is that LLMs do not dynamically execute a function call, but merely recommend which function to be called and it is the responsibility of the application to call the function and return to LLM with the response. Various response handling patterns were good learning.
- **User Input Variability** - Users may describe recipes or ask questions in highly varied and sometimes ambiguous ways. Most of this was managed efficiently with good prompting techniques.
- **Multi-Turn Context Management** – Multiple messages exchanged to arrive at the intent clarification was a challenging implementation. A lot of this task was simplified with Function Calling. Since the intent can be prompted as calling the function with right parameters. However there is still a lot of scope for improvement.

## 7. Assignment Source Code

Source code can be found here - <https://github.com/yeshwanthbr/RecipeAssistant>

### To run the app

Add your OpenAI API key to the file OpenAI\_API\_Key.txt

Command to run Example with Function Calling

```
FLASK_APP=app.py flask run
```

Command to run Example without Function Calling

```
FLASK_APP=app_without_fc.py flask run
```

Start the server and access the chat app from <http://127.0.0.1:5000>