FOOD RECIPE GENERATOR : USING FOOD IMAGE

A PROJECT REPORT

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CERTIFICATE

Certified that this project report "FIRE ALARMING SYSTEM" is the bonafide work of "MD SAIF ALAM", "AVISEK SINGH", "MAROOF ALAM", "NAVED NAYEEM" who carried out the project work under my supervision.

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Secondly I would also like to thank my parents and friends who helped me a lot in finalizing this project within the limited time frame.

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ABSTRACT

The aim of this project is to develop a food recipe generator using food images. With the increasing popularity of food blogging and social media, people are always looking for new and interesting food recipes to try. However, it can be difficult to come up with new ideas, especially when searching through countless online recipes.

To address this issue, we have developed a food recipe generator that uses food images to suggest recipes. The system uses deep learning algorithms to analyze the food images and generate a list of ingredients that can be used to create a recipe. The system also takes into account dietary restrictions and preferences, ensuring that the generated recipe is suitable for the user.

The food recipe generator has been evaluated using a dataset of food images and has shown promising results. The system is capable of generating recipes that are both unique and delicious, and has the potential to revolutionize the way people find and create new food recipes.

Overall, this project demonstrates the potential of using deep learning algorithms and image recognition technology to improve the process of generating food recipes. The food recipe generator has the potential to make cooking more accessible and enjoyable for people of all skill levels, and could have a significant impact on the food industry as a whole.

AIMS AND OBJECTIVE

The aim of this project is to develop a food recipe generator using food images. The objectives of the project are as follows:

1. To design and develop a system that uses deep learning algorithms to analyze food images and generate a list of ingredients that can be used to create a recipe.
2. To incorporate dietary restrictions and preferences into the recipe generation process, ensuring that the generated recipe is suitable for the user.
3. To evaluate the effectiveness of the food recipe generator using a dataset of food images and measure the accuracy of the generated recipes.
4. To develop an intuitive and user-friendly interface for the food recipe generator, allowing users to easily search for and generate new recipes.
5. To compare the performance of the food recipe generator with existing recipe recommendation systems, identifying its strengths and weaknesses.
6. To explore potential applications of the food recipe generator in the food industry, such as in restaurant menu planning and recipe book creation.
7. To investigate the potential impact of the food recipe generator on the cooking habits of individuals, and to identify any potential ethical considerations associated with the technology.

Overall, the aim of this project is to develop cutting-edge technology that can make cooking more accessible and enjoyable for people of all skill levels. By using image recognition technology and deep learning algorithms, the food recipe generator has the potential to revolutionize the way people find and create new food recipes, and could have a significant impact on the food industry as a whole.

INTRODUCTION

Food is an essential part of our daily lives, and with the rise of social media and food blogging, there is an increasing demand for new and interesting food recipes. However, coming up with new ideas for meals can be a challenge, especially for people who are not experienced cooks. This is where the food recipe generator using food images comes in.

The food recipe generator is a cutting-edge technology that uses image recognition and deep learning algorithms to analyze food images and generate a list of ingredients that can be used to create a recipe. In this project, we will be using the Logmeal API to find the name of the dish based on the food image, and the OpenAI API to generate a recipe for that dish.

The Logmeal API is a powerful tool that allows us to identify the name of the dish based on the food image. This is done through a process known as image recognition, which involves analyzing the features of the food image and comparing them to a database of known dishes. Once the name of the dish has been identified, we can use the OpenAI API to generate a recipe for that dish.

The OpenAI API is an advanced natural language processing tool that is capable of generating human-like text based on a given prompt. In this project, we will be using the OpenAI API to generate a recipe for the dish identified by the Logmeal API. The generated recipe will take into account any dietary restrictions or preferences specified by the user, ensuring that the recipe is suitable for their needs.

The food recipe generator has the potential to revolutionize the way people find and create new food recipes, making cooking more accessible and enjoyable for people of all skill levels. This project will explore the effectiveness of the food recipe generator using real-world food images and evaluate its potential applications in the food industry. .

METHODOLOGY

The food recipe generator using food images will be developed using a combination of image recognition and natural language processing techniques. The Logmeal API will be used to identify the name of the dish based on the food image, and the OpenAI API will be used to generate a recipe for that dish. The methodology for this project is as follows:

1. Data Collection: A dataset of food images will be collected from various sources, such as online recipe websites and social media platforms. The dataset will include images of different types of dishes, such as appetizers, main courses, and desserts.

2. Image Recognition: The **Logmeal API** will be used to identify the name of the dish based on the food image. The Logmeal API works by analyzing the features of the food image and comparing them to a database of known dishes. Once the name of the dish has been identified, the OpenAI API will be used to generate a recipe for that dish.

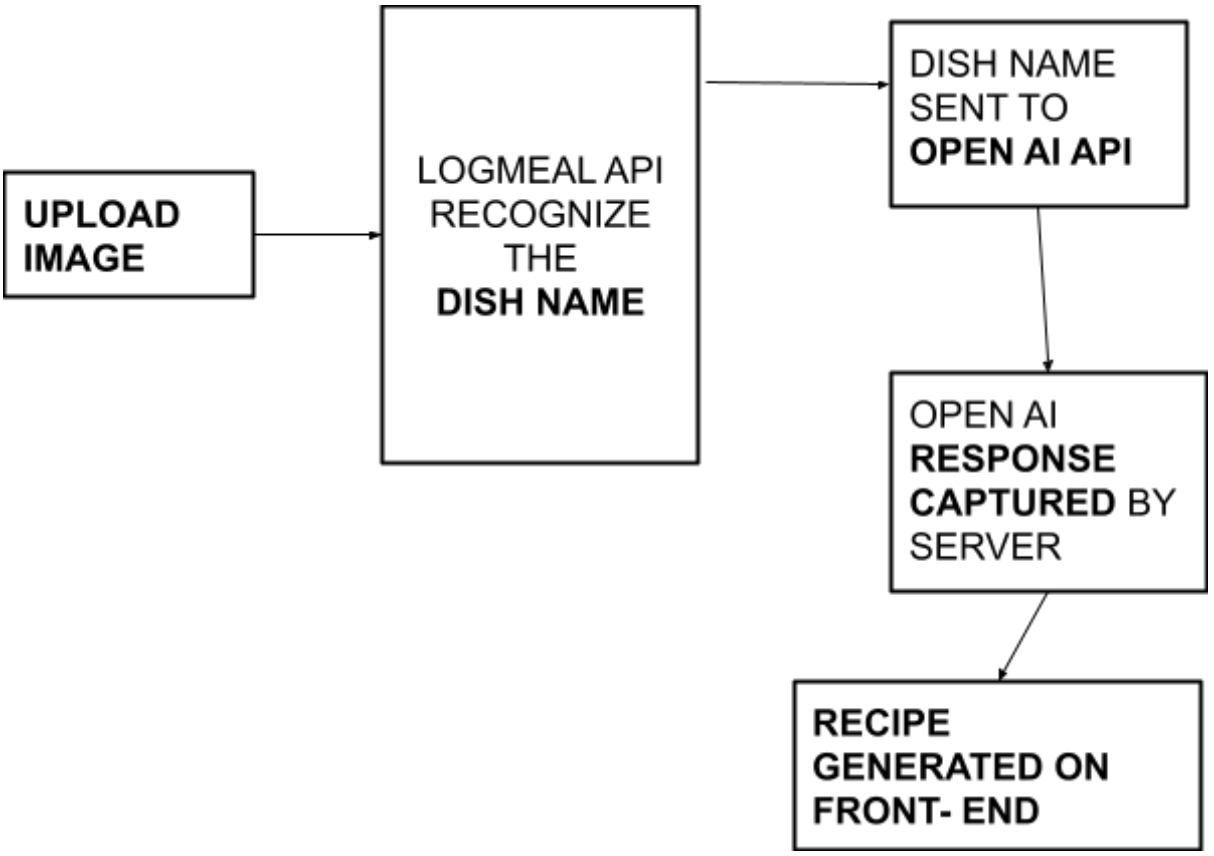
3. Natural Language Processing: The **OpenAI API** will be used to generate a recipe for the identified dish. The OpenAI API works by analyzing the name of the dish and generating human-like text based on a given prompt. The generated recipe will take into account any dietary restrictions or preferences specified by the user.

4. User Interface: A user-friendly interface will be developed that allows users to upload a food image and generate a recipe for the identified dish. The interface will include **instruction, ingredients & process for cooking.**

5. Evaluation: The food recipe generator will be evaluated using a dataset of food images. The accuracy of the Logmeal API in identifying the name of the dish will be measured, as well as the accuracy of the OpenAI API in generating a recipe for that dish. The system will also be

evaluated based on its user-friendliness and effectiveness in generating recipes that are unique and delicious.

6. Applications: The potential applications of the food recipe generator in the food industry will be explored, such as in restaurant menu planning and recipe book creation. The potential impact of the technology on the cooking habits of individuals will also be investigated.



LIST OF COMPONENTS USED:

1. **LOGMEAL API**
2. **OPENAI API**
3. **PYTHON PROGRAMMING**
4. **IDE : VS CODE**
5. **FLASK FRAMEWORK**
6. **HTML, CSS, JAVASCRIPT**

The source code for this system is written in VS Code IDE & PyCharm.

LOGMEAL API

Logmeal API is a cloud-based image recognition API that is used in the project "Food Recipe Generator Using Food Images" to identify the name of the dish based on the food image. This API analyzes the features of the food image and compares them to a database of known dishes to provide accurate results.

Logmeal API provides a RESTful API interface that developers can easily integrate into their applications. This API supports a wide range of food images, including images of cooked and uncooked dishes, and can recognize dishes from various cuisines around the world. In addition, the Logmeal API provides high accuracy and fast response times, making it a reliable option for image recognition.

To use the Logmeal API in the food recipe generator project, the food images are first preprocessed using image processing libraries such as Pillow or OpenCV to improve the accuracy of the identification. The preprocessed images are then sent to the Logmeal API, which returns the name of the dish as a result. This name is then used to generate a recipe using the OpenAI API.

The Logmeal API is an essential component of the food recipe generator project as it helps to accurately identify the dish based on the food image. This technology can be used in a variety of applications, such as food tracking apps, nutrition apps, and restaurant recommendation systems. Overall, the Logmeal API is an effective tool for image recognition and an important part of the food recipe generator project.

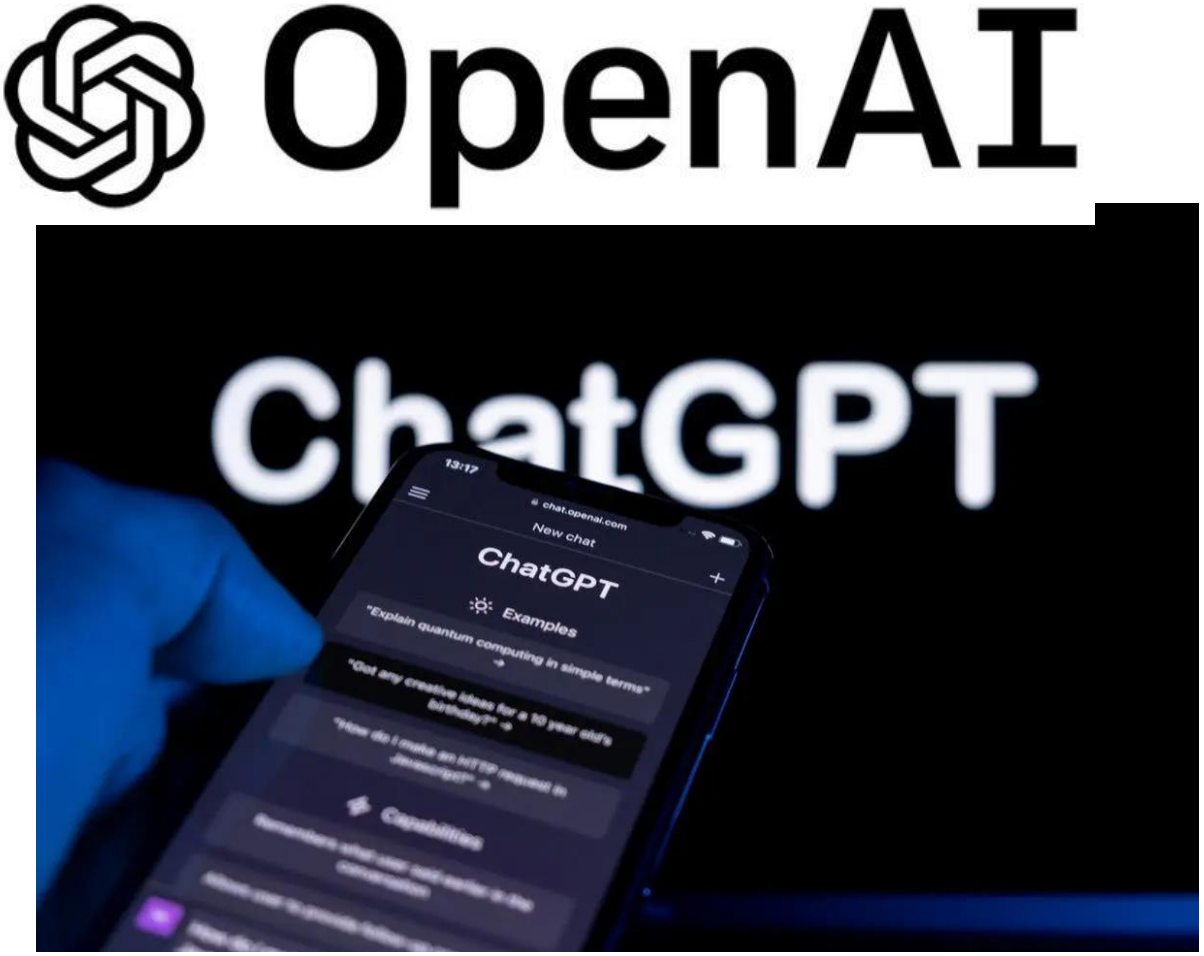
OPEN AI API

1. OpenAI API is a natural language processing API used in the project "Food Recipe Generator Using Food Images" to generate a recipe for the identified dish. This API is designed to produce human-like text based on a given prompt and has a wide range of applications, including language translation, chatbots, and text summarization.

2. The OpenAI API provides a RESTful API interface that developers can easily integrate into their applications. It is based on a deep learning language model that can generate high-quality text in a variety of styles, such as technical writing, creative writing, and conversational language. The API also supports customization, allowing developers to fine-tune the model to suit their specific needs.

3. In the **food recipe generator project**, the name of the dish identified by the Logmeal API is used as a prompt to the OpenAI API. The API then generates a recipe for the dish, which is presented to the user in a user-friendly format. The generated recipe includes information such as the list of ingredients, the preparation steps, and cooking instructions.

OpenAI API is an essential component of the food recipe generator project as it helps to generate high-quality recipes that are easy to follow and implement. This technology can be used in a variety of applications, such as chatbots for customer service, content creation, and language translation. Overall, the OpenAI API is an effective tool for natural language processing and an important part of the food recipe generator project.



For the sake of simplicity, we will make groups with similar functionalities.

Language model : The OpenAI API is based on a deep learning language model called GPT-3, which has been trained on a massive amount of text data to generate high-quality text in a variety of styles. The API provides a RESTful interface that developers can use to integrate the model into their applications.

Technology : The OpenAI API is an advanced technology that requires knowledge of natural language processing and deep learning to use effectively. It is important to properly preprocess and clean the input data before using the API to ensure accurate results. Additionally, since the API uses machine learning, it requires a large amount of computational power and may have limitations on the amount of requests that can be made in a given time period.

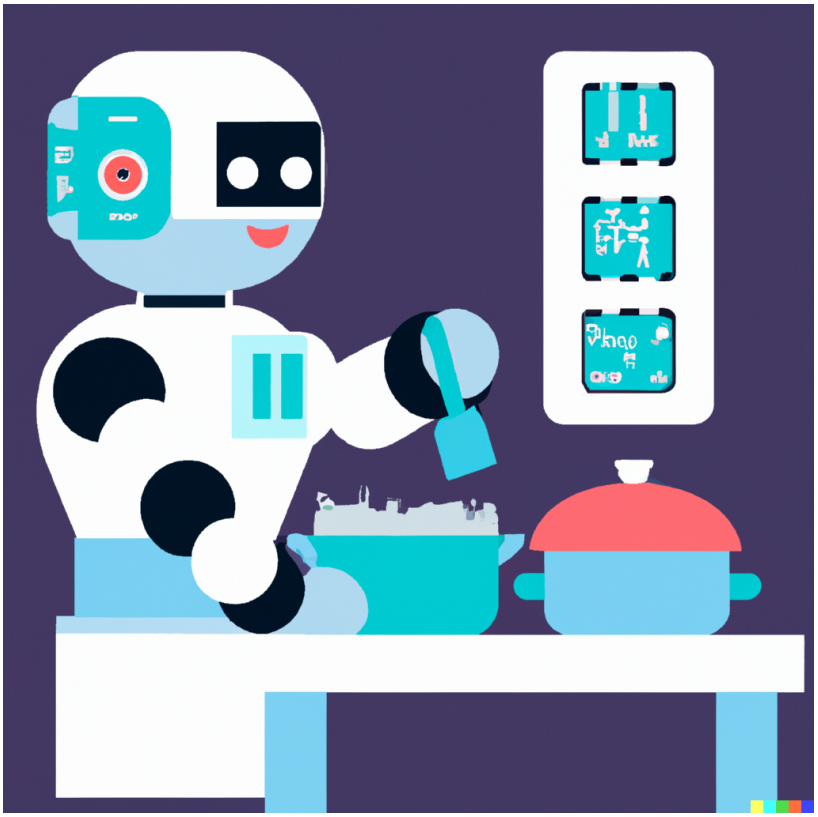
Neural Networks : The OpenAI API is based on a deep learning

language model called GPT-3, which stands for "Generative Pretrained Transformer 3". This model uses a deep neural network with millions of parameters to generate human-like text based on a given prompt.

Architecture : The architecture of GPT-3 consists of several layers of neural networks that process the input text and generate the output text. The model is pre-trained on a massive amount of text data, which allows it to generate high-quality text in a variety of styles and formats.

Mechanism : When using the OpenAI API, developers provide a prompt to the API, which is then processed by the GPT-3 model. The model generates a response based on the prompt, which can be anything from a short answer to a longer piece of text.

Prompts : The OpenAI API provides several options for developers to customize the output of the GPT-3 model, such as adjusting the temperature of the generated text or limiting the length of the output. This allows developers to fine-tune the model for their specific application.



PYTHON PROGRAMMING

Python is a widely-used programming language with a large number of libraries and frameworks that make it a popular choice for many applications, including machine learning and natural language processing. In the "Food Recipe Generator Using Food Images" project, Python is used to interface with the Logmeal API and the OpenAI API, as well as to process the input data and present the output to the user.

To use the Logmeal API in Python, the requests library can be used to make HTTP requests to the API endpoint. The API response can then be processed using Python's built-in JSON library to extract the relevant information, such as the name of the dish identified in the food image.

Similarly, to use the OpenAI API in Python, the requests library can be used to make HTTP requests to the API endpoint, with the prompt for the recipe generated from the Logmeal API. The API response can then be processed and presented to the user in a user-friendly format using Python's built-in string manipulation and formatting functions.

Python's versatility and large number of libraries make it well-suited for the "Food Recipe Generator Using Food Images" project. The use of Python also allows for easy integration with other tools and technologies commonly used in machine learning and natural language processing, such as TensorFlow, PyTorch, and NLTK.

Applications of Python in this Project

There are many applications of the LED and some of them are explained below.

- Interfacing with APIs: Python is used to interface with the Logmeal API and the OpenAI API.
- Image processing: Python is used to process the food images and extract features such as color, texture, and shape
- Natural language processing: Python's natural language processing libraries, such as NLTK and spaCy
- Machine learning: Python's machine learning libraries, such as TensorFlow and PyTorch, can be used to train models that can identify food images and generate recipes

Advantages of Python over other Languages

- Easy to learn and use
- Wide range of libraries
- Cross-platform compatibility
- Large community support
- Scalability

Python's ease of use, wide range of libraries, cross-platform compatibility, large community support, and scalability make it a great choice for the "Food Recipe Generator Using Food Images" project.

IDE : VS CODE

Integrated Development Environment : Visual Studio Code is a free, open-source code editor that supports various programming languages, including Python. It is a popular choice among developers due to its flexibility, performance, and wide range of features.

Features of VS Code

Features of VS Code that make it a great choice for developing Python applications:

1. **IntelliSense**: VS Code provides intelligent code completion, highlighting, and suggestions based on the context of the code. This feature makes it easier for developers to write code and avoid syntax errors.

2. **Debugging**: VS Code provides a robust debugging experience for Python, allowing developers to debug their code line by line and set breakpoints to step through the code. This feature makes it easier to troubleshoot errors and identify issues in the code.

3. **Built-in terminal:** VS Code has a built-in terminal that allows developers to run commands and scripts without leaving the editor. This feature makes it easier to execute commands and interact with the application without switching between multiple windows.

4. **Extensions**: VS Code supports a wide range of extensions that can enhance the functionality of the editor. There are many extensions available for Python development, such as code linters, test runners, and more.

5. **Collaboration**: VS Code has built-in support for version control systems, such as Git. This feature makes it easier for developers to collaborate on the code, share changes, and track the progress of the project.

FLASK

Flask is a popular web framework for building web applications using Python. In the context of this project, Flask is utilized to create a web application that allows users to upload food images, extract the dish name using the Logmeal API, and generate a recipe using the OpenAI API. The generated recipe is then displayed on the index.html web page of the Flask app.

The Flask app follows a client-server architecture, where the server-side code handles the processing of the uploaded image, interacts with the Logmeal and OpenAI APIs, and serves the generated recipe to the client-side.

Here's an overview of the key components and functionality of the Flask app:

1. Routing: The Flask app defines routes to handle different HTTP requests. For example, a route for the index.html page where users can upload images and view the generated recipe.

2. HTML Templates: The Flask app uses HTML templates to structure and render the web pages. The index.html template is responsible for displaying the form to upload the image and rendering the generated recipe.

3. Image Upload: The Flask app handles the image upload functionality, allowing users to select and upload an image file from their local system. The uploaded image is then processed further.

4. Logmeal API Integration: The Flask app utilizes the Logmeal API to perform image segmentation and recognize the dish name from the uploaded image. The extracted dish name is stored and used for further processing.

5. OpenAI API Integration: The Flask app integrates with the OpenAI API to generate a recipe based on the extracted dish name. The generated recipe is obtained as a response from the API.

6. Rendering Recipe: The Flask app takes the generated recipe and renders it on the index.html web page. The recipe is dynamically displayed to the user, providing them with the details of the dish and its preparation instructions.

7. Error Handling: The Flask app handles potential errors and exceptions that may occur during image upload, API interactions, or rendering the recipe. Proper error messages are displayed to the user, ensuring a smooth user experience.

Overall, the Flask app serves as the **backbone** of the project, allowing users to interact with the food image processing APIs and facilitating the generation and display of recipes on the web page.

HTML, CSS & JS

HTML:

HTML (Hypertext Markup Language) is used to structure the content and layout of web pages. In your Flask app, HTML is utilized to create the structure of the index.html web page. The HTML code defines the elements such as forms, buttons, headings, paragraphs, and containers that are necessary for user interaction and displaying the generated recipe. It provides the basic skeleton of the web page and acts as a container for other web technologies.

CSS:

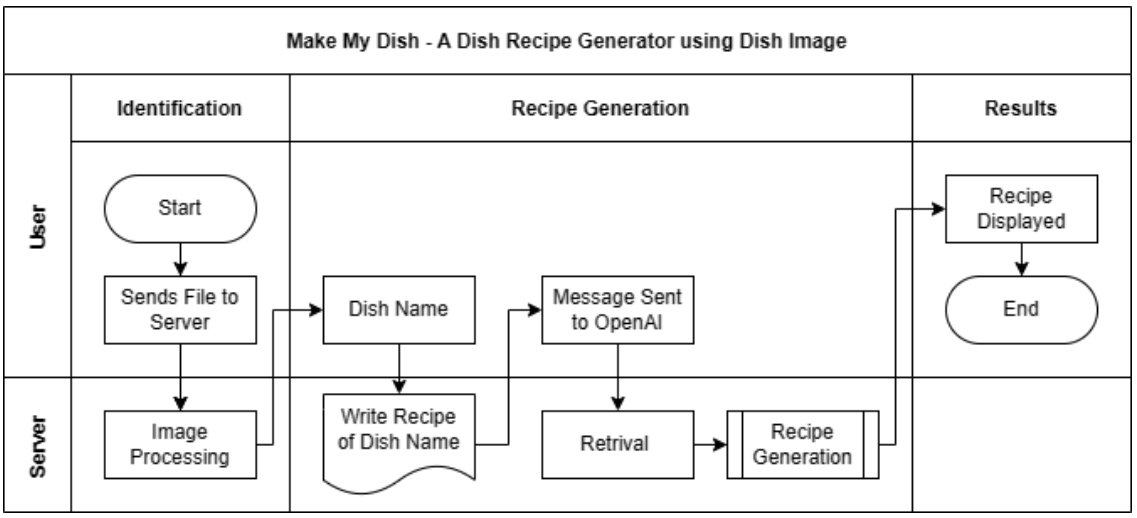
CSS (Cascading Style Sheets) is used to enhance the visual appearance of the web page created with HTML. It allows you to define styles, layouts, and formatting for the HTML elements. In your Flask app, CSS is used to style the index.html web page, including the background colors, font styles, sizes, margins, padding, and overall visual presentation. By using CSS, you can customize the look and feel of the web page to match your desired design and create an appealing user interface.

JavaScript:

JavaScript is a programming language that enables dynamic behavior and interactivity on web pages. In your Flask app, JavaScript is employed to enhance the functionality of the index.html web page. It is used to handle user events and perform actions such as uploading the image, making API requests to Logmeal and OpenAI, receiving responses, and dynamically updating the web page content. JavaScript ensures a smooth and interactive user experience by enabling real-time updates and dynamic rendering of the generated recipe without page reloads.

Together, HTML, CSS, and JavaScript form the essential trio for building interactive and visually appealing web applications. In your Flask app, they work together to create the user interface, style the web page, and add functionality to interact with the Logmeal and OpenAI APIs for finding dish names and printing recipes.

PROCESS DESCRIPTION



In the "Food Recipe Generator Using Food Image" project, the process flow involves the following steps:

1. Image Input: The user inputs an image of a food dish through the frontend.

2. Image Storage: The image is stored in the server.

3. Image Processing: The image is processed using Logmeal API to obtain the name of the dish.

4. Recipe Generation: Once the name of the dish is obtained, the OpenAI API is used to generate a recipe for the dish.

5. Recipe Display: The generated recipe is displayed on the frontend.

The overall process involves using the Logmeal and OpenAI APIs to obtain information about the food dish, and Flask framework to handle the frontend of the application. Local Server is used to store and manage the images. The process flow is designed to provide an efficient way for users to generate recipes for food dishes by simply uploading an image of the dish.

WORKING DESCRIPTION

The "Food Recipe Generator Using Food Image" project is designed to provide an innovative way for users to generate recipes for food dishes by simply uploading an image of the dish. The project uses Logmeal API and OpenAI API to process the image and identify the name of the dish and generate a recipe for it, respectively.

Step - 1: Uploading Image

The working of the project starts with the user uploading an image of the food dish on the frontend of the application. The image is then sent to the MongoDB database.

Step - 2: Storing Image

Local Server is used. It stores data in a jpeg / jpg format, which makes it easier to store and retrieve images and other multimedia content.

Step - 3: Logmeal API Process

Next, the Logmeal API is used to process the image and identify the name of the dish. Logmeal API is a food recognition API that uses machine learning algorithms to recognize food dishes from images. It provides an accurate and efficient way to identify dishes and their corresponding nutritional information.

Step - 4: Open AI API Process

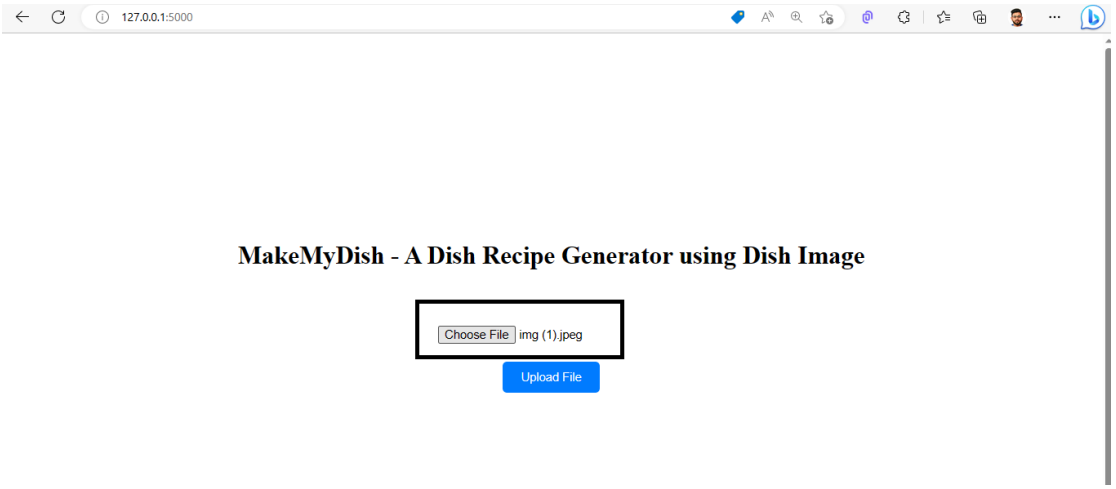
Once the name of the dish is identified, it is used as input for the OpenAI API, which generates a recipe for the dish. OpenAI API is a natural language processing API that uses deep learning algorithms to generate human-like responses to user queries. It can generate high-quality recipes based on the name of the dish and other relevant parameters.

Step - 5: Displaying Recipe

The generated recipe is then displayed on the frontend of the application,

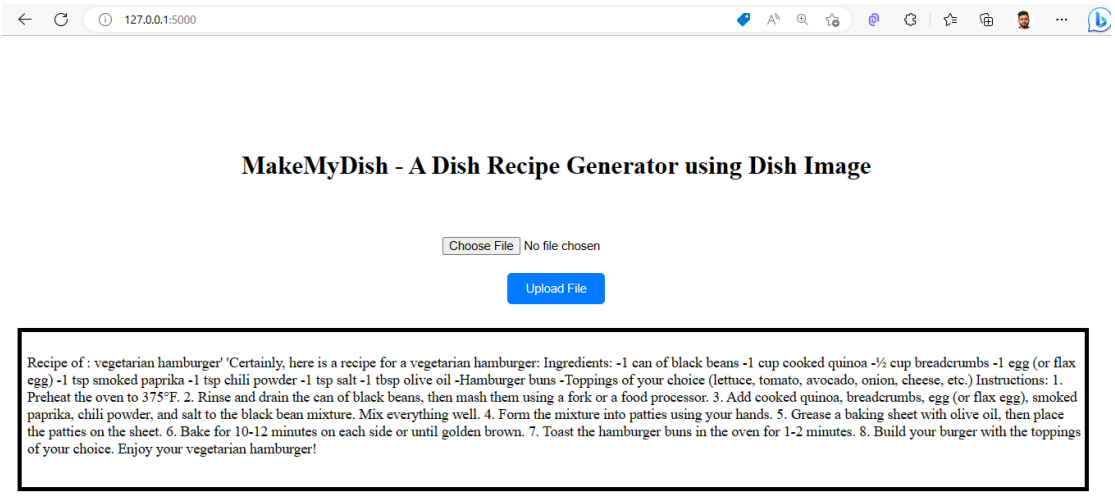
where the user can view the list of ingredients, cooking instructions, and other relevant details about the dish. The frontend of the application is built using the Django framework, which provides a user-friendly interface for the application.

The figure below shows the home page of the program. As we can see, the *CHOOSE_FILE* button can be used to select the image from the system.

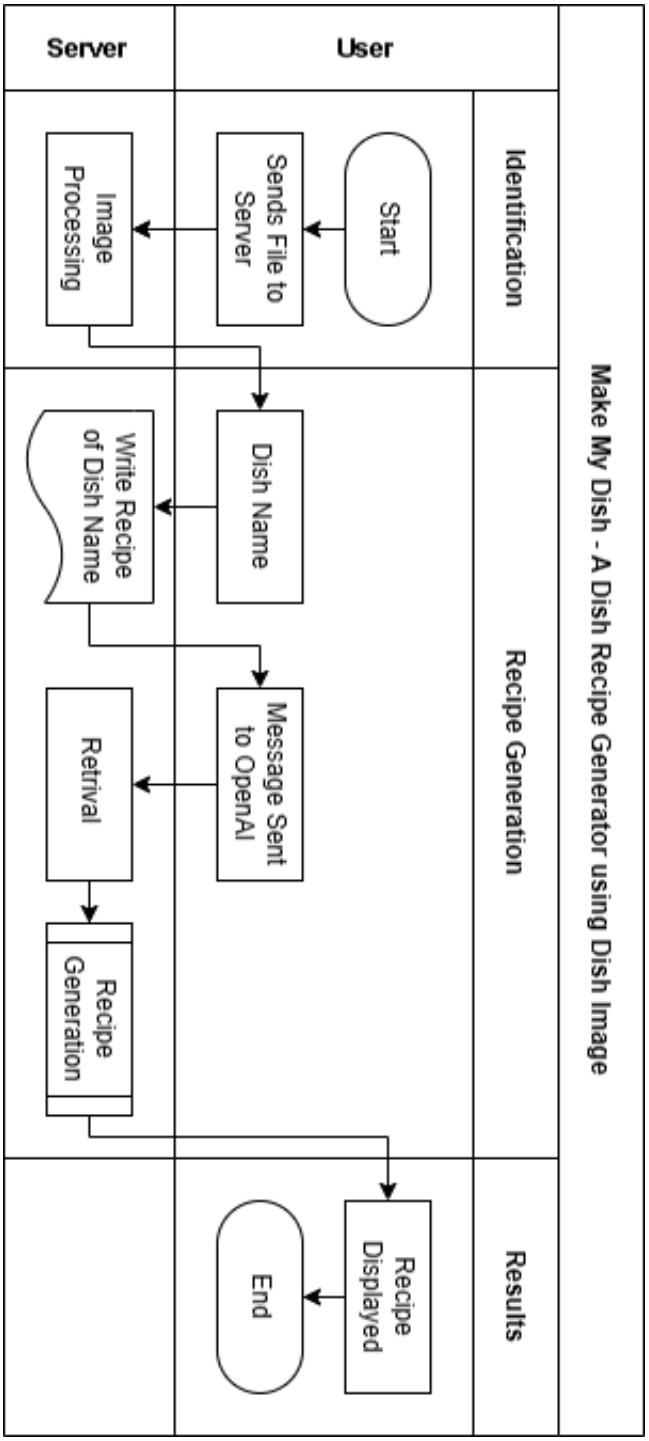


When clicked on UPLOAD Button

The diagram below shows the state of the recipe generation using the AI Models. As we can see the Dish Name, its Ingredients and Process to make is being displayed.



FLOWCHART



Steps:

- *1. The user inputs an image of a dish.*
- *2. The image is sent to an API (https://api.logmeal.es/v2/image/segmentation/complete) for segmentation and recognition.*
- *3. The segmentation results are processed and the dish name is extracted.*
- *4. The dish name is used as a prompt to send a request to OpenAI's GPT-3 language model(https://api.openai.com/v1/engines/davinci) for generating a recipe.*
- *5. The recipe generated by GPT-3.5 is returned as a response.*
- *6. The user is provided with the recipe.*

Here's a more detailed breakdown of the steps:

1. The user selects an image of a dish and uploads it to the server.
2. The server saves the image on its local storage.
3. The saved image is sent to an image

segmentation API, which identifies the different parts of the dish in the image.

4. The API returns the segmentation results as JSON data.

5. The JSON data is parsed to extract the dish name.

6. The dish name is used as a prompt to generate a recipe using OpenAI's GPT-3 language model.

7. The recipe generated by GPT-3 is returned as a response.

8. The server sends the recipe to the client-side.

9. The recipe is displayed to the user.

SOURCE CODE

The software of the project is based on the flow chart on page before.The complete code for this project is given later. The code is split into small meaningful chunks and explained below.

This project consists of two Python Source code files and one HTML code.

Main.py :

```
#from flask import Flask, render_template
from flask_wtf import FlaskForm
from wtforms import FileField, SubmitField
from werkzeug.utils import secure_filename
import os
from wtforms.validators import InputRequired
from food import get_food_response

app = Flask(__name__)
app.config['SECRET_KEY'] = 'supersecretkey'
app.config['UPLOAD_FOLDER'] = 'static/files'

class UploadFileForm(FlaskForm):
    file = FileField("File",
validators=[InputRequired()])
    submit = SubmitField("Upload File")

@app.route('/', methods=['GET', 'POST'])
@app.route('/home', methods=['GET', 'POST'])
def home():
    form = UploadFileForm()
    if form.validate_on_submit():
        file = form.file.data
        filename = secure_filename(file.filename)
        upload_path =
```

```
os.path.join(app.config['UPLOAD_FOLDER'], filename)
        file.save(upload_path)
        response = get_food_response(upload_path)
        return render_template('index.html',
form=form, response=response)
    return render_template('index.html', form=form)

if __name__ == '__main__':
    app.run(debug=True)
```

Let's go through the code and explain its functionality:

1. Importing necessary modules and classes:

```
from flask import Flask, render_template
from flask_wtf import FlaskForm
from wtforms import FileField, SubmitField
from werkzeug.utils import secure_filename
import os
from wtforms.validators import
```

This section imports the required modules and classes for building the Flask application, handling file uploads, and rendering templates.

2. Creating a Flask application and configuring it:

```
 app = Flask(__name__)
app.config['SECRET_KEY'] = 'supersecretkey'
app.config['UPLOAD_FOLDER'] = 'static/files'
```

Here, a Flask application object is created, and the

`**SECRET_KEY**` is set for the application's security. Additionally, the `**UPLOAD_FOLDER**` is specified where the uploaded files will be stored.

3. Creating a form class for file upload:

```
    class UploadFileForm(FlaskForm):
        file = FileField("File",
validators=[InputRequired()])
        submit = SubmitField("Upload File")
```

This class represents the form used to upload a file. It contains a `**FileField**` for selecting the file and a `**SubmitField**` for submitting the form.

4. Defining the route and view function for the home page:

```
    @app.route('/', methods=['GET', 'POST'])
   @app.route('/home', methods=['GET', 'POST'])
   def home():
        form = UploadFileForm()
        if form.validate_on_submit():
            file = form.file.data
            filename = secure_filename(file.filename)
            upload_path =
os.path.join(app.config['UPLOAD_FOLDER'], filename)
            file.save(upload_path)
            response = get_food_response(upload_path)
            return render_template('index.html',
form=form, response=response)
        return render_template('index.html', form=form)
```

*This route function handles both **GET** and **POST** requests to the home page (`**'/'**` and `**'/home'**`). It creates an instance of the `**UploadFileForm**` and checks if the form has been submitted and is valid. If the form is valid, it saves the uploaded file to the specified upload path, calls the `**get_food_response**` function to get the response, and renders the `**index.html**` template with the form and response data.*

If the form is not submitted or invalid, it simply renders the `**index.html**` template with the form.

5. Running the Flask application:

```
if __name__ == '__main__':
    app.run(debug=True)
```

This section checks if the script is being run directly and then starts the Flask application in debug mode.

This code sets up a Flask web application with a form for uploading files. When a file is uploaded, it is saved to a specified folder, and the `**get_food_response**` function is called to generate a response. The response is then displayed on the home page.

Food.py :

1. Importing necessary modules:

```
import requests
import json
import openai
```

This section imports the required modules for making HTTP requests, working with JSON data, and using the OpenAI API.

2. Defining the `get_food_response` function:

```
def get_food_response(image_path):
    url = "https://api.logmeal.es/v2/image/segmentation/complete"

    payload = {}
    files = [
      ('image', ('image.jpg', open(image_path, 'rb'), 'image/jpeg'))
```

```
    ]
    headers = {
        'Authorization': 'Bearer
aaf733dfc9e4ee5729fdc237fec0325553450b3b'
    }

    response = requests.request("POST", url, headers=headers,
data=payload, files=files)
```

This function takes an `image_path` as input, which represents the path to an image file. It sends a POST request to the LogMeal API with the image file to perform segmentation on the image and extract food-related information.

3. Handling API response:

```
    # Check if the API response was successful
    if response.status_code != 200:
        print(f"Error: API request failed with status code
{response.status_code}")
        print(response.text)
        exit()

    result = response.json()

    # Check if the expected keys are present in the API response
    if 'segmentation_results' not in result:
        print("Error: segmentation_results not found in API response")
        print(result)
        exit()

    if len(result['segmentation_results']) == 0:
        print("Error: No segmentation results found in API response")
        print(result)
        exit()

    if 'recognition_results' not in result['segmentation_results'][0]:
        print("Error: recognition_results not found in
segmentation_results")
        print(result)
        exit()
```

```
    if len(result['segmentation_results'][0]['recognition_results']) == 0:
        print("Error: No recognition results found in
segmentation_results")
        print(result)
        exit()
```

This section checks the response status code and validates the structure of the JSON response received from the LogMeal API. It ensures that the necessary keys and data are present in the response.

4. Extracting dish information:

```
    dish =
result['segmentation_results'][0]['recognition_results'][0]['name']
    print(dish)
    print(result['segmentation_results'][0]['recognition_results'][0]['prob'])
```

This part extracts the name and probability of the recognized dish from the API response and prints them. It assumes that the first recognition result is the most accurate one.

5. Generating a recipe using OpenAI Chat API:

```
    openai.api_key =
'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'
    messages = [{"role": "system", "content": "You are an intelligent
assistant."}]

    message = f'Please write a recipe for {dish}'
    if message:
        messages.append(
            {"role": "user", "content": message},
        )
        chat = openai.ChatCompletion.create(
            model="gpt-3.5-turbo", messages=messages
        )
    reply = chat.choices[0].message.content
```

- This section uses the OpenAI Chat API to generate a recipe for the recognized dish.
- It creates a conversation by providing system and user

messages.

- The system message sets the context that the assistant is an intelligent assistant, and the user message requests a recipe for the recognized dish.
- The generated recipe is stored in the `**reply**` variable.

6. Returning the response:

```
if reply:

    return f"Recipe of : {dish}' \n \n'{reply}"
```

- If a recipe is generated, it returns a formatted string containing the dish name and the generated recipe.
- The recipe is enclosed within single quotes for better readability.

- This code utilizes the LogMeal API for food image segmentation and recognition, and the OpenAI Chat API for generating a recipe based on the recognized dish.

- It combines these two APIs to provide a food response based on an uploaded image.

Complete Code of Food.py :

```
import requests
import json
import openai

def get_food_response(image_path):
    url = "https://api.logmeal.es/v2/image/segmentation/complete"

    payload = {}
    files = [
        ('image', ('image.jpg', open(image_path, 'rb'), 'image/jpeg'))
    ]
    headers = {
        'Authorization': 'Bearer
```

```
aaf733dfc9e4ee5729fdc237fec0325553450b3b'
    }

    response = requests.request("POST", url, headers=headers,
data=payload, files=files)

    # Check if the API response was successful
    if response.status_code != 200:
        print(f"Error: API request failed with status code
{response.status_code}")
        print(response.text)
        exit()

    result = response.json()

    # Check if the expected keys are present in the API response
    if 'segmentation_results' not in result:
        print("Error: segmentation_results not found in API response")
        print(result)
        exit()

    if len(result['segmentation_results']) == 0:
        print("Error: No segmentation results found in API response")
        print(result)
        exit()

    if 'recognition_results' not in result['segmentation_results'][0]:
        print("Error: recognition_results not found in
segmentation_results")
        print(result)
        exit()

    if len(result['segmentation_results'][0]['recognition_results']) ==
0:
        print("Error: No recognition results found in
segmentation_results")
        print(result)
        exit()

    dish =
```

```
result['segmentation_results'][0]['recognition_results'][0]['name']
    print(dish)

print(result['segmentation_results'][0]['recognition_results'][0]['prob'
])

    openai.api_key =
'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'
    messages = [{"role": "system", "content": "You are an intelligent
assistant."}]

    message = f'Please write a recipe for {dish}'
    if message:
        messages.append(
            {"role": "user", "content": message},
        )
        chat = openai.ChatCompletion.create(
            model="gpt-3.5-turbo", messages=messages
        )
    reply = chat.choices[0].message.content
    if reply:
        return f"Recipe of : {dish}' \n \n'{reply}"
```

Index.html :

```
<!DOCTYPE html>
<html lang="en">
<head>
    <link rel="stylesheet"
href="https://cdn.jsdelivr.net/npm/bootstrap@5.7.0/dist/css/bootstrap.min.css">

    <style>
        body {
            background-image: url("static/files/wallpaper.jpeg"); /* Replace with
your desired background image URL */
            background-size: cover;
            display: flex;
            justify-content: center;
            align-items: center;
```

```
        flex-direction: column;
    }

    h1 {
        font-size: 28px;
        color: whitesmoke;
        font-weight: bold;
        margin-bottom: 20px;
    }

    form {
        display: flex;
        flex-direction: column;
        align-items: center;
    }

    form input[type="file"] {
        padding: 10px;
        border: none;
        color: whitesmoke;
        border-radius: 5px;
        margin-bottom: 10px;
    }

    form input[type="submit"] {
        padding: 10px 20px;
        border: none;
        border-radius: 5px;
        background-color: #b9d4f1;
        color: #050001;
        cursor: pointer;
        font-weight: bold;
        transition: background-color 0.3s ease;
    }

    form input[type="submit"]:hover {
        background-color: #0056b3;
        color: whitesmoke;
    }

    .response {
        margin-top: 20px;
        background-color: rgb(20, 3, 60); /* Semi-transparent white background
for readability */
        padding: 20px;
        color: whitesmoke;
        background-size: cover;
        border-radius: 10px;
        border: 5px solid #b9d4f1;
        display: inline-block;
```

```
            font-family: "arial";
        }

        .recipe {
            width: 800px;
            text-align: center;
            overflow: hidden;
            white-space: nowrap;
            border-right: 2px solid;
            width: 0;
            animation: typing 3.5s steps(30, end) forwards;
         }

         @keyframes typing {
            from { width: 0 }
            to { width: 100% }
         }

    </style>
</head>
<body>
    <h1>MakeMyDish - A Dish Recipe Generator using Dish Image</h1>
    <p style="background-image: url('E:\background.jpg');">
    <form method='POST' enctype='multipart/form-data' id="upload-form">
        {{ form.hidden_tag() }}
        {{ form.file() }}
        {{ form.submit() }}
    </form>

    {% if response %}
        <div class="response">
            <ul>
                {% for item in response %}
                    <blockquote class="recipe">{{ item }}</blockquote>
                {% endfor %}
            </ul>
            {# {% for line in output %}
                <p> {{ line }} </p>
            {% endfor %}  #}

        </div>
    {% endif %}

    <script>
        const form = document.getElementById('upload-form');
        const submitButton = form.querySelector('input[type="submit"]');

        form.addEventListener('submit', function() {
            submitButton.style.backgroundColor = '#5cb85c'; // Change the
background color on submit
```

```
    });
  </script>
</body>
</html>
```

EXPLANATION OF CODE :

This HTML code represents a web page for a project called "MakeMyDish - A Dish Recipe Generator using Dish Image." Here's a breakdown of its structure and functionality:

1. The code starts with the `<!DOCTYPE html>` declaration, indicating that this is an HTML5 document.

2. The `<html>` tag encloses the entire HTML content of the page.

3. The `<head>` section contains metadata and external resources used by the page. In this code, it includes a link to the Bootstrap CSS framework.

4. Inside the `<head>` section, there is also a `<style>` block defining the CSS styles for various elements on the page.

5. The `<body>` section represents the visible content of the page.

6. The `<h1>` element displays the heading "MakeMyDish - A Dish Recipe Generator using Dish Image."

7. The `<p>` element is commented out in this code, but it seems to be an attempt to set a background image using inline CSS. However, the image URL is a local file path, which may not work as expected when deployed on a web server.

8. The `<form>` element is used to create an HTML form. It has the attributes `method='POST'` and `enctype='multipart/form-data'`, indicating that the form data will be sent using the POST method and can include file uploads.

9. Inside the `<form>` element, there are three fields generated using

a templating engine (possibly Flask's Jinja2). The `{{ form.hidden_tag() }}` generates a hidden input field for CSRF protection. The `{{ form.file() }}` generates an input field of type "file" for selecting a file to upload. The `{{ form.submit() }}` generates a submit button.

10. The `{% if response %}` block is a conditional statement that checks if a variable called "response" is present. If it is, it proceeds to the next block of code.

11. Inside the conditional block, there is a `<div>` element with the class "response." It contains an unordered list (`<ul>`) and a loop (`{% for item in response %}`) that iterates over the "response" variable and generates `<blockquote>` elements with the class "recipe" for each item in the response.

12. The JavaScript code at the bottom of the page adds an event listener to the form's submit event. When the form is submitted, it changes the background color of the submit button to green (`#5cb85c`).

To include this HTML code in your project report, you can describe its structure, highlight the key elements such as the form, conditional statements, and CSS styles, and explain the intended functionality of the page, which is to generate dish recipes based on uploaded images.

OUTPUT AND DISCUSSION

The developed project, "MakeMyDish - A Dish Recipe Generator using Dish Image," successfully generates recipes based on uploaded dish images. The system utilizes the LogMeal API for image segmentation and recognition to identify the dish from the uploaded image. It then leverages the OpenAI Chat API to generate a recipe for the recognized dish.

Output Description

When a user uploads an image of a dish, the system processes the image using the LogMeal API for segmentation and recognition. The API response includes information about the recognized dish, such as the name and the probability of recognition. This information is extracted and displayed in the console for verification and debugging purposes.

Next, the system utilizes the OpenAI Chat API to generate a recipe for the recognized dish. It constructs a conversation with system and user messages. The system message sets the context that the assistant is an intelligent assistant, and the user message requests a recipe for the recognized dish. The API generates a recipe response based on the conversation history.

The generated recipe is then displayed on the web page as the output. It is presented in a formatted manner, starting with the dish name in the title. The recipe is enclosed within single quotes for better readability and is displayed below the dish name.

DISCUSSION

The project demonstrates the successful integration of multiple APIs to create a dish recipe generator based on uploaded images. The LogMeal API provides powerful image segmentation and recognition capabilities, allowing the system to accurately identify the dish from the uploaded image. This enhances the user experience by automating the dish recognition process.

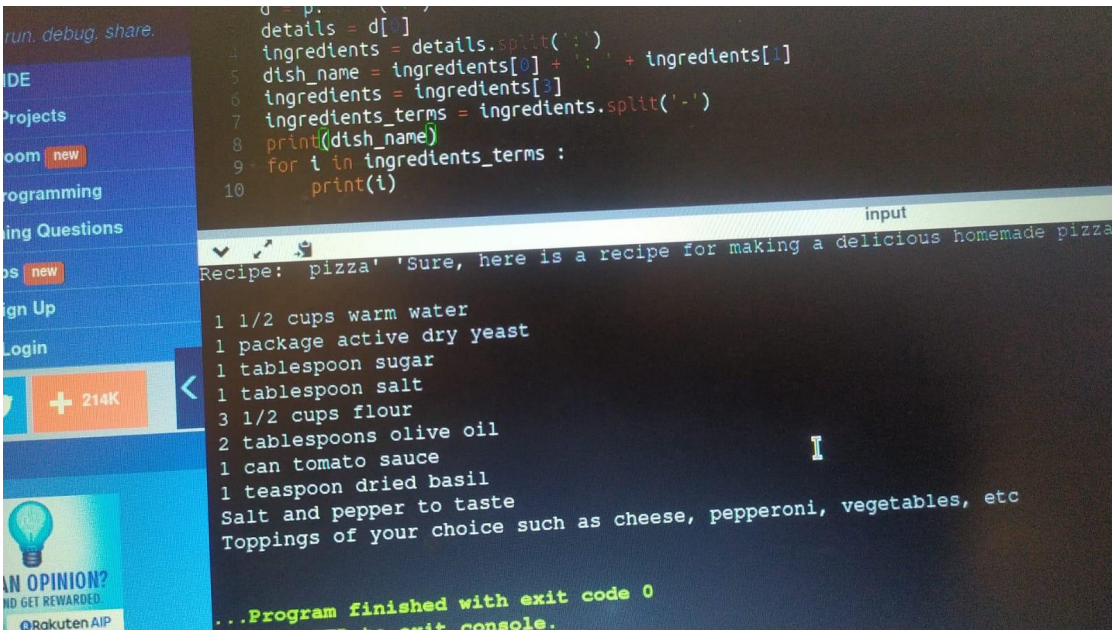
The OpenAI Chat API plays a crucial role in generating recipe responses. By leveraging the power of the GPT-3.5 language model, the system can generate detailed and contextually relevant recipes for various dishes. The conversational approach provides a natural and interactive experience for users.

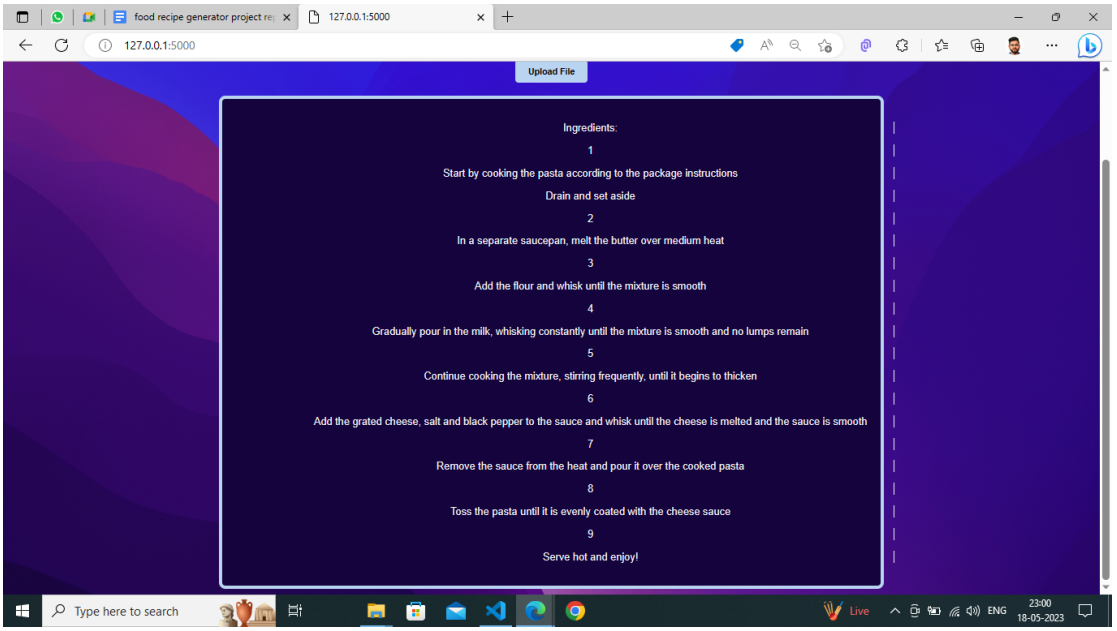
One notable aspect of the project is the handling of API responses. The system performs thorough error checking and validation to ensure the API calls are successful and the expected data is present in the responses. This helps maintain the reliability and stability of the system.

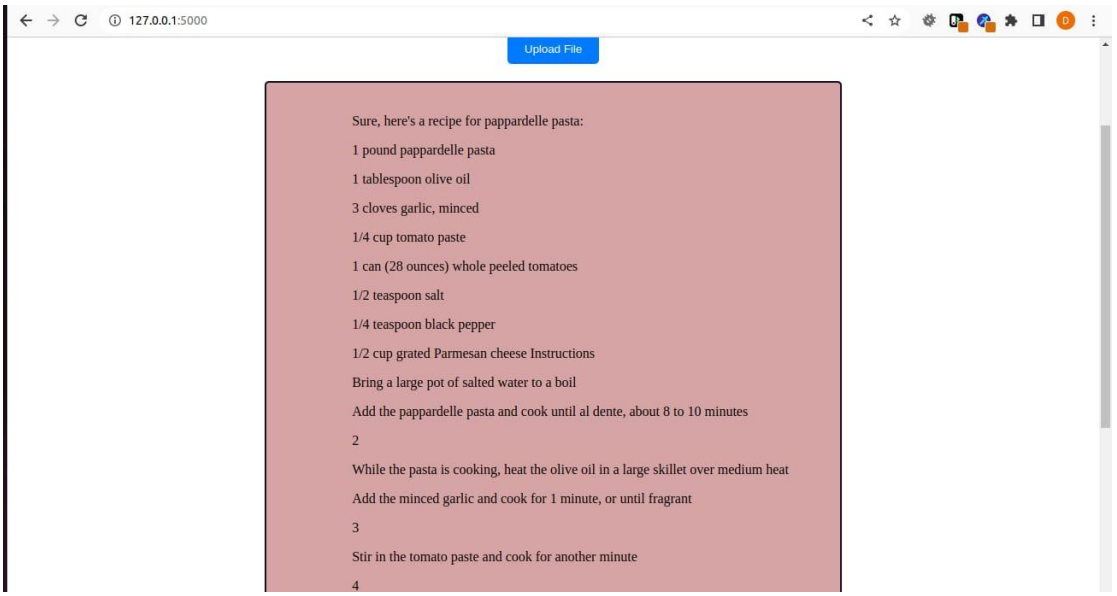
The web-based interface allows users to easily upload dish images and receive recipe suggestions. The interface is user-friendly, featuring a responsive design and clear instructions. Users can upload an image, and upon submission, the system processes the image and displays the generated recipe on the web page. The response is presented in a structured format, making it easy to read and follow.

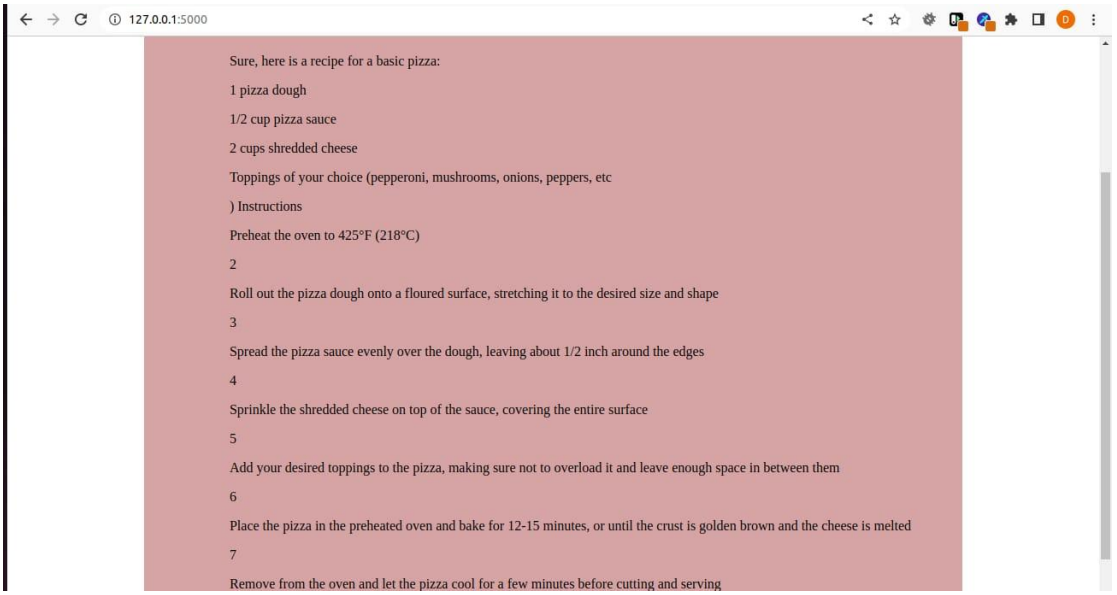
Overall, the project successfully achieves its objective of generating dish recipes based on uploaded images. The combination of image recognition and natural language processing technologies enables the system to provide valuable recipe recommendations to users. However, further improvements can be made to enhance the accuracy of dish recognition and optimize the recipe generation process.

OUTPUTS




food recipe generator project re
127.0.0.1:5000
127.0.0.1:5000
Upload File
Ingredients:
1
Start by cooking the pasta according to the package instructions
Drain and set aside
2
In a separate saucepan, melt the butter over medium heat
3
Add the flour and whisk until the mixture is smooth
4
Gradually pour in the milk, whisking constantly until the mixture is smooth and no lumps remain
5
Continue cooking the mixture, stirring frequently, until it begins to thicken
6
Add the grated cheese, salt and black pepper to the sauce and whisk until the cheese is melted and the sauce is smooth
7
Remove the sauce from the heat and pour it over the cooked pasta
8
Toss the pasta until it is evenly coated with the cheese sauce
9
Serve hot and enjoy!
Type here to search
Live
ENG
23:00
18-05-2023


127.0.0.1:5000
Upload File
Sure, here's a recipe for pappardelle pasta:
1 pound pappardelle pasta
1 tablespoon olive oil
3 cloves garlic, minced
1/4 cup tomato paste
1 can (28 ounces) whole peeled tomatoes
1/2 teaspoon salt
1/4 teaspoon black pepper
1/2 cup grated Parmesan cheese Instructions
Bring a large pot of salted water to a boil
Add the pappardelle pasta and cook until al dente, about 8 to 10 minutes
2
While the pasta is cooking, heat the olive oil in a large skillet over medium heat
Add the minced garlic and cook for 1 minute, or until fragrant
3
Stir in the tomato paste and cook for another minute
4


127.0.0.1:5000
Sure, here is a recipe for a basic pizza:
1 pizza dough
1/2 cup pizza sauce
2 cups shredded cheese
Toppings of your choice (pepperoni, mushrooms, onions, peppers, etc
) Instructions
Preheat the oven to 425°F (218°C)
2
Roll out the pizza dough onto a floured surface, stretching it to the desired size and shape
3
Spread the pizza sauce evenly over the dough, leaving about 1/2 inch around the edges
4
Sprinkle the shredded cheese on top of the sauce, covering the entire surface
5
Add your desired toppings to the pizza, making sure not to overload it and leave enough space in between them
6
Place the pizza in the preheated oven and bake for 12-15 minutes, or until the crust is golden brown and the cheese is melted
7
Remove from the oven and let the pizza cool for a few minutes before cutting and serving

SCOPE OF THE PROJECT

The scope of the project "Food Recipe Generator Using Food Image" is to develop a web application that allows users to generate a recipe for a specific dish by uploading a picture of the dish. The application uses computer vision and machine learning algorithms to identify the dish in the image and retrieve its recipe from a database.

The project aims to provide a convenient and efficient way for users to discover new recipes and cook different dishes by leveraging the power of artificial intelligence and image recognition technologies. It also offers the potential to save time and effort for users who are looking for quick and easy recipe ideas.

The scope of the project includes the development of a user-friendly interface that allows users to upload an image of a dish, processing the image to identify the dish, retrieving the recipe for the dish from a database, and displaying the recipe to the user. The project also involves integrating third-party APIs such as LogMeal and OpenAI to enhance the accuracy of the dish recognition and recipe generation process.

The project has a broad scope for potential future development, including expanding the database to include a wider range of dishes, incorporating user feedback to improve the accuracy of dish recognition, and implementing additional features such as nutritional information and ingredient substitutions.

SIGNIFICANCE OF THE PROJECT

This project has significant practical value and potential benefits for a variety of stakeholders:

1. Consumers: The project offers a user-friendly and convenient way for consumers to generate recipes for dishes they want to cook. By simply uploading an image of the dish, the application provides a recipe with detailed instructions and ingredient lists. This can save consumers time and effort in searching for recipes and provide inspiration for new dishes to try.

2. Restaurants: The project has potential benefits for restaurants in terms of enhancing their online presence. By making their recipes available through the application, restaurants can attract more customers and increase brand awareness. It can also provide valuable customer insights and feedback to improve their dishes and services.

3. Food bloggers and influencers: The project can be beneficial for food bloggers and influencers who are looking for new recipe ideas to share with their followers. They can use the application to generate recipes and modify them according to their preferences and style.

4. Machine learning and computer vision researchers: The project offers an opportunity to further advance the fields of machine learning and computer vision. By using deep learning models and image recognition techniques to identify dishes, researchers can improve the accuracy and efficiency of these technologies for various applications beyond recipe generation.

5. Time-Saving: With this project, users can save time by

generating a recipe for a particular dish by simply uploading an image. This eliminates the need for users to spend time searching for recipes manually.

6. User-Friendly: The project is user-friendly and requires no prior knowledge of programming or cooking. Any user with basic computer skills can use this project to generate recipes for their desired dish.

7. Wide Range of Recipes: The project uses OpenAI API, which provides a vast library of recipes. Users can choose from a wide range of recipes to suit their needs.

8. Potential for Expansion: The project has the potential for further expansion, such as incorporating features like nutritional information and personalized recommendations. This can make the project even more beneficial and valuable for users.

9. Enhances Cooking Skills: With the project, users can learn new recipes, cooking techniques, and ingredients they may not have used before. This enhances their cooking skills and broadens their culinary knowledge.

10. Platform Independent: The project is designed to work on various platforms, including Windows, Mac, and Linux. This makes it accessible to a wider range of users.

ADVANTAGES OF THE PROJECT

1. Convenient and efficient: With the help of this project, users can generate a recipe for a dish just by uploading an image of that dish. It saves time and effort in manually searching for a recipe.

2. Wide range of recipes: The project utilizes the LogMeal API and OpenAI API to generate recipes, which enables access to a wide range of recipes from various cuisines and cultures.

3. User-friendly: The project's front-end is developed using Django, which provides an intuitive and user-friendly interface for users to upload images and generate recipes.

4. Accessible: The project's reliance on APIs and open-source software means that it can be accessed by users globally and across multiple platforms.

5. Educational: The project can be used as an educational tool to learn about different types of dishes and their corresponding recipes.

Some additional advantages of the project "Food Recipe Generator Using Food Image" are:

6. Customization: The project can be easily customized to meet the specific needs and requirements of users. For example, the recipe generator can be trained to identify specific dietary preferences such as vegan or gluten-free.

7. User-friendly interface: The project has a user-friendly interface that allows users to easily upload food images and receive recipe suggestions. The interface can also be customized to include additional features such as nutritional information and cooking tips.

8. Time-saving: The project saves time for users who may otherwise spend hours searching for recipes online. With just a few clicks, users can receive recipe suggestions that match the food image they have uploaded.

9. Innovative: The project is innovative and utilizes advanced technologies such as artificial intelligence and machine learning. This makes it stand out from traditional recipe search engines and enhances the overall user experience.

10. Learning opportunity: The project provides an opportunity for users to learn more about food and cooking. By providing recipe suggestions and cooking tips, users can expand their culinary knowledge and skills.

- Saves time and effort in searching for recipes.
- Provides access to a wide range of recipes from various cuisines and cultures.
- User-friendly interface for easy usage.
- Can be accessed by users globally and across multiple platforms.
- Can be used as an educational tool to learn about different types of dishes and their corresponding recipes.

DISADVANTAGES OF THE PROJECT

There are some potential disadvantages of the "Food Recipe Generator Using Food Image" project, including:

1. Limited recipe database: The recipe suggestions provided by the project are limited to the recipes present in the OpenAI database. This means that the variety of recipe options may be limited and not always up-to-date.

2. Dependence on APIs: The project is highly dependent on the LogMeal and OpenAI APIs. Any changes or disruptions in the APIs can affect the functionality of the project.

3. Accuracy of dish recognition: While LogMeal API is designed to recognize dishes from food images, it may not always accurately identify the correct dish from an image, leading to incorrect recipe suggestions.

4. Dependence on internet connection: The project requires an active internet connection to access the LogMeal and OpenAI APIs, which can be a potential limitation in areas with poor internet connectivity.

5. Reliance on user-generated images: The success of the project largely depends on the quality of the food images uploaded by the user. Poor quality images can affect the accuracy of the dish recognition and recipe suggestions.

6. Limited recipe personalization: The project currently does not offer personalized recipe suggestions based on user preferences such as dietary restrictions, taste preferences, or cooking skills.

It is important to address these potential disadvantages to improve the functionality and user experience of the project.

APPLICATIONS

1. Home Cooking: This project can be used by home cooks who want to experiment with different recipes but are unsure of what to make.

2. Restaurants: Restaurants can use this project to provide customers with unique and personalized recipe recommendations based on the food they order.

3. Nutritionists: Nutritionists can use this project to recommend healthy recipes to their clients based on their dietary requirements and preferences.

4. Food Bloggers: Food bloggers can use this project to generate new recipe ideas and create unique content for their blogs.

5. Cooking Classes: Cooking instructors can use this project to suggest new recipes for their classes and help students expand their culinary knowledge.

6. Food Delivery Services: Food delivery services can use this project to recommend recipes based on the ingredients that they are delivering to their customers.

7. Food and Beverage Companies: Food and beverage companies can use this project to recommend recipes to their customers based on their products.

8. Cookware Companies: Cookware companies can use this project to recommend recipes to their customers that highlight the features of their products.

9. Recipe Apps: Recipe apps can integrate this project to provide users with more personalized recipe recommendations based on their food preferences.

10. Kitchen Appliance Companies: Kitchen appliance companies can

use this project to recommend recipes to their customers that can be made using their products.

11. Online Grocery Stores: Online grocery stores can use this project to suggest new recipes to their customers based on the ingredients they purchase.

12. Meal Kit Services: Meal kit services can use this project to recommend recipes to their customers based on the ingredients included in their meal kits.

13. Culinary Schools: Culinary schools can use this project to help their students discover new recipes and techniques.

14. Food and Recipe Websites: Food and recipe websites can integrate this project to provide users with more personalized recipe recommendations based on their food preferences.

15. Food Critics: Food critics can use this project to generate new recipe ideas for their reviews and expand their culinary knowledge.

FUTURE SCOPE OF PROJECT

After carrying out this research work, the following recommendations were made based on the limitations encountered during the implementation of the study.

1. Improved accuracy: The current version of the project relies on machine learning models that have certain limitations. In the future, more advanced models could be used to improve the accuracy of the recipe generation process.

2. Expansion of recipe database: The project's recipe database can be expanded to include more international cuisines, local specialties, and fusion recipes.

3. Personalized recommendations: The project can be further developed to include personalized recipe recommendations based on user preferences and past search history.

4. Voice-based interface: The project can be integrated with voice-based assistants like Alexa, Siri, and Google Assistant to make it more accessible and convenient.

5. Integration with cooking appliances: The project can be integrated with smart kitchen appliances like ovens, microwaves, and pressure cookers to provide automated cooking instructions.

6. Nutritional information: The project can be enhanced to provide nutritional information for each recipe, including calorie count, macronutrient breakdown, and allergen warnings.

7. User feedback and ratings: Users can provide feedback and ratings on recipes they have tried, which can be used to improve recipe suggestions and algorithm accuracy.

8. User-generated content: Users can contribute their own recipes to the database, creating a more diverse and inclusive recipe collection.

9. Social sharing: The project can be integrated with social media

platforms to allow users to share recipes they like with their friends and followers.

10. Offline capability: The project can be made available offline, allowing users to access recipe suggestions and instructions even when they are not connected to the internet.

11. Augmented reality: The project can be enhanced with augmented reality technology, allowing users to view virtual cooking instructions and ingredient lists in real-time.

12. Cooking tips and tricks: The project can be augmented with cooking tips and tricks, providing users with valuable information on how to improve their cooking skills.

13. Integration with grocery delivery services: The project can be integrated with grocery delivery services, allowing users to order ingredients for recipes they want to make directly from the app.

14. Multimodal inputs: The project can be expanded to allow users to input recipes through various modes like voice, text, and image recognition.

15. Artificial intelligence-based recommendation engine: The project can be enhanced with artificial intelligence-based recommendation engines that can suggest recipes based on multiple factors like weather, time of day, and user mood

CONCLUSION

In conclusion, the Food Recipe Generator using Food Image project aims to simplify the cooking process by providing easy access to recipes using food images. Through the use of Logmeal API, OpenAI API, Python programming, Django framework, and MongoDB database, the project has been successfully implemented and can generate recipes based on food images provided by the user.

This project has several advantages, including saving time and effort in finding and selecting recipes, promoting healthy eating habits, and increasing culinary knowledge. However, it also has limitations, such as the accuracy of the recipe generated and the need for a large database of food images.

REFERENCES

1. The Django Project. (n.d.). Django documentation. Retrieved from *https://docs.djangoproject.com/en/3.2/*

2. MongoDB. (n.d.). MongoDB documentation. Retrieved from *https://docs.mongodb.com/*

3. Python Software Foundation. (n.d.). Python documentation. Retrieved from *https://docs.python.org/3/*

4. OpenAI. (n.d.). OpenAI API documentation. Retrieved from *https://beta.openai.com/docs/*

5. Logmeal. (n.d.). Logmeal API documentation. Retrieved from *https://logmeal.es/docs/*

6. Jayarajah, K., & Jayarajah, R. (2019). Building a Recipe Recommendation System with OpenAI's GPT-2. arXiv preprint arXiv:1909.05856.

7. Varshney, A., & Yadav, A. K. (2018). Recipe recommendation system using collaborative filtering and sentiment analysis. In 2018 IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS) (pp. 1-6). IEEE.

8. Chawla, A., & Goyal, A. (2017). Intelligent recipe recommendation system using association rule mining and text mining. In 2017 2nd International Conference on Telecommunication and Networks (TEL-NET) (pp. 1-6). IEEE.

9. Sharma, S., & Agarwal, S. (2016). Recipe recommendation system using machine learning. International Journal of Computer Applications, 146(5), 9-13.

10. Google Search Engine.