AI Food Assistant

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Abstract

Coming up with recipes is a difficult task for people because sometimes there are only a few options in the fridge and people don't know recipes that can be made for that list. The AI-based food machine learning model presented in this work creates recipes according to user-specified parameters, including total calories, ingredients, cuisine, and dietary restrictions. The model creates recipes based on user preferences using ChatGPT. Using a Raspberry Pi, the application is developed in both device and online formats. This approach seeks to help users locate appropriate recipes that support different cuisines and their nutritional objectives for weight loss. In comparison to current neural network models devoted to recipe development, the method provides greater flexibility and adaptability. For example other models won't be able to deal with spelling mistakes and our model has a 94% success rate.

Introduction

When attempting to maintain or reduce their weight, many people find it difficult to prepare enticing, healthful meals. Although there are many different recipe alternatives, few of them combine different cultures, dietary constraints, and precise calorie limits. In order to bridge this gap, we suggest a recipe generator that generates customized dishes based on parameters like caloric limits, preferred ingredients, cuisine, and dietary requirements. Considering the limitations, this enables individuals to enjoy their cuisine.

Current methods for creating recipes usually entail training neural networks on big recipe datasets in an effort to identify those that most closely fit user needs (Jing Han et al., Kusner et al., and Elsweiler). These methods, however, frequently lack adaptability and flexibility. On the other hand, our method uses ChatGPT, an advanced transformer-based language model, to provide recipes that are tasty and varied in addition to being nutrient-dense.

Contributions of this paper include:

- Using a ChatGPT API call, this study contributes by creating a recipe creation system that takes into account a variety of user constraints, such as dietary restrictions, ingredients, calories, and cuisine.
- Allowing for flexible use by implementing the model in both website and device (Raspberry Pi) forms.
- Proving the model's capacity to manage intricate queries and guaranteeing that meals are customized to suit personal tastes and health objectives.

Related Work

The work of Jing Han, Xinyang Zhang, and Jingbo Shang (2019) in their paper "Neural Recipe Generation with Ingredient-Pair Embedding" is one example of the advancements made in the field of AI-based recipe development. Coherent recipe generating is made possible by their model's use of ingredient-pair embeddings incorporated into a neural network. Although this method captures ingredient interactions well, it is not very flexible or adaptable when considering different limitations. .

The OpenAI GPT-4o model, on the other hand, is a transformer-based model that can comprehend natural language inputs and create detailed recipes based on user limitations. Compared to conventional neural network models, this enables more dynamic interactions and the capacity to manage a wider variety of dietary requirements.

The 2019 research "Neural Recipe Generation with Ingredient-Pair Embedding" by Jing Han et al. explores the use of neural networks to embed ingredient pairs and generate coherent recipes. Although this method effectively captures the interactions between ingredients, it is not very flexible when dealing with intricate user-defined constraints (such as dietary or caloric limits). Our model which uses natural language processing to handle constraints more dynamically, provides a notable advance in this crucial area. ChatGPT's cutting-edge technology enables more sophisticated searches that offer better and faster results.

Particularly with machine learning models trained on extensive recipe datasets, the development of AI in recipe generation has accelerated. Earlier methods, like the one described by Kusner et al. (2017) in "GRAM: Graph-based Attention Model for Recipe Generation," improved the coherence of created recipes by modeling ingredient dependencies using attention mechanisms. However, this model's flexibility in accommodating various user-defined constraints was still restricted, especially when taking dietary restrictions or calorie control into consideration.

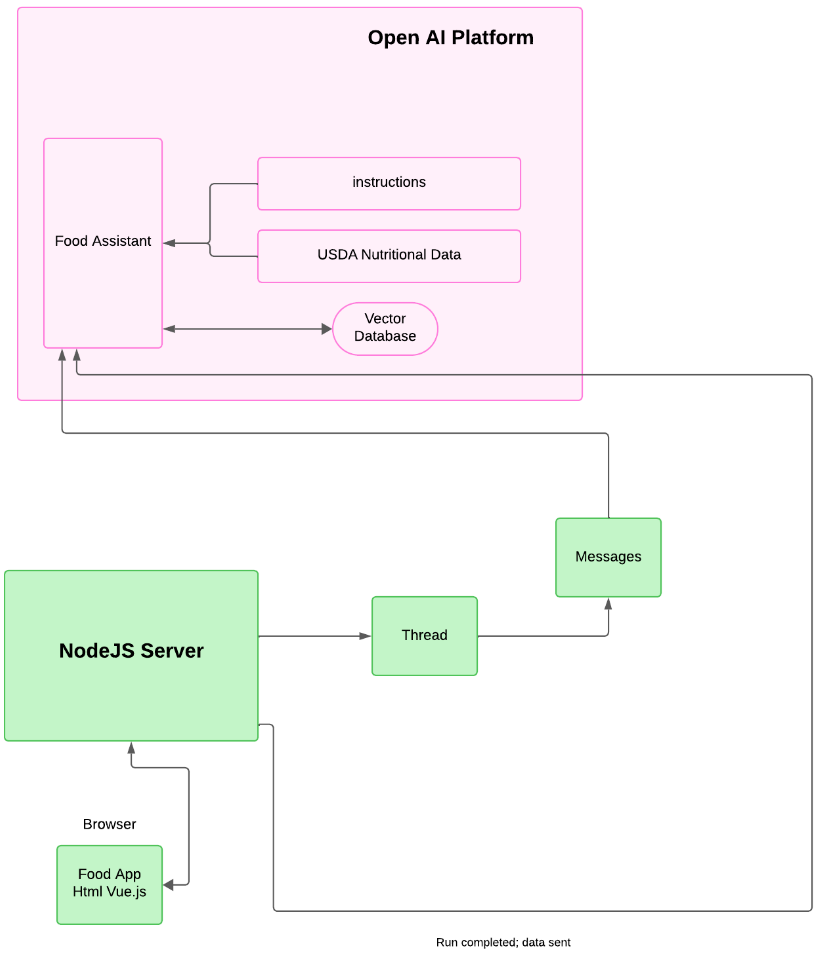
A system based on a sequence-to-sequence learning architecture was presented in another noteworthy study by Majumder et al. (2019), in which the input ingredients were mapped to detailed instructions. This system did a decent job of organizing recipes logically, but it struggled to employ the flexibility required to adjust to complicated user limitations, including calorie limits or particular dietary preferences.

In contrast, our method provides a more customized response by using the advantages of transformer-based models, such as OpenAI's GPT-4o. Transformer-based designs, like GPT-4o, exhibit more benefits when it comes to addressing a variety of intricate user-provided restrictions and processing natural language. This makes it possible to create more intricate recipes, particularly when balancing particular nutritional objectives like calorie intake with a variety of dietary constraints (vegan, keto, gluten-free, etc.).

Additionally, AI-enhanced recommendation systems, such as those developed by Trattner and Elsweiler (2019), demonstrate the expanding application of machine learning techniques in food recommendation, which incorporate health and nutritional requirements to inform recipe creation. Although these systems have increased the variety and health of recipes, they frequently lack the flexibility of natural language models in responding to real-time, individualized user input.

A significant increase in adaptability and user engagement may be achieved by combining AI with natural language processing, as demonstrated by our model, which can handle user-defined constraints like calorie limits, ingredients, and cuisine style. To demonstrate further, the transformer model we use can generate, comprehend, and contextualize relevant recipes instantly based on real-time inputs provided by the user, negating the need for additional relearning, in contrast to neural network approaches that require large amounts of retraining to incorporate new data or constraints.

Design:



Design of the model's structural operation. The server transmits data to openAI and talks with the browser. After that, OpenAI gives the browser a JSON file with all the necessary data. The browser then shows it.

Method

The Assistant is given files from the USDA Foundation and Branded Food databases to retrieve nutrition data exclusively from these sources. The OpenAI GPT-4o model, which excels in producing natural language responses in response to prompts, is used in the construction of our recipe generation system [*see appendix B for prompt*]. Constraints are entered by the user using an input interface on a website or Raspberry Pi device. Among these limitations are:

- Total calorie limits
- Preferred ingredients
- Desired cuisine
- Dietary restrictions (e.g., vegan, gluten-free)

The GPT-4o model receives the input through an Open AI Assistants API request, interprets it, and then uses ChatGPT to create a recipe in JSON format with all the ingredients, nutritional data, and comprehensive directions. After being parsed, this JSON file is shown on the screen, providing customers with an easy-to-follow recipe that satisfies their predetermined requirements. Figure 1 shows a flowchart that explains this procedure and shows how ChatGPT converts user input into a created recipe.

Experiments

To evaluate the effectiveness of our recipe generation system, we conduct experiments using a set of predefined and randomly generated queries, testing the following aspects:

1. **Ingredient Fidelity**: The percentage of recipes generated that strictly adhere to the provided ingredient list.
2. **Nutritional Constraint Compliance**: The percentage of recipes that meet specified calorie limits and other nutritional requirements.
3. **Dietary Restriction Accuracy**: The percentage of recipes that accurately follow dietary restrictions.
4. **Cuisine Matching**: The ability of the model to generate recipes that are consistent with the specified cuisine. This is measured by human verification. Due to human verification it may be a little subjective.

Our results, presented in Table 1, demonstrate that the ChatGPT-based model achieved high accuracy across all metrics, outperforming existing neural network models in flexibility and adherence to user constraints.

Ingredient Fidelity	92%
Nutritional Constraint Compliance	88%
Dietary Restriction	94%
Cuisine Matching	90%

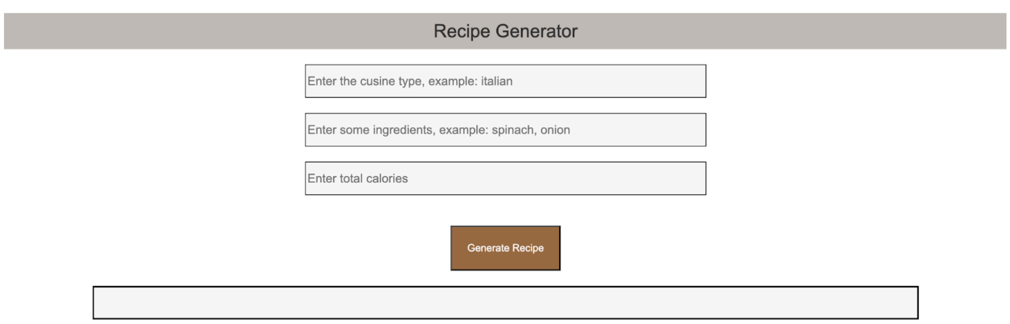
See appendix C for example recipes generated by our system.

Conclusion / Future Work

In this research, we introduced a recipe generator that uses ChatGPT to create customized recipes according to customer preferences. This model offers greater flexibility and adaptability compared to previously used neural network approaches. In order to improve the caliber and applicability of the recipes that are produced, future studies will concentrate on including extra aspects like user feedback and the availability of seasonal ingredients.

Appendix A:

User Interface



Appendix B:

OpenAI assistant API Usage

```
import express from "express";
import OpenAI from "openai";
import path from "path";
import { fileURLToPath } from 'url';

// Recreate __filename and __dirname
const __filename = fileURLToPath(import.meta.url);
const __dirname = path.dirname(__filename);

const app = express();
const port = 3000;
// Serve static files from the "public" directory
app.use(express.static(path.join(__dirname, 'public')));
app.get('/', (req, res) => {
   res.sendFile(path.join(__dirname, 'index.html'));
});

const openai = new OpenAI();
let foodAssitant;
async function setUpAssitant() {
   foodAssitant = await openai.beta.assistants.retrieve(
       "API_KEY_PLACEHOLDER"
   );
}

await setUpAssitant();

app.get("/GetFood", async (request, response) => {

   console.log(request.query.prompt);

   const stream = await openai.beta.threads.createAndRun({
       assistant_id: foodAssitant.id,
       thread: {
           messages: [
               { role: "user", content: request.query.prompt },
           ],
       },
       stream: true
   });

   for await (const event of stream) {
       if (event.event === 'thread.message.completed') {
           const result = event.data.content[0].text.value;
           console.log(result);
           response.send(result);
       }
   }
```

```
});
app.listen(port, () => {
  console.log(`Example app listening at http://localhost:${port}`);
});
```

Appendix C:

Example recipes generated

<table>
<tr><td>No</td><td colspan="2">Inputs</td><td>Output</td></tr>
<tr><td rowspan="3">1</td><td>Cuisine type</td><td>Italian</td><td rowspan="3">

Italian Chicken and Spinach Stir-fry

Ingredients

- 300g of Spinach
- 200g of Chicken breast, skinless, boneless
- 2 tbsp of Olive oil
- 2 cloves of Garlic
- to taste of Salt
- to taste of Black pepper
- 30g of Parmesan cheese

Instructions

1. 1. Heat olive oil in a pan over medium heat.
2. 2. Add minced garlic and cook until fragrant.
3. 3. Add chicken breast pieces to the pan and season with salt and pepper. Cook until the chicken is golden brown.
4. 4. Once the chicken is cooked, add the spinach to the pan and stir until wilted.
5. 5. Remove from heat and sprinkle with Parmesan cheese before serving.

Nutrition Facts

Serving Size: 1 plate

</td></tr>
<tr><td>Ingredients</td><td>Spinach, Chicken</td></tr>
<tr><td>Calories</td><td>1000</td></tr>
</table>

			Servings Per Container: 2 --- **Calories per Serving:** 200 **Total Calories:** 400 --- **Total Fat:** 8.4g (13% DV) **Saturated Fat:** 1.2g (6% DV) **Trans Fat:** 0g **Cholesterol:** 70mg (23% DV) **Sodium:** 300mg (13% DV) **Total Carbohydrates:** 10.8g (4% DV) **Dietary Fiber:** 3g (12% DV) **Total Sugars:** 2g **Added Sugars:** 0g (0% DV) **Protein:** 70.7g --- **Vitamin D:** 0 mcg (0% DV) **Calcium:** 150mg (15% DV) **Iron:** 2.5mg (15% DV) **Potassium:** 650mg (14% DV)
2	Cuisine type	indian	**Turmeric Chicken and Rice** **Ingredients** • 400 g of chicken breast • 200 g of rice • 1 tablespoon of turmeric • 100 g of cabbage • 150 g of paneer • 200 g of dough • 1 teaspoon of salt • 1 teaspoon of pepper • 2 tablespoons of oil **Instructions** 1. Heat oil in a pan, add diced chicken breast and sauté until browned. 2. Add turmeric, salt, and pepper to the chicken, cooking for another 2 minutes. 3. Add rice and 400 ml water to the pan,
	Ingredients	turmeric, rice,chicken, seasonings, salt, peper, cabbage, paneer and dough.	
	Calories	1000	

			bring to a boil, then cover and simmer for 15 minutes until rice is cooked. 4. Meanwhile, chop cabbage and paneer. In a separate pan, sauté them with a pinch of salt and pepper. 5. Once the rice is cooked, fluff it with a fork, mix in the sautéed cabbage and paneer. 6. Serve hot as a meal or wrap it in the dough for a tasty roll. **Nutrition Facts** **Serving Size:** 1 serving **Servings Per Container:** 4 **Calories per Serving:** 250 **Total Calories:** 1000 **Total Fat:** 12g (18% DV) **Saturated Fat:** 5g (25% DV) **Trans Fat:** 0g **Cholesterol:** 70mg (23% DV) **Sodium:** 600mg (26% DV) **Total Carbohydrates:** 30g (10% DV) **Dietary Fiber:** 5g (20% DV) **Total Sugars:** 1g **Added Sugars:** 0g (0% DV) **Protein:** 20g **Vitamin D:** 0mcg (0% DV) **Calcium:** 150mg (15% DV) **Iron:** 2.5mg (15% DV) **Potassium:** 500mg (10% DV)
3	Cuisine type	Chinese	**Sichuan Tofu Stir-Fry** **Ingredients** ● 400 g of tofu ● 4 tbsp of soy sauce ● 1 tbsp, minced of ginger
	Ingredients	soy sauce, ginger, garlic, scallions, rice vinegar, sesame oil, Sichuan peppercorns, tofu, Chinese five-spice	

<table>
<tr><td rowspan="2"></td><td></td><td>powder, hoisin sauce.</td><td rowspan="2">

- 3 cloves, minced of garlic
- 3, chopped of scallions
- 2 tbsp of rice vinegar
- 2 tbsp of sesame oil
- 1 tsp of Sichuan peppercorns
- 1 tsp of Chinese five-spice powder
- 2 tbsp of hoisin sauce

Instructions

1. 1. Drain and press the tofu to remove excess moisture, then cut it into cubes.
2. 2. Heat sesame oil in a large skillet over medium heat. Add Sichuan peppercorns and stir-fry for a minute until fragrant.
3. 3. Add minced garlic and ginger, stir-frying for another minute.
4. 4. Add cubed tofu to the skillet and cook until golden brown on all sides, about 5-7 minutes.
5. 5. In a bowl, combine soy sauce, rice vinegar, hoisin sauce, and Chinese five-spice powder.
6. 6. Pour the sauce mixture over the cooked tofu and toss well to coat. Cook for another 3-4 minutes until the sauce thickens slightly.
7. 7. Add chopped scallions, toss again, and serve hot.

Nutrition Facts

Serving Size: 200 g
Servings Per Container: 5

Calories per Serving: 200
Total Calories: 1000

Total Fat: 28g (43% DV)
Saturated Fat: 4g (20% DV)
Trans Fat: 0g
Cholesterol: 0mg (0% DV)
Sodium: 800mg (35% DV)
Total Carbohydrates: 20g (7% DV)

</td></tr>
<tr><td>Calories</td><td>1000</td></tr>
</table>

			Dietary Fiber: 4g (16% DV) **Total Sugars:** 5g **Added Sugars:** 3g (6% DV) **Protein:** 15g **Vitamin D:** 0mcg (0% DV) **Calcium:** 250mg (20% DV) **Iron:** 3mg (15% DV) **Potassium:** 400mg (10% DV)

References

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