Building a Comprehensive Menu Database for Personalized Recommendations

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Date: 18.04.2022

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1. ABSTRACT

This report outlines the development of a personalized menu recommendation system that utilizes AI technologies such as machine learning and natural language processing to enhance the customer experience in the food and beverage industry. The system employs a chatbot that engages in natural language conversations with customers to gather information about their dietary preferences and feedback. It then utilizes a content-based filtering algorithm to suggest menu items that match the customer's desired ingredients, allergies, and dietary preferences. The system is also capable of analyzing social media and online platforms to identify food and beverage trends and maintain a comprehensive database of menu items. The system provides valuable data insights for restaurant owners, such as customer behavior, preferences, and trends, which can inform menu items and marketing strategies. Ultimately, this personalized menu recommendation system represents a promising application of AI in the food and beverage industry, with potential benefits for both customers and restaurant owners.

KEYWORDS

Personalized Menu Recommendation System, AI (Artificial Intelligence), Machine Learning, Natural Language Processing, Chatbot, Content-Based Filtering Algorithm.

2. PROBLEM STATEMENT

The problem statement of this report is to develop a personalized menu recommendation system that addresses the challenge faced by the food and beverage industry in keeping up with changing customer preferences and trends. Without such a system, restaurants may struggle to recommend personalized menu items to their customers, leading to reduced customer satisfaction and loyalty, as well as missed opportunities for sales. The objective of this report is to utilize AI technologies such as machine learning and natural language processing to create a personalized recommendation system that can gather information about the customer's dietary preferences, feedback, and other relevant data through natural language conversations. The system will then employ a content- based filtering algorithm to suggest menu items based on the customer's desired ingredients, allergies, and dietary preferences.The system will also analyze social media and other online platformsto identify food and beverage trends and maintain a comprehensive database of menu items. Ultimately, the personalized menu recommendation system aims to improve the customer experience, increase sales, and provide valuable data insights for restaurant owners in the highly competitive food and beverage industry.

3. MARKET, CUSTOMER AND BUSINESS NEED ASSESSMENT

Market Assessment

The food and beverage industry is a highly competitive market with constantly evolving customer preferences and trends. Customers increasingly seek a personalized experience when dining out, and restaurants that fail to provide this risk losing customer loyalty and sales. Therefore, there is a clear need for a personalized menu recommendation system that can address the challenge faced by restaurants in keeping up with changing customer preferences and trends.

Customer Assessment

Customers today are looking for a personalized dining experience that caters to their individual dietary preferences and restrictions. However, with the vast number of menu items available, it can be challenging for customers to find dishes that meet their specificneeds. A personalized menu recommendation system that utilizes AI technologies such as machine learning and natural language processing to recommend menu items that match the customer's dietary preferences and restrictions can provide a valuable solution to this problem.

Business Needs Assessment

Restaurant owners face the challenge of providing a personalized

dining experience to their customers while remaining competitive in a highly saturated market. A personalized menu recommendation system can help restaurant owners achieve this goal by providing valuable data insights into customer behavior, preferences, and trends that can inform menu items and marketing strategies. Additionally, the system can help increase sales by providing personalized recommendations to customers, ultimately resulting in improved customer satisfaction and loyalty. Therefore, a personalized menu recommendation system can address the businessneeds of restaurant owners and provide a competitive advantage in the food and beverage industry.

4. TARGET SPECIFICATION AND CHARACTERIZATION

Target Specification

1. The system should be able to gather information about the customer's dietary preferences, feedback, and other relevant data through natural language conversations.

2. The system should employ a content-based filtering algorithm to suggest menu items based on the customer's desired ingredients, allergies, and dietary preferences.

3. The system should utilize AI technologies such as machine learning and natural language processing to personalize menu recommendations for customers.

4. The system should analyze social media and other online platforms to identify food and beverage trends and incorporate them into the recommendations.

5. The system should maintain a comprehensive database of menu items, including detailed descriptions, ingredients, nutritional information, and customer feedback.

6. The system should allow the customer to provide feedback on the recommended dishes, which the system can use to further personalize recommendations in the future.

7. The system should provide valuable data insights for restaurant owners, such as customer behavior, preferences, and trends.

Characterization

1. User-friendly and intuitive, allowing customers to easily input their dietary preferences and restrictions.

2. Accurate in its recommendations, providing menu items that accurately match the customer's preferences and restrictions.

3. Responsive and adaptive, able to update recommendations based on new information provided by the customer or changes in trends.

4. Efficient in its processing, able to quickly gather and analyze customer data to provide personalized recommendations.

5. Comprehensive, providing a wide range of menu items and incorporating the latest food and beverage trends.

6. Reliable, providing consistent recommendations to customers and accurate data insights to restaurant owners.

7. Scalable, able to handle a large volume of customers and data while maintaining accuracy and efficiency.

5. EXTERNAL SEARCH

https://www.kaggle.com/code/ajitrajput/food-recommendation-using-bert/input?select=indian_food.csv

https://www.koreascience.or.kr/article/JAKO201403460491634.page

https://web.s.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=20888708&AN=153170354&h=HISzChlmm8ARUvAz0OfwpE29Vg%2f5w%2fXe%2bq%2bj%2bGYvilm4AstlKz72Qjjzu0e8OlQHDsj%2feHoX%2bGVAf2gtsNS9og%3d%3d&crl=c&resultNs=AdminWebAuth&resultLocal=ErrCrlNotAuth&crlhashurl=login.aspx%3fdirect%3dtrue%26profile%3dehost%26scope%3dsite%26authtype%3dcrawler%26jrnl%3d20888708%26AN%3d153170354

https://link.springer.com/article/10.1007/s10639-016-9504-y

https://www.sciencedirect.com/science/article/abs/pii/S0957417411016332

https://www.researchgate.net/figure/Content-based-recommendation-flow-chart_fig4_348424866

https://towardsdatascience.com/how-to-build-from-scratch-a-content-based-movie-recommender-with-natural-language-processing-25ad400eb243

https://www.geeksforgeeks.org/ml-content-based-recommender-system/

https://www.hindawi.com/journals/complexity/2021/5589285/

https://analyticsindiamag.com/collaborative-filtering-vs-content-based-filtering-for-recommender-systems/

https://www.upwork.com/resources/what-is-content-based-filtering

6. BENCHMARKING ALTERNATE PRODUCTS

During the external search, it was found that there are already several personalized menu recommendation systems available in the market, such as Yelp, OpenTable, and Zomato. However, most of these systems rely on user-generated reviews and ratings, which may not accurately reflect individual preferences and dietary requirements.

One notable example of a personalized menu recommendation system is DishQ, which uses machine learning to analyze customer taste preferences based on their food choices and contextual information. The system then provides personalized recommendations that cater to each customer's unique taste profile.

Other companies in the food and beverage industry are also exploring the use of AI and machine learning to improve customer experience and increase sales. For instance, McDonald's hasacquired Dynamic Yield, a company that provides personalized recommendations and offers based on customer order history and other data points.

Overall, there is a growing trend towards using AI and machine learning in the food and beverage industry to provide personalized recommendations and improve customer experience. This suggests that the proposed personalized menu recommendation system using machine learning and NLP has a viable market and customer base.

7. APPLICABLE PATENTS

"System and Method for Generating a Personalized Recipe Based on User Preferences and Nutrition Information."
This patent describes a system for generating personalized recipes based on user preferences and dietary restrictions. The system analyzes user data to create tailored recipes that meet the user's needs.

"Machine Learning-Based Menu Recommendation System for Restaurants."
This patent describes a system for recommending menu items to restaurant customers based on their preferences and past orders. The system uses machine learning algorithms to analyze customer data and make personalized recommendations.

"Natural Language Processing for Food Ordering and Recommendations."
This patent describes a system for using natural language processing to understand customer orders and make personalized recommendations based on their preferences. The system can understand complex orders and make recommendations based on the customer's past orders and preferences.

"Dynamic Personalized Food Recommendations Based on Social Network Data."

This patent describes a system for analyzing social media data to make personalized food recommendations. The system can analyze social media posts to understand a customer's preferences and make recommendations based on their interests.

8. APPLICABLE REGULATIONS

The development and implementation of a personalized menu recommendation system in India would be subject to various government regulations and environmental standards. Here are some examples of applicable regulations in India:

Food Safety and Standards Act, 2006

This act establishes food safety and standards regulations in India. The act sets standards for food products, including labeling andpackaging requirements, and ensures that food products meet safety and quality standards.

Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011

These rules require companies to protect sensitive personal data or information of their customers. The rules provide guidelines on the collection, use, and storage of personal data and require companies to implement reasonable security practices and procedures to protect personal information.

Consumer Protection Act, 2019

This act provides for the protection of consumer rights and interests. The act establishes a mechanism for filing consumer complaints and seeks to ensure that consumers are protected from unfair trade practices and deceptive advertising.

Environmental laws

 Depending on the specific technologies and software used in the development of the personalized menu recommendation system, environmental regulations may also apply. For example, if the system involves the use of electronic devices, the company mayneed to comply with regulations on electronic waste management and disposal.

9. APPLICABLE CONSTRAINTS

The development and implementation of a personalized menu recommendation system in the food and beverage industry in India would be subject to various constraints, including the need for space, budget, and expertise. Here are some examples of applicable constraints:

Space: Depending on the size of the restaurant and the specific hardware and software required for the system, there may be space constraints that need to be considered. For example, if the system requires large servers or storage units, the restaurant may need to allocate space for these components.

Budget: Developing and implementing a personalized menu recommendation system can be costly. The restaurant would need to budget for the development of the software, hardware, and other necessary components. The restaurant may also need to budget for ongoing maintenance and updates to the system.

Expertise: Developing a personalized menu recommendation system requires expertise in machine learning, natural language processing, and other relevant technologies. The restaurant may need to hire specialized personnel with expertise in these areas or partner with a third-party provider with the necessary expertise.

Integration with existing systems: The restaurant may already have existing point-of-sale systems or other software that needs to be integrated with the personalized menu recommendation system. This can pose challenges that need to be considered and addressed during

the development and implementation process.

It is important to note that this list is not exhaustive, and other constraints may also apply depending on the specific features and functionalities of the personalized menu recommendation system. It is essential to carefully consider all relevant constraints during the planning and development stages to ensure the system can be implemented successfully within the restaurant's constraints.

10. BUSINESS MODEL

A potential business model for a personalized menu recommendation system in the food and beverage industry in India would be to offer the system as a software-as-a-service (SaaS) solution. Here are some monetization ideas for such a business model:

Subscription model

The restaurant pays a monthly or annual subscription fee for access to the personalized menu recommendation system. The subscription fee can be based on the number of users or the number of restaurantsusing the system.

Commission-based model

The system can be offered to restaurants for free, but the company charges a commission on the increased sales resulting from the use of the system. The commission can be a percentage of the increased sales or a fixed fee per transaction.

Licensing model

The company can license the personalized menu recommendation system to food and beverage chains or other businesses that operate multiple restaurants. The licensing fee can be based on the number of restaurants or the number of users using the system.

Upsell model

The company can offer additional features or services to restaurants using the personalized menu recommendation system for anadditional fee. For example, the company can offer data analytics services or marketing services to help restaurants optimize their menu and increase sales.

Integration model

The company can partner with existing point-of-sale (POS) system providers and offer the personalized menu recommendation system as an add-on to their existing products. The company can charge a fee for each integration or a percentage of the increased sales resulting from the use of the system.

11. CONCEPT DEVELOPMENT

The personalized menu recommendation system is a software product/service that utilizes machine learning and natural language processing to provide tailored recommendations to customers in the food and beverage industry. The system will collect and analyze customer feedback, dietary preferences, and other relevant data to create personalized recommendations for each customer. It will also incorporate information from social media and other online platforms to identify food and beverage trends and include them in the recommendations.

The system can be implemented in various settings, including restaurants, cafes, bars, and other food and beverage establishments. Customers can access the recommendations through the restaurant's website or mobile app, where they can view recommended menu items and place orders directly.

The system will provide restaurant owners with valuable data insights on customer behavior, preferences, and trends, which can inform menu items, marketing strategies, and business decisions. The system's benefits to both customers and restaurant owners include improved customer satisfaction, increased sales, and enhanced business performance.

12. FINAL PRODUCT PROTOTYPE
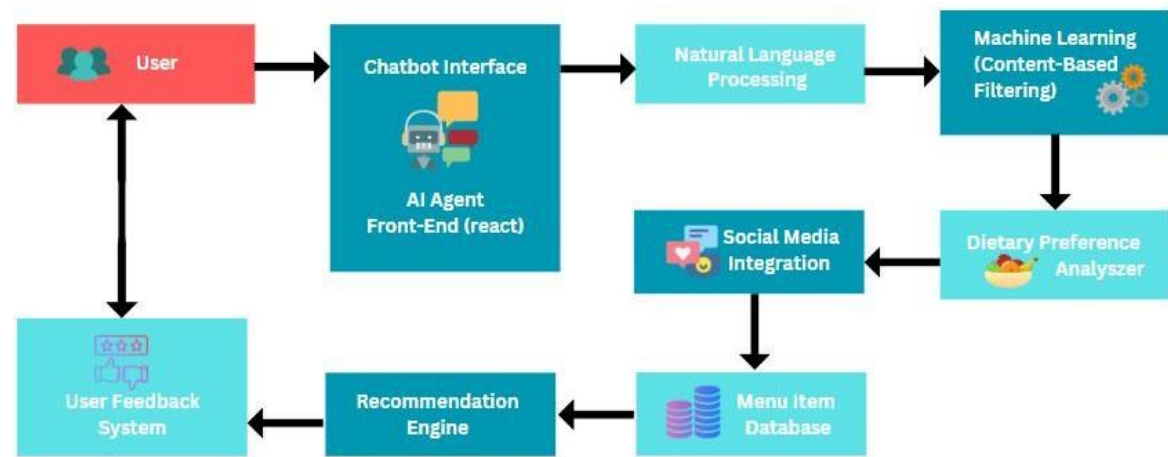
The final product prototype is a chatbot-based personalized menu recommendation system that uses machine learning and natural language processing in the food and beverage industry.

The chatbot would gather information about the customer's dietary preferences, feedback, and other relevant data through natural language conversations.

The system uses a content-based filtering algorithm to suggest menu items based on the customer's desired ingredients, allergies, and dietary preferences.

To use the system, the customer enters their desired ingredients, allergies, and dietary preferences, and the system filters out dishes that do not contain the desired ingredients or contain allergens using content-based filtering technique. The system then uses CountVectorizer to extract features from the ingredients column and computes the cosine similarity matrix to find the most similar dishes

to the customer's input.

A dietary preference analyser processes information about the customer's dietary restrictions and preferences and accordingly evaluates the most similar dishes found.

The system would also analyze social media and other online platforms to identify food and beverage trends and incorporate them into the recommendations.

The system also maintains a comprehensive database of menu items, including detailed descriptions, ingredients, nutritional information, and customer feedback.

The system then presents the top recommended dishes to the customer. The customer can select a dish to view more information, such as the ingredients and nutritional information.

The system also allows the customer to provide feedback on the recommended dishes, which the system can use to further personalize recommendations in the future.

The system also provides valuable data insights for restaurant owners, such as customer behavior, preferences, and trends. This information can help restaurant owners make informed decisions about menu items and marketing strategies.

Overall, this personalized menu recommendation system is a promising AI product for the food and beverage industry that can improve the customer experience, increase sales, and provide valuable data insights for restaurant owners.

13. PRODUCT   DETAILS

13.1. How the product works?

From the user's point of view, the personalized menu recommendation system is a chatbot-based system that provides personalized menu recommendations in the food and beverage industry.

To use the system, the user interacts with the chatbot through natural language conversations. The chatbot gathers information about the user's dietary preferences, feedback, and other relevant data through these conversations.

The user can then input their desired ingredients, allergies, and dietary preferences, and the system filters out dishes that do not contain the desired ingredients or contain allergens using the content-based filtering technique. The system then presents the top recommended dishes to the user based on their input.

The user can view more information about a dish, such as the ingredients and nutritional information, and provide feedback on recommended dishes. The system uses this feedback to further personalize recommendations in the future.

The system also analyzes social media and other online platforms to identify food and beverage trends and incorporates them into the recommendations. Additionally, the system maintains a comprehensive database of menu items, including detailed descriptions, ingredients, nutritional information, and customer

feedback.

The system provides valuable data insights for restaurant owners, such as customer behavior, preferences, and trends, which can inform menu items and marketing strategies.

13.2. Data Sources

The personalized menu recommendation system uses several data sources to provide personalized menu recommendations to users. These sources include:

<u>User input</u>

The system collects information directly from the user through natural language conversations with the chatbot. This information includes the user's desired ingredients, allergies, and dietarypreferences.

<u>Menu database</u>

The system maintains a comprehensive database of menu items that includes detailed descriptions, ingredients, nutritional information, and customer feedback. This database serves as a source of information for the system to identify menu items that meet the user's preferences.

<u>Social media and other online platforms</u>

The system also analyzes social media and other online platforms to identify food and beverage trends and incorporate them into the recommendations. This source of data helps the system stay up-to-date with the latest food and beverage trends and provide more relevant recommendations to users.

Machine learning algorithms

The system uses machine learning algorithms to analyze the data collected from various sources and provide personalized recommendations to users. These algorithms learn from user feedback and other data to improve the accuracy and relevance of recommendations over time.

The personalized menu recommendation system uses multiple data sources to provide personalized and relevant menu recommendations to users.

13.3. Detailed Requirements

The personalized menu recommendation system is a complex system that involves various algorithms, software tools and frameworks. Here are some of the key components:

Machine learning algorithms

The system uses several machine learning algorithms such as content-based filtering, cosine similarity matrix, and CountVectorizer to analyze user data and provide personalized menurecommendations.

Natural language processing (NLP)

The system uses NLP techniques to understand natural language conversations with the chatbot and extract relevant information such as dietary preferences and desired ingredients.

Database management system

The system requires a robust database management system to store

and manage the menu item data, user preferences, and feedback.

Programming languages: The system can be implemented using various programming languages such as Python, JavaScript, and SQL.

Chatbot development platform

The system requires a chatbot development platform such as Dialogflow, Amazon Lex, or Microsoft Bot Framework to build and deploy the chatbot.

Cloud computing services

The system can be deployed on a cloud computing platform such as Amazon Web Services (AWS), Google Cloud Platform, or Microsoft Azure to ensure scalability and availability.

Data visualization tools

The system can also use data visualization tools such as Tableau or Power BI to provide insights and analytics to restaurant owners.

14. CODE IMPLEMENTATION

14.1. Importing necessary libraries

```
import datetime
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics.pairwise import cosine_similarity
```

14.2. Loading Dataset

```
df=pd.read_csv("/content/drive/MyDrive/Internship0/indian_food.csv")
display(df)
```

	name	ingredients	diet	prep_time	cook_time	flavor_profile	course	state	region
0	Balu shahi	Maida flour, yogurt, oil, sugar	vegetarian	45	25	sweet	dessert	West Bengal	East
1	Boondi	Gram flour, ghee, sugar	vegetarian	80	30	sweet	dessert	Rajasthan	West
2	Gajar ka halwa	Carrots, milk, sugar, ghee, cashews, raisins	vegetarian	15	60	sweet	dessert	Punjab	North
3	Ghevar	Flour, ghee, kewra, milk, clarified butter, su...	vegetarian	15	30	sweet	dessert	Rajasthan	West
4	Gulab jamun	Milk powder, plain flour, baking powder, ghee,...	vegetarian	15	40	sweet	dessert	West Bengal	East
...	...	...	...	...	...	...	...	...	...
250	Til Pitha	Glutinous rice, black sesame seeds, gur	vegetarian	5	30	sweet	dessert	Assam	North East
251	Bebinca	Coconut milk, egg yolks, clarified butter, all...	vegetarian	20	60	sweet	dessert	Goa	West
252	Shufta	Cottage cheese, dry dates, dried rose petals, ...	vegetarian	-1	-1	sweet	dessert	Jammu & Kashmir	North
253	Mawa Bati	Milk powder, dry fruits, arrowroot powder, all...	vegetarian	20	45	sweet	dessert	Madhya Pradesh	Central
254	Pinaca	Brown rice, fennel seeds, grated coconut, blac...	vegetarian	-1	-1	sweet	dessert	Goa	West

255 rows × 9 columns

The above dataset is a sample for the dataset obtained from the menu database. It was collected from the source: https://www.kaggle.com/code/ajitrajput/food-recommendation-using-bert/input?select=indian_food.csv

It consits of the following coloumns:

➢ name : name of the dish

➢ ingredients : main ingredients used

➢ diet : type of diet - either vegetarian or non vegetarian

➢ prep_time : preparation time

➢ cook_time : cooking time

The above dataset was used only as a sample however during the production of the system a much better dataset should be used as this dataset consisted of only 255 entries and limited information (Food was classified based on only two types of diet and nutritional information of the item was not specified).
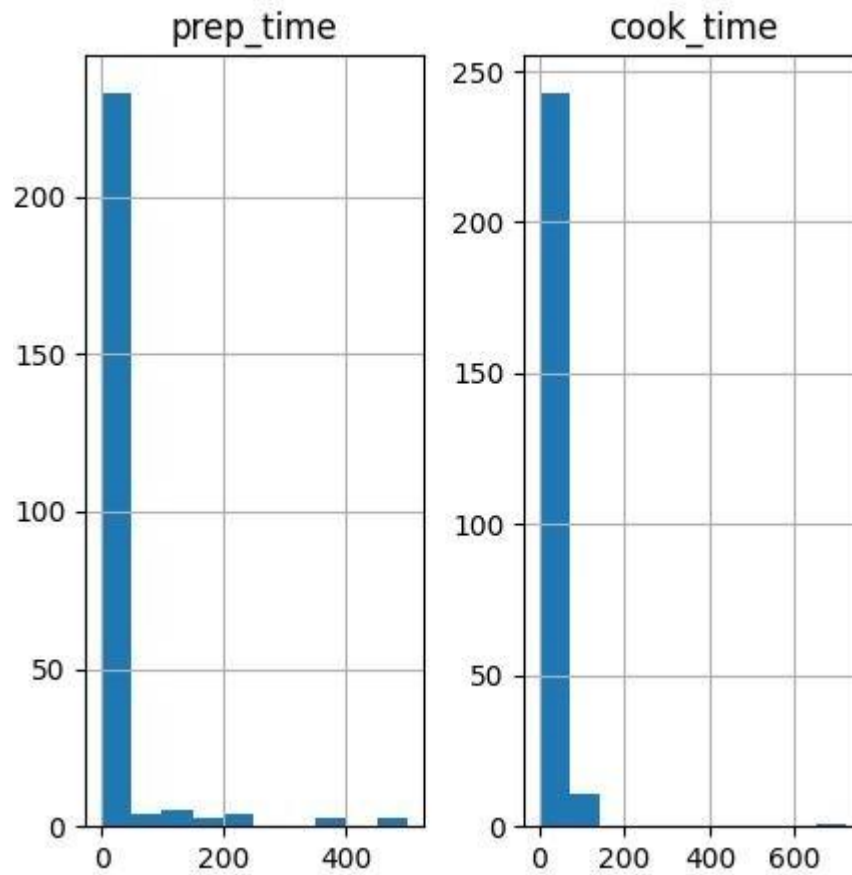
14.3. Exploratory Analysis

```
print(df.describe())
```

```
         prep_time    cook_time
count   255.000000   255.000000
mean     31.105882    34.529412
std      72.554409    48.265650
min      -1.000000    -1.000000
25%      10.000000    20.000000
50%      10.000000    30.000000
75%      20.000000    40.000000
max     500.000000   720.000000
```
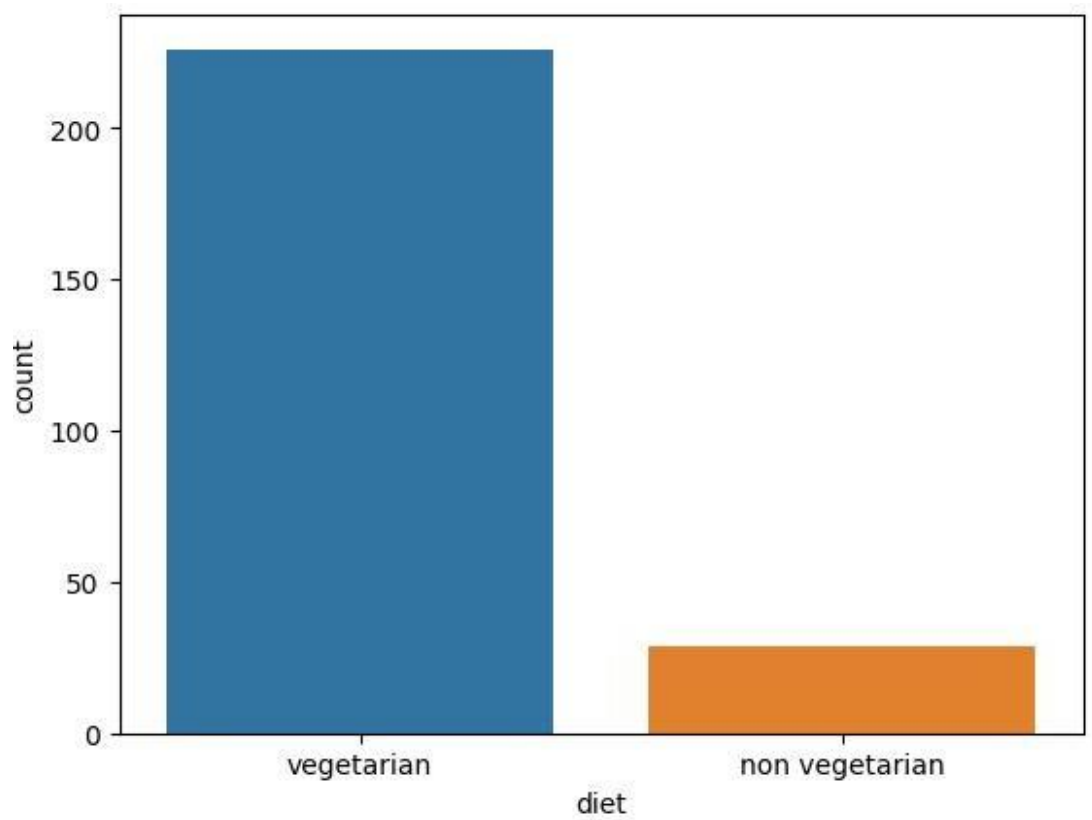
Visualizing the distribution of numeric columns using histograms
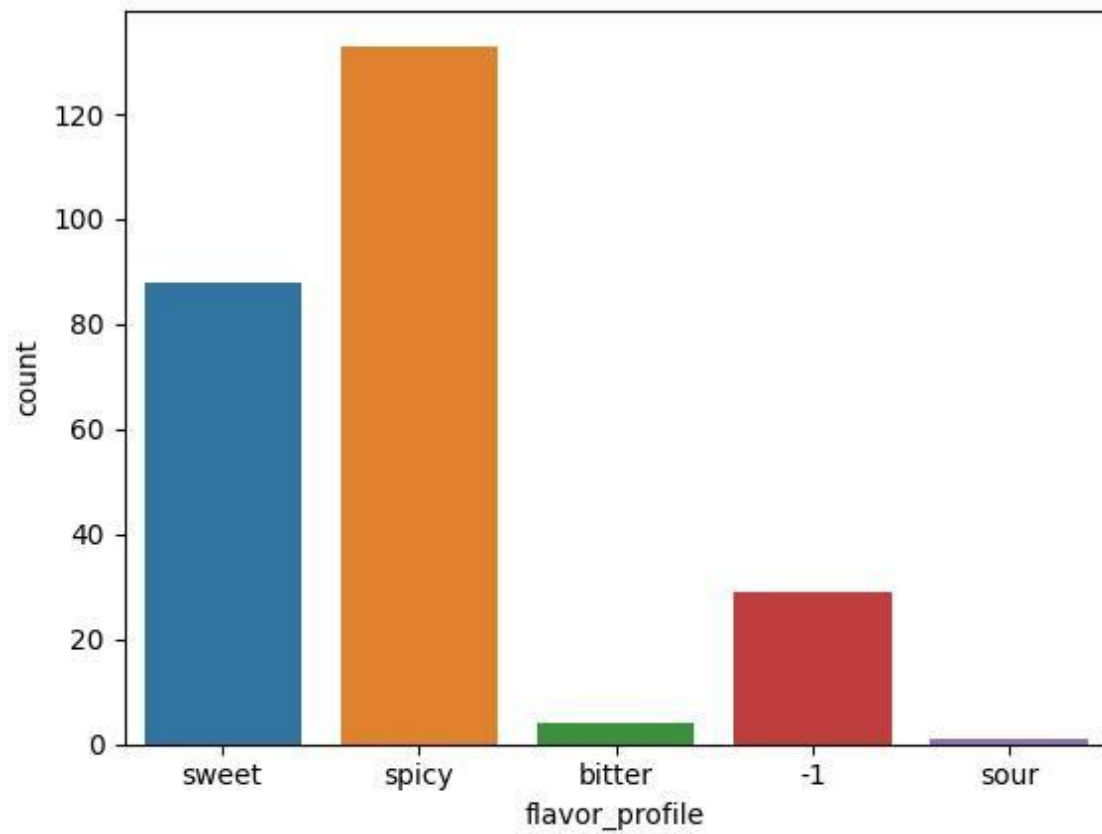
```
df.hist(bins=10, figsize=(10,10))
plt.show()
```

Visualizing the count of categorical columns using bar plots
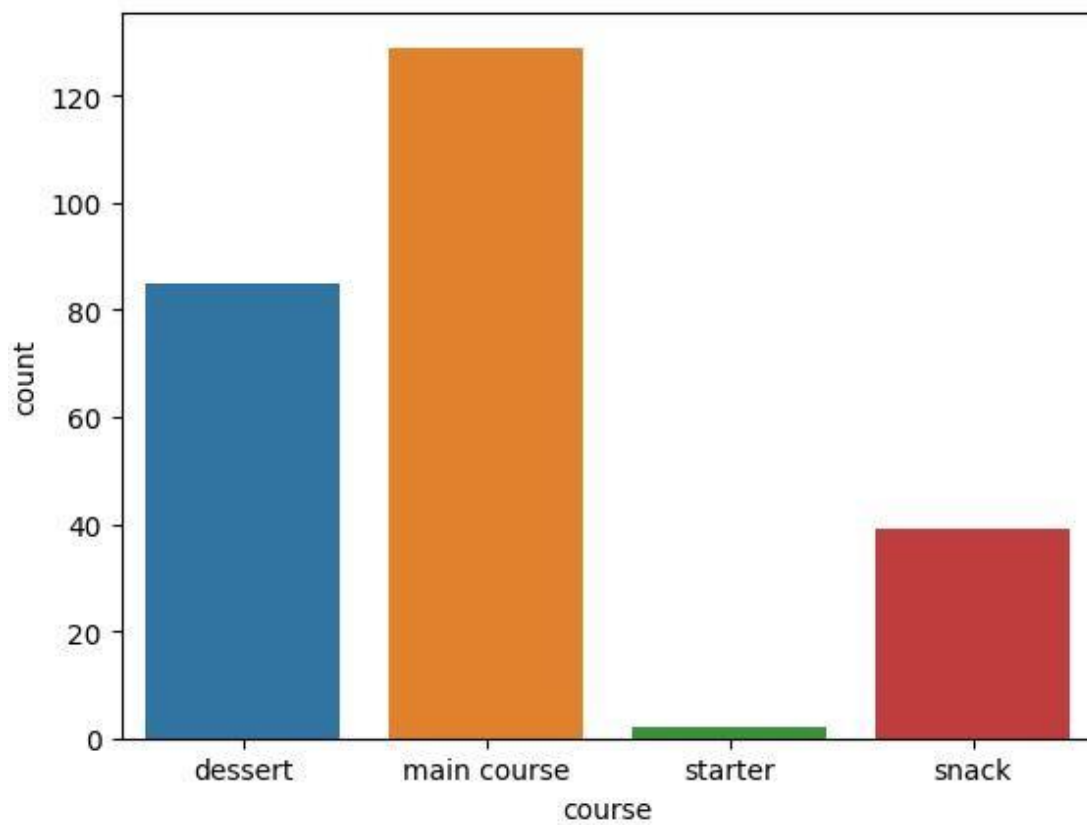
```
sns.countplot(x='diet', data=df)
plt.show()
```
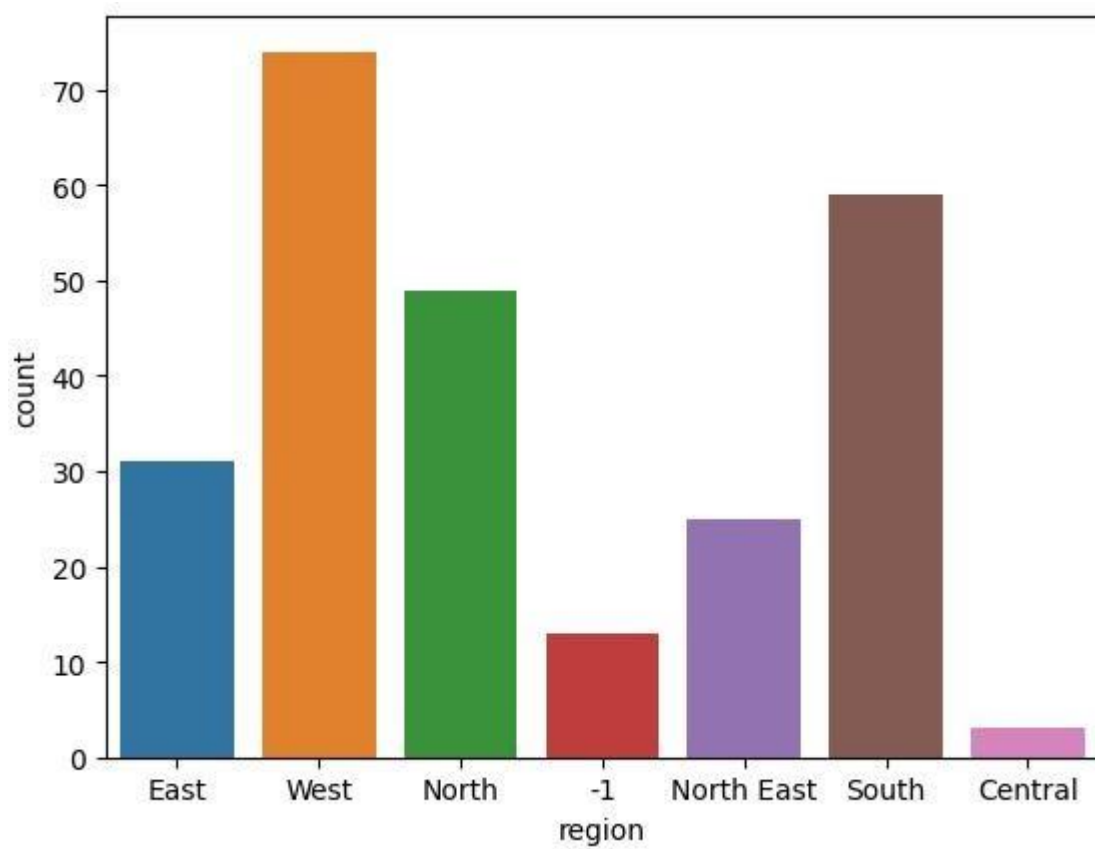
```
sns.countplot(x='flavor_profile', data=df)
plt.show()
```

```
sns.countplot(x='course', data=df)
plt.show()
```
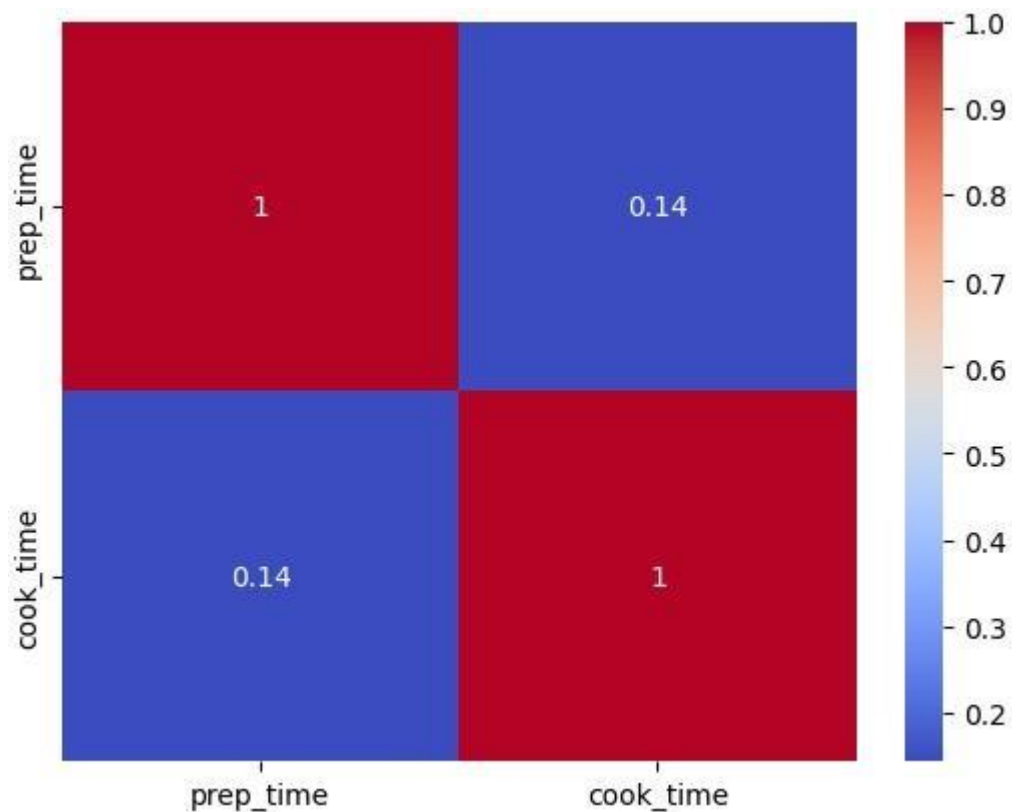
```
sns.countplot(x='region', data=df)
plt.show()
```


Checking the correlation between the numerical columns using heatmaps.

```
corr_matrix = df.corr()
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm')
plt.show()
```

14.4. Code

```python
def get_time():
  currentTime = datetime.datetime.now()
  currentTime.hour
  if currentTime.hour < 12:
      print('Good morning.')
  elif 12 <= currentTime.hour < 18:
      print('Good afternoon.')
  else:
      print('Good evening.')
```

```python
def model(desired_ingredients,allergies,diett):
  df = pd.read_csv("/content/drive/MyDrive/Internship0/indian_food.csv")
  df = df[df['ingredients'].apply(lambda x: all([ingredient in x for in
gredient in desired_ingredients]))]
  df = df[df['ingredients'].apply(lambda x: not any([allergy in x for a
llergy in allergies]))]
  df = df[df['diet'].apply(lambda x: all([diett in x for diett in diett]
))]
  cv = CountVectorizer()
  ingredient_matrix = cv.fit_transform(df['ingredients'])
  cosine_sim = cosine_similarity(ingredient_matrix)
```

```python
    indices = pd.Series(df.index)
    top_indices = indices[cosine_sim[0].argsort()[::-1][1:6]]
    print('\nTop recommended dishes:\n')
    for index in top_indices:
        print('- ' + df.loc[index]['name'])
```

```python
def run_chatbot():
    get_time()
    print("Hello!\nWelcome to the personalized menu recommendation chatbot!\nYou can ask me to recommend a menu item based on your preferences.\n")
    while(True):
        print("Please enter a number based on your choice")
        print("\n1. If you want a customized recommendation\n2. If you want a meal to be suggested\n3. Exit")
        ch=input("\nPlease Enter your choice: ")
        if ch=='1':
            print("\nDo you have any ingredients you wish your meal to include? (y/n)")
            choice=input()
            if choice=='y':
                desired_ingredients_str = input('Enter desired ingredients (comma-separated): ')
                desired_ingredients = [ingredient.strip() for ingredient in desired_ingredients_str.split(',')]
                print(desired_ingredients)
            print("\nDo you have any ingredients you wish to avoid/allergic to? (y/n)")
            choice=input()
            if choice=='y':
                allergies = input('Enter undesired ingredients (comma-separated): ')
                allergies=['gluten']
                print(allergies)
            print("\nDo you have any preferred diet? (y/n)")
            choice=input()
            diet='vegeterian'
            if choice=='y':
                diet=input("Enter your diet: ")
            model(desired_ingredients,allergies,diet)
        elif ch=='2':
            pass
        elif ch=='3':
            print("\nEnd")
            break
        else:
            print("\nInvalid Choice..Please re-enter input\n")
            continue
```

```
run_chatbot()
```

14.5. Output

```
Good evening.
Hello!
Welcome to the personalized menu recommendation chatbot!
You can ask me to recommend a menu item based on your preferences.


Please enter a number based on your choice

1. If you want a customized recommendation
2. If you want a meal to be suggested
3. Exit

Please Enter your choice: 1

Do you have any ingredients you wish your meal to include? (y/n)
y
Enter desired ingredients (comma-separated): sugar,ghee
['sugar', 'ghee']

Do you have any ingredients you wish to avoid/allergic to? (y/n)
y
Enter undesired ingredients (comma-separated): gluten
['gluten']

Do you have any preferred diet? (y/n)
n
```

```
Top recommended dishes:

- Laddu
- Sohan papdi
- Pantua
- Mihidana
- Pootharekulu

Please enter a number based on your choice

1. If you want a customized recommendation
2. If you want a meal to be suggested
3. Exit

Please Enter your choice: 3

End
```

15. CONCLUSION

The personalized menu recommendation system is a state-of-the-art chatbot-based AI product that uses machine learning and natural language processing to provide customized food and beverage recommendations to customers. The system is equipped with advanced features, including content-based filtering, cosine similarity matrix, and dietary preference analysis, to ensure accurate recommendations that meet the customer's needs and preferences. Additionally, the system continuously updates its database with customer feedback and incorporates food and beverage trends from social media and other online platforms. Moreover, the system provides valuable data insights to restaurant owners to help them make informed decisions about menu items and marketing strategies. Overall, this system has the potential to revolutionize the food and beverage industry by improving the customer experience, increasing sales, and providing actionable insights to restaurant owners.