Recipe Recommendation System

School of Computer Science and Engineering

COMP9900 Computer Science / Information Technology

Project

Proposal

Group: WildPointer

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1. Background

1.1. Problem Statement

Food is an important part of everyone’s life and has a great cultural influence. However, people may simply be overwhelmed by plenty of choices or struggle with constraints such as some dishes are not recommended for health reasons.
So recently, Keiji & Yanai (2013) proposed that websites and mobile applications for recipe recommendations such as ‘SuperCook’ and ‘Taste’ have become more and more popular. People who live with the elderly and children or who are newbies in the kitchen can use these sites to obtain the details of cooking recipes. However, to use these sites, In Smart Kitchen Project (2008) leaded by Minoh Lab,KyotoUniversity, the recipe explorer has to input some keywords or select menu items to indicate his/her preferences; the recipe contributor can contribute their recipes which will be searched by recipe explorer. Based on these situations, in this project, we propose a recipe recommendation system.
In this section, after our research, Geng et al. (2021) proposed the most commonly used recommendation mechanism is based on the collaborative filtering, which uses the similarity between users to recommend the recipes that users are interested in. Individuals give the recipe's evaluation (such as rating/like) and record it, and then help others sift through recipes afterwards. Evaluations are not necessarily limited to those of particular interest, and records of particularly unlike information are also quite important. However, VIvek et al. (2018) analyzed that there are two problems that are difficult to solve. One is sparsity, that is, during the early stage of system use, it is difficult to use these evaluations to find similar users (as the system has not obtained enough evaluations). The other is scalability which means with the increase of system users and resources, the performance of the system will get worse and worse.

As for the recommended recipes, the recommendation systems based on the collaborative filtering algorithm are almost all currently used. The main reason is that the recipes are difficult to be processed as they contain unstructured information and can only be recommended based on the similarity between users, even if it is a content-based recommendation system. The level of recommendation is comparable to the keyword search of search engines.

Next, we explain some works introduced by Pazzani & Billsus (2007) that content filtering recommends products based on the similarity between recipes stored in the database and user interests, and actively sends recipes with high similarity to users. The similarity can be obtained by calculating the vector similarity between the user interest model and the recipe feature vector. Since each user operates independently and has an independent feature vector, there is no need to consider the interests of other users, and there is no question of how many evaluation levels are, and new items or unpopular items can be recommended. These advantages make content

filtering-based recommender systems immune to cold-start and sparsity problems. It is usually used for recommendations with high personalization needs.

1.2. Existing System Analysis

For reference, the following will be based on the analysis of two existing recipe recommendation websites, SuperCook (*https://www.supercook.com*) and Allrecipes (*https://www.allrecipes.com*), and summarize their advantages and disadvantages.

In the function of searching recipes by ingredients, SuperCook can also select ingredients from the list or input methods. Allrecipes can only find an ingredient by typing its name exactly. In addition, the above two websites do not realize the function of associative input of food ingredients.

For the logged-in user available functions. In superCook, users can only "like" or "unlike" recipes, while Allrecipes have more functionality, such as writing reviews and viewing recipes' history, but no more Summary or achievement system, which does not inspire enthusiasm and recognition.

In the function of recipe recommend and associate, Supercook can only suggest recipes with the same ingredients, while Allrecipes occasionally add vague associations based on recipe characteristics, such as spaghetti or borscht, to beef, but the feature seldom works only when searching for a subset of recipes, and for the most part replaces that recommendation field with an advertisement.

As for sharing function, only a few summaries can be shared via text links, especially since Allrecipes already store the images that users upload, which can greatly undermine the ability of users to share, it is worth to improving.

2. User stories

User stories for the recipe recommendation project are shown below. They are divided into 8 buckets while each bucket represents a project objective with a simple description. The stories are designed based on the project objectives and analysis of existing systems.

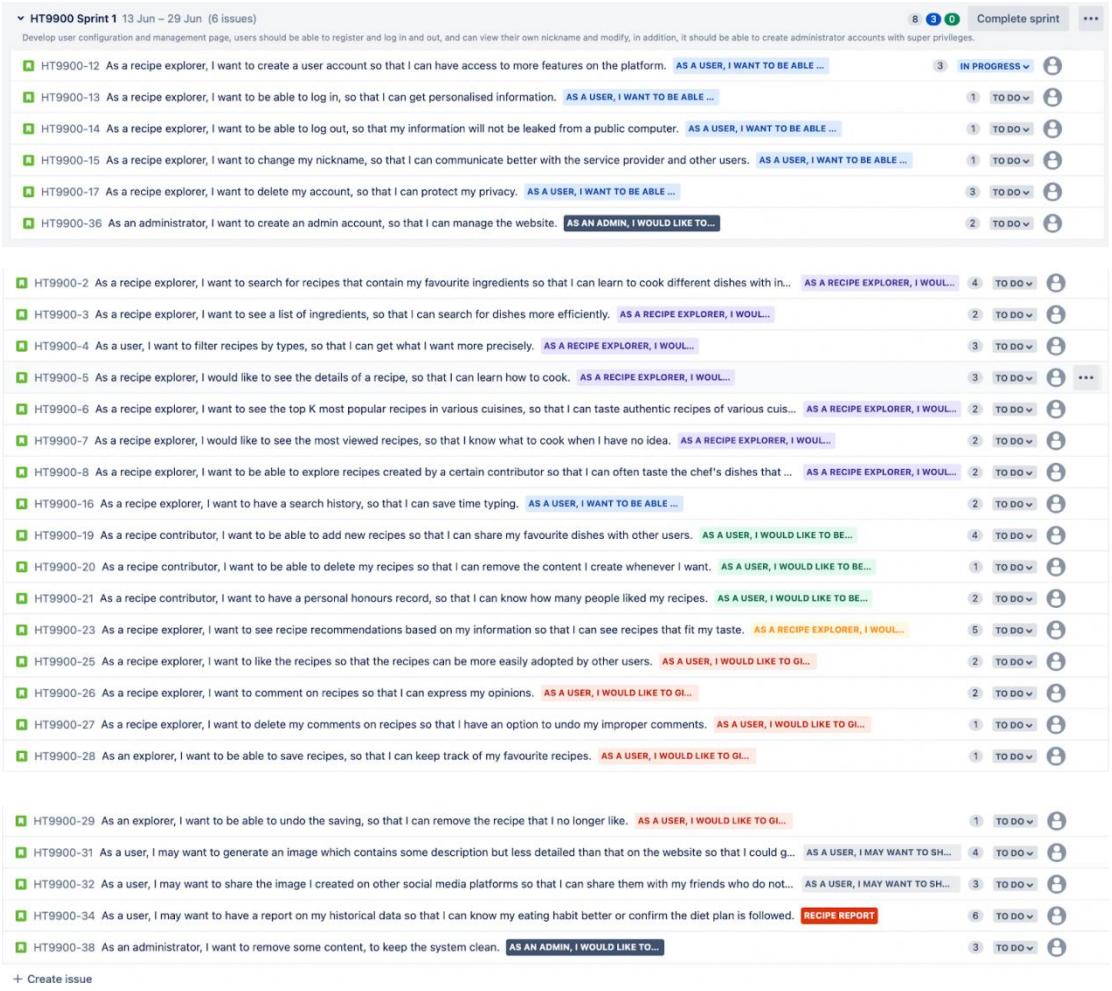

Figure 2.1 all user stories in Jira

2.1. For general user (unregistered or registered):

2.1.1. Objective 1: As a recipe explorer, I would like to search for recipes.

1. As a recipe explorer, I want to search for recipes that contain my favourite ingredients so that I can learn to cook different dishes with ingredients I like.
2. As a recipe explorer, I want to see a list of ingredients, so that I can search for dishes more efficiently.
3. As a user, I want to filter recipes by types, so that I can get what I want

more precisely.

4. As a recipe explorer, I would like to see the details of a recipe, so that I can learn how to cook.

5. As a recipe explorer, I want to see the top K most popular recipes in various cuisines, so that I can taste authentic recipes of various cuisines.

6. As a recipe explorer, I would like to see the most viewed recipes, so that I know what to cook when I have no idea.

7. As a recipe explorer, I want to be able to explore recipes created by a certain contributor so that I can often taste the chef's dishes that suit my taste better.

2.2. For registered user:

2.2.1. Objective 2: As a user, I want to be able to manage my own account.

8. As a recipe explorer, I want to create a user account so that I can have access to more features on the platform.

9. As a recipe explorer, I want to be able to log in, so that I can get personalised information.

10. As a recipe explorer, I want to be able to log out, so that my information will not be leaked from a public computer.

11. As a recipe explorer, I want to set my nickname, so that I can communicate better with the service provider and other users.

12. As a recipe explorer, I want to have a search history, so that I can save time typing.

13. As a recipe explorer, I want to delete my account, so that I can protect my privacy.

2.2.2. Objective 3: As a user, I would like to be able to become a recipe contributor.

14. As a recipe contributor, I want to be able to add new recipes so that I can share my favourite dishes with other users.

15. As a recipe contributor, I want to be able to delete my recipes so that I can remove the content I create whenever I want.

16. As a recipe contributor, I want to have a personal honours record, so that I can know how many people liked my recipes.

2.2.3. Objective 4: As a recipe explorer, I would like to receive receipt recommendations.

17. As a recipe explorer, I want to see recipe recommendations based on my information so that I can see recipes that fit my taste.

2.2.4. Objective 5: As a user, I would like to give feedback to recipes.

18. As a recipe explorer, I want to like the recipes so that the recipes can be more easily adopted by other users.
19. As a recipe explorer, I want to comment on recipes so that I can express my opinions.
20. As a recipe explorer, I want to delete my comments on recipes so that I have an option to undo my improper comments.
21. As an explorer, I want to be able to save recipes, so that I can keep track of my favourite recipes.
22. As an explorer, I want to be able to undo the saving, so that I can remove the recipe that I no longer like.

2.2.5. Objective 6: As a user, I may want to share some recipes with my friends.

23. As a user, I may want to generate an image which contains some description (could be self-defined) but less detailed than that on the website so that I could get something compact but informative to share. (Novel)
24. As a user, I may want to share the image I created on other social media platforms so that I can share them with my friends who do not use this website.

2.2.6. Objective 7: As a user, I may want to get my personal recipe report.

25. As a user, I may want to have a report on my historical data so that I can know my eating habit better or confirm the diet plan is followed. (Novel)

2.3. For administrator:

2.3.1. Objective 8: As an admin, I would like to be able to manage the website

26. As an administrator, I want to create an admin account, so that I can manage the website.
27. As an administrator, I want to remove some users, to keep the system healthy.
28. As an administrator, I want to remove some content, to keep the system clean.

2.4. Novelty

With respect to novel functionalities, our team has proposed 2 new(enhanced) functionalities.

The first one tackles an issue when users want to share a recipe. Based on the background research, we find that sharing recipes is not satisfying for both sharer and sharee. A typical recipe sharing is like:

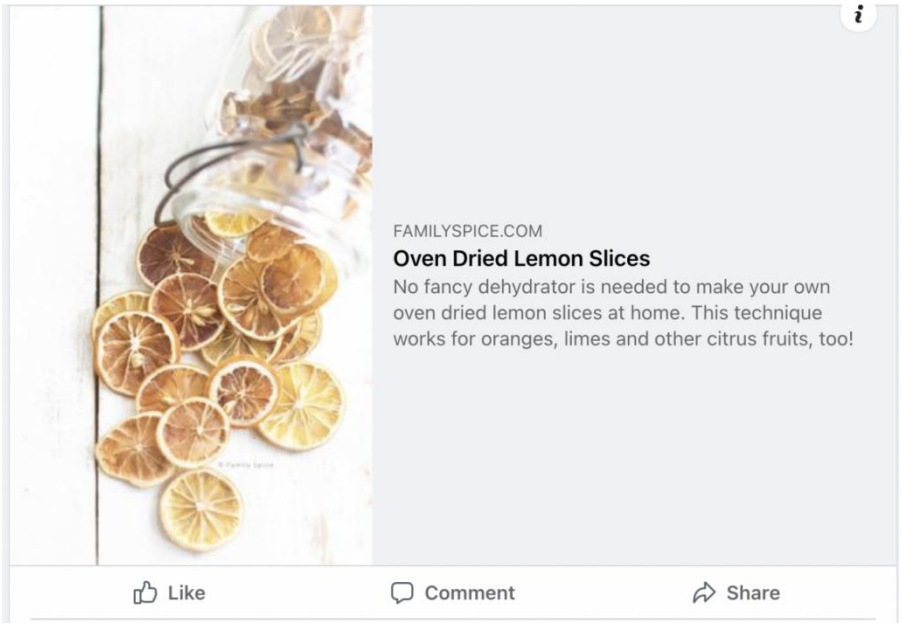

Figure 2.4.1 typical recipe sharing

Basically, it is a link and when people who are interested click on it, it would redirect those people to another website. For the sharer, the major issue of sharing a favourite recipe in this manner is lacking the sense of participation. In other words, the sharer would just be a conveyor of some pre-existing information. The absence of interaction with friends here clearly is contrary to the fact that people share things to resonate with friends and cooking is such an interesting practice! In our solution, as mentioned in the first user story of objective 6, it enables the user to add some experience-related information to the generated image. For example, the sharer could change the background image from the default one stored in the system to a real photo of dishes the sharer makes. They can also add some short comments on it. We believe that this way of sharing could raise the enthusiasm of our users to try and share more recipes so that we could have a more active user community.

For the share, the current way of reading the shared information is also annoying since it is a link. When a reader wants to gain more information about the recipe, they have to bear the inconvenience of being redirected to some other website. To address this issue, we decided to utilize the QR-code. We would have enough but less detailed information in the image generated so that the reader could have a rough idea about the recipe without leaving the current page (window). If they want to know more, the QR-code provided would enable them to access our website and get all the details.

The second novel functionality is a user report. We have not found this in similar systems on which we are doing background research. We would like to add this functionality to our project based on a common experience of trouble choosing. Our team embraces the idea that the better you know yourself, the less difficulties when making choices. Thus, we would like to provide our users with information including what kind of recipes they have tried so far so that they could find it easier to explore more recipes. The report would be informative and vivid because we would generate a short video of what recipes they have tried. Besides, people using the recipe

recommendation system are probably the learners of cooking. The report could also be a record of the progress of culinary arts of our users. This could also increase the activity of our users and potentially increase user retention.

3. Project sprints

3.1. Sprint Plan

In this project, we used a three-stage sprint structure to complete the project. The start and end time, and general goal of each sprint are shown in the following table.

Sprint	Start Dates	End Dates	General goal
1	Jun 13 (week 3)	Jun 29 (week 5)	Develop user configuration and management page, users should be able to register and log in and out, and can view their own nickname and modify, in addition, it should be able to create administrator accounts with super privileges. Progress Demo A is scheduled on Thursday in Week 5.
2	Jul 1 (week 5)	Jul 20 (week 8)	Develop the basic recipe recommendation function, so that the recipe explorer can find the corresponding recipe in the system through the list of ingredients category or directly enter the ingredient name, so that the system can return all the details of the recipe search, and the recipe builder can add all the details to the recipe. Progress Demo B is scheduled on Thursday in Week 8
3	Jul 22 (week 8)	Aug 03 (week 10)	When the system is basically completed, innovative functions will be added. Recipe explorers will be able to generate posters that can be accessed by QR-code to share recipes and recall report function will be developed to enable the system to summarize and give feedback to recipe explorers' use of recipes. Software and report are due in Week 10.

3.2. First Sprint

All of the user stories in sprint 1 and their Jira Backlog ID are shown as below.

Sprint	User stories	Jira Backlog ID
1	As a recipe explorer, I want to create a user account so that I can have access to more features on the platform.	HT9900-12
	As a recipe explorer, I want to be able to log in, so that I can get personalize information.	HT9900-13
	As a recipe explorer, I want to be able to log out, so that my information will not be leaked from a public computer.	HT9900-14
	As a recipe explorer, I want to change my nickname, so that I can communicate better with the service provider and other users.	HT9900-15
	As a recipe explorer, I want to delete my account, so that I can protect my privacy.	HT9900-17
	As an administrator, I want to create an admin account, so that I can manage the website.	HT9900-36

The following screen shot below reveals the creation and the commencement of the Sprint 1.

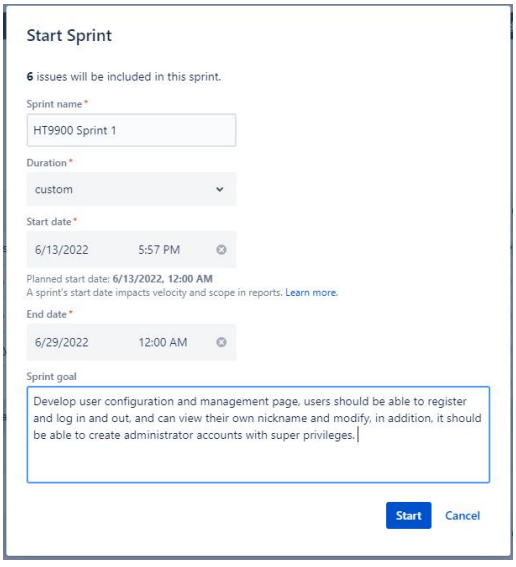

Figure 3.1.1 Sprint 1 Creation

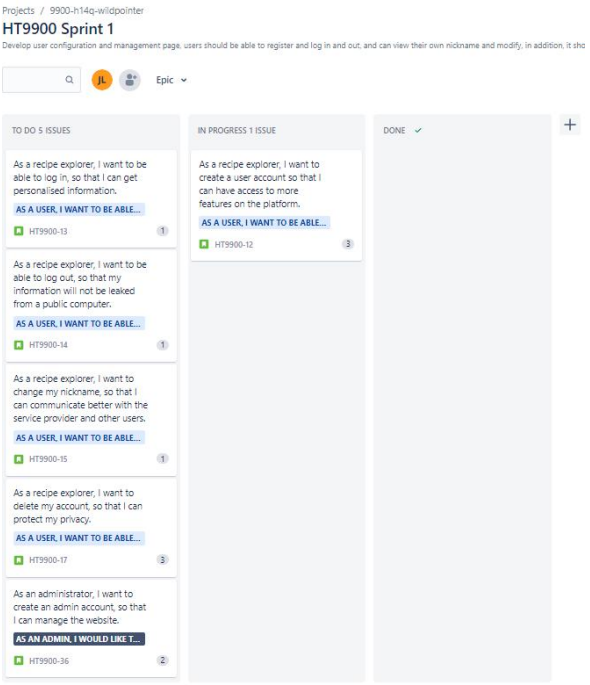

Figure 3.1.2 Sprint 1 Commencement

4. Interface and Flow Diagram

4.1. Log in/out and Register Page

The login page provides login and registration functions. After a successful login, the search page is displayed. User can click the button to log out or change the username. The storyboard corresponds to items 8 and 11 in the user stories.

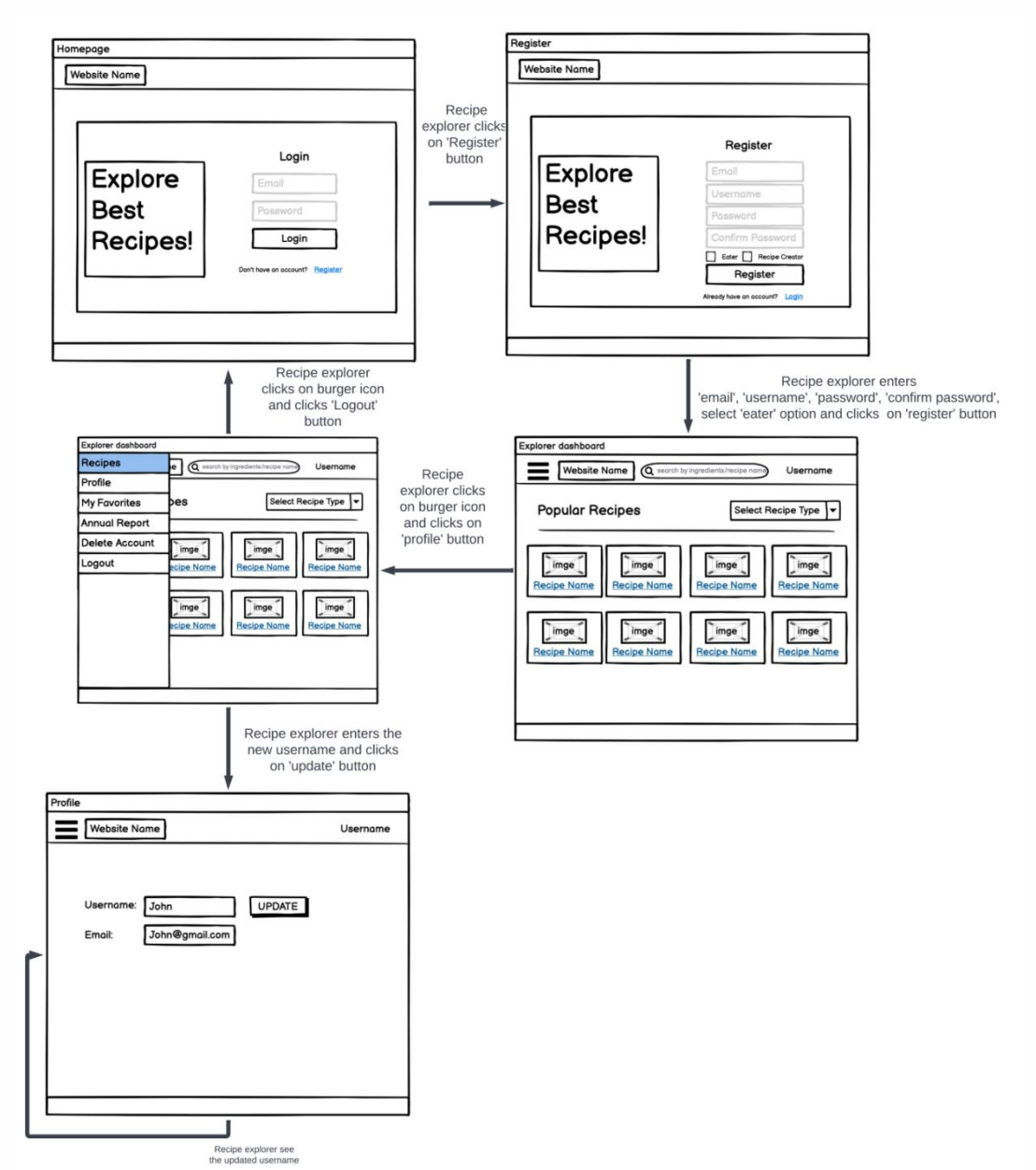

Figure 4.1.1 Login & Logout page Flow Diagram

4.2. Search Page

On the search page, users can select a category in the recipe category or directly search for ingredients or recipes. In addition, users can click the corresponding button to choose to delete their account or view the annual summary. The storyboard is corresponding to items 1, 2, 3, 9, 12, 13 and 17 in the user stories.

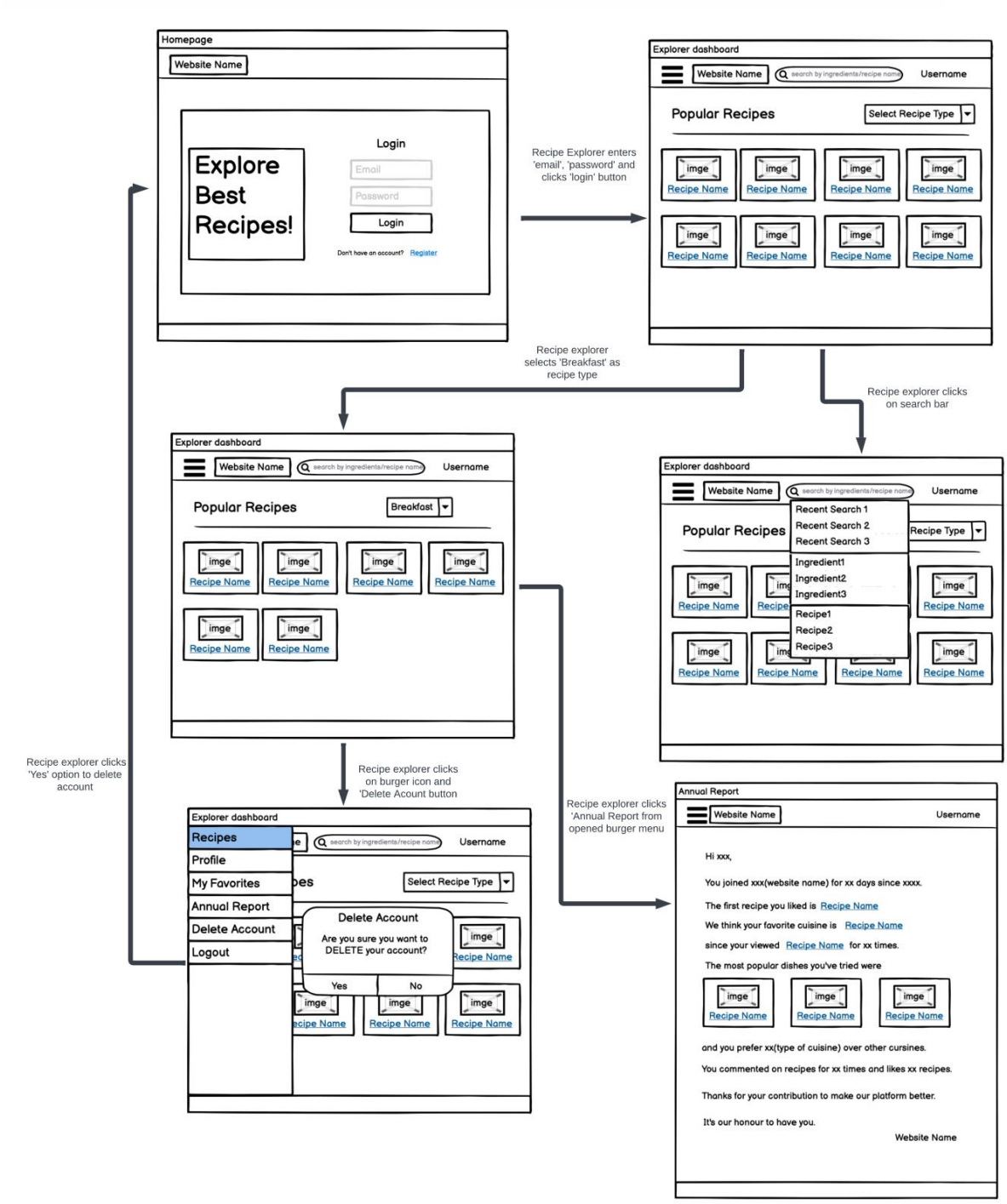

Figure 4.2.1 recipe search page Flow Diagram

4.3. Administrator Management Page

The management page provides login and registration functions. After a successful login, the main page is displayed, and the administrator can search for users by email or recipes by name. After this, the administrator can delete corresponding recipes or users by clicking the delete button. The storyboard is corresponding to items 25, 26, 27 and 28 in the user stories.

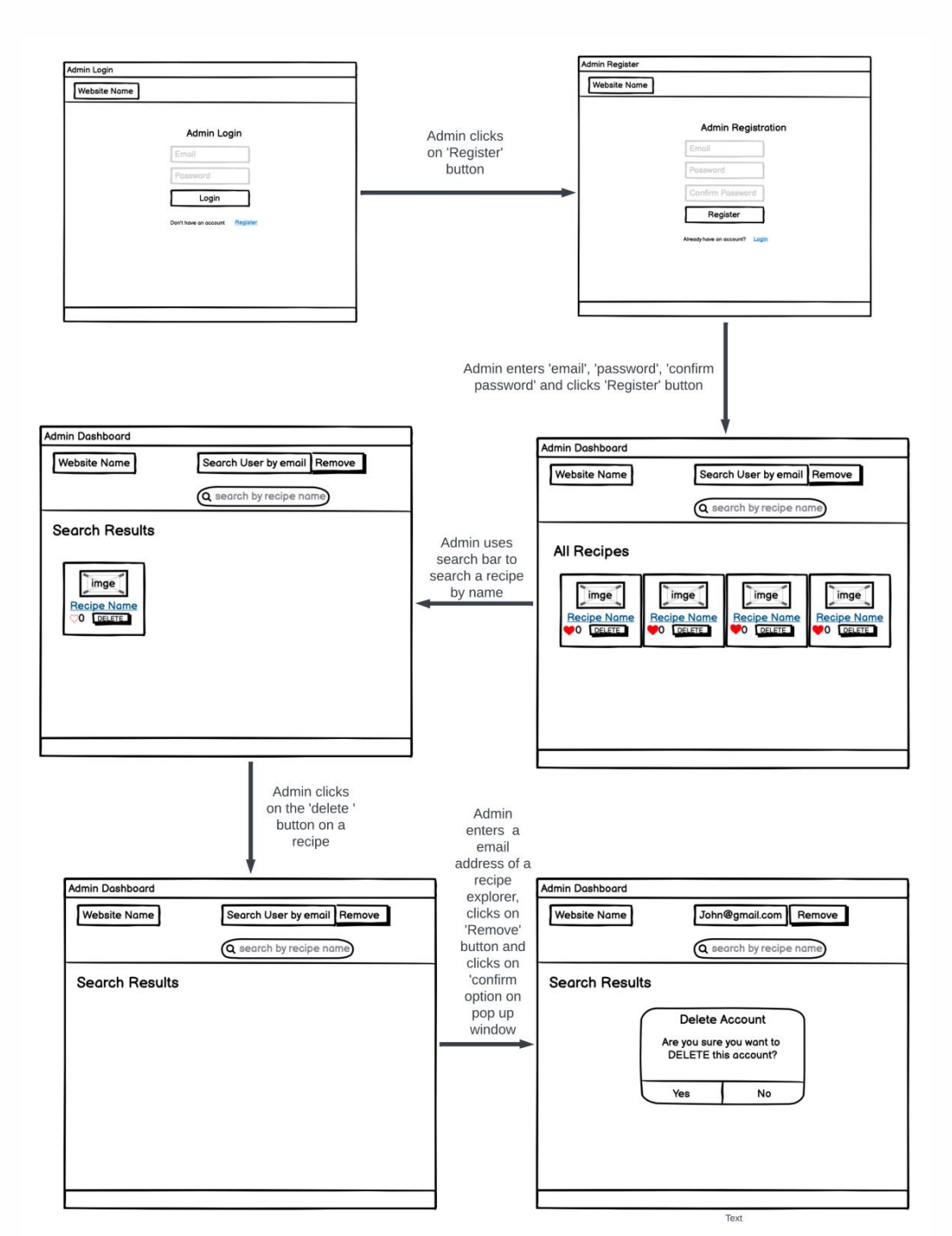

Figure 4.3.1 Administrator management page Flow Diagram

4.4. Recipe Detail Page

Clicking on any recipe, user will jump to the Recipe Details screen, which describes ingredients and cooking steps in detail, as well as features such as following recipe builders, liking recipes, bookmarking recipes, writing or deleting feedback, and sharing recipes as photos to other platforms. The storyboard is corresponding to items 5, 6, 18, 19, 20, 21, 23 and 24 in the user stories.

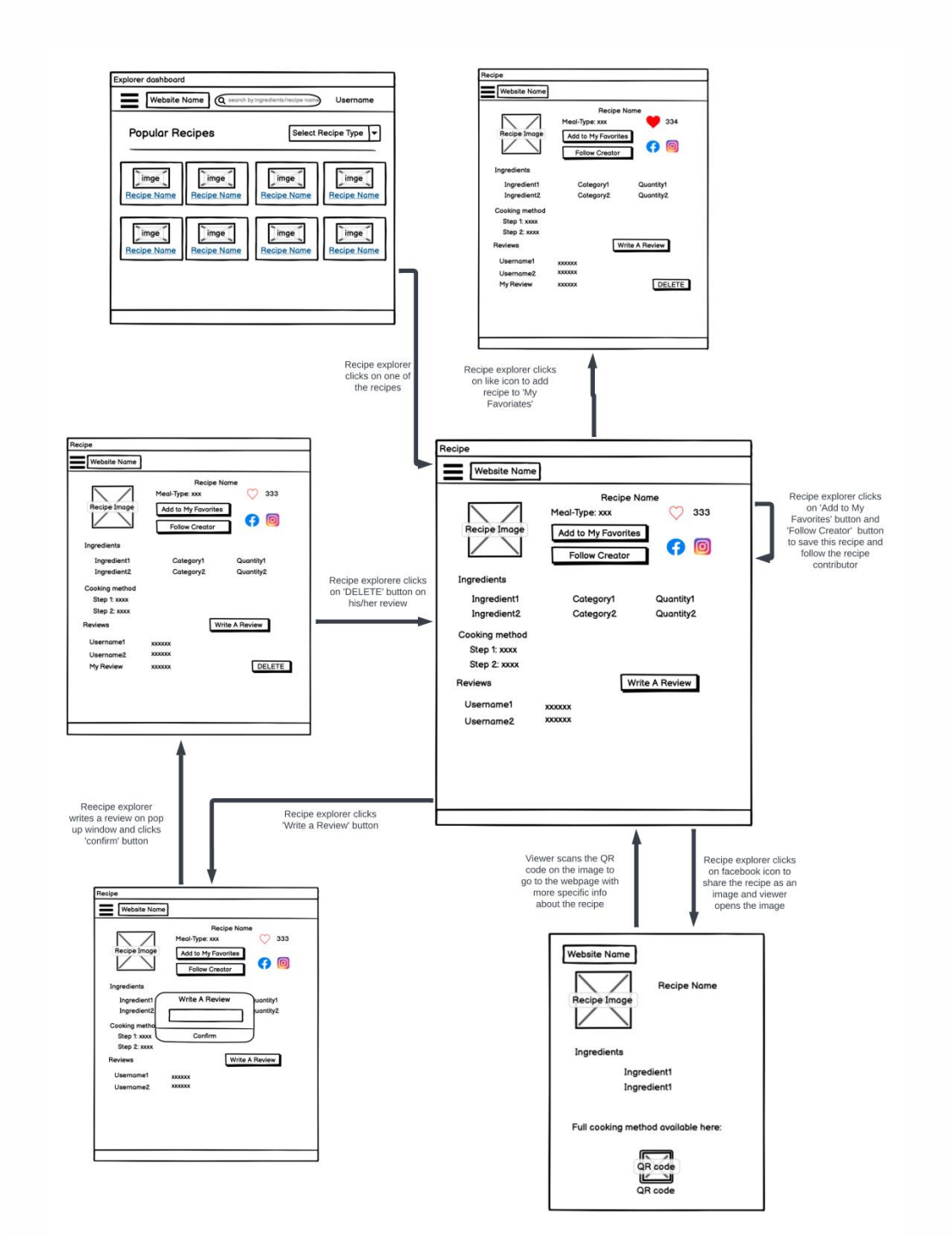

Figure 4.4.1 Recipe detail page flow diagram

4.5. User Favorites Page

Users can enter the user favorites page by clicking my favorite button in the search page, user can click the recipes in the favorites page to view details, or remove the recipes from the list by the delete button corresponding to each recipe. The storyboard is corresponding to items 7, 10 and 22 in the user stories.

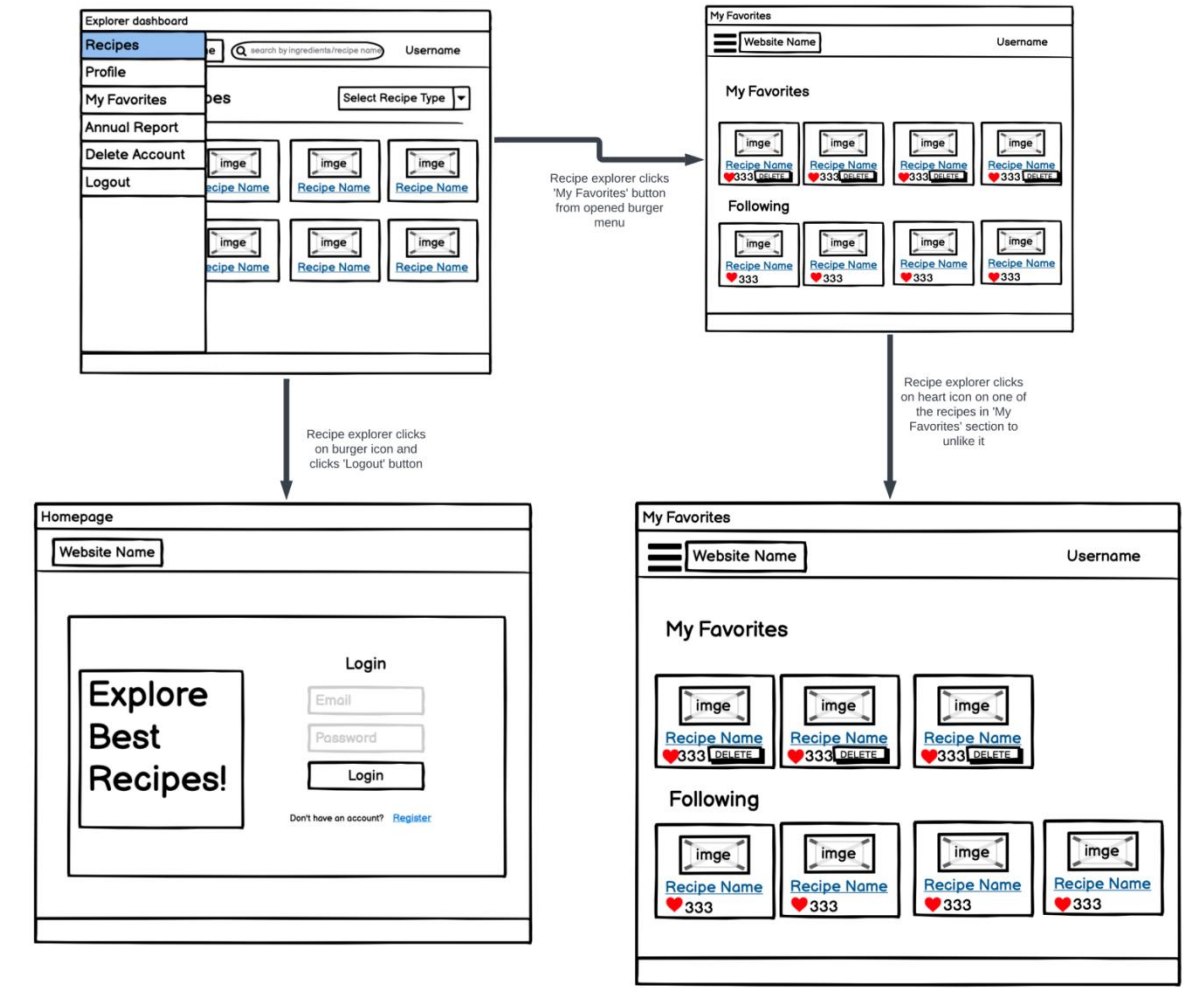

Figure 4.5.1 User Favorites Page Flow Diagram

4.6. Recipe Management Page

The recipe builder can log in through the recipe Management page. After successful login, the recipe builder can see all the recipes he has created. The recipe builder can choose to delete any of above recipes or create new recipes through the button.The storyboard is corresponding to items 14, 15 and 16 in the user stories.

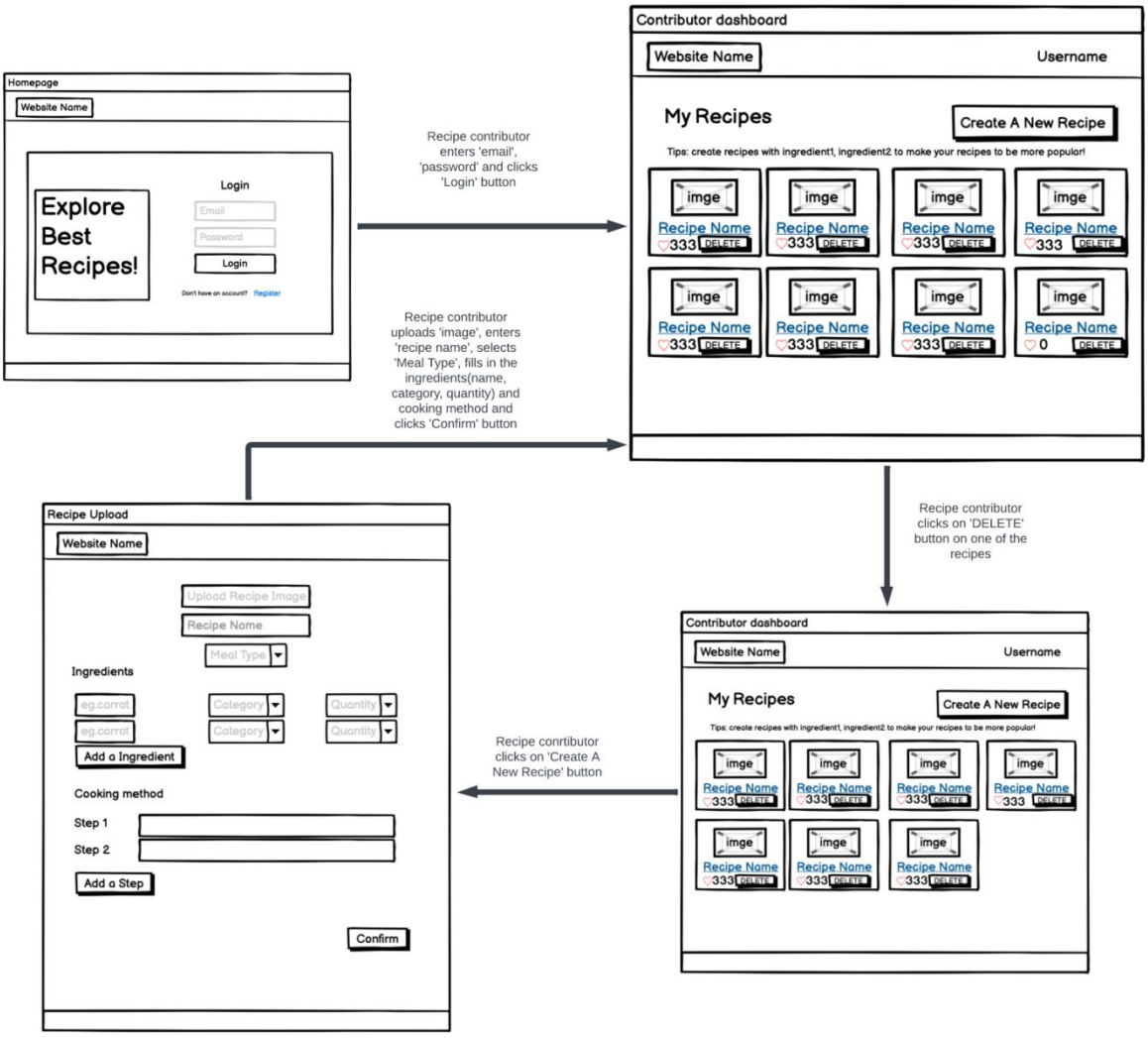

Figure 4.6.1 Recipe Management Page Flow Diagram

5. System Architecture

5.1. Separate Front-end and Back-end system

We want to split the system into two-part subsystems: ***Front End System*** and ***Back End System***. The front-end system is a graphical interface that users can access; users can interact with the system to achieve their desired functions. The back-end system is unreachable to users, but the system supports the front-end functions while maintaining and processing data. Since the two systems operate relatively independently, we will develop the two subsystems separately.

5.2. Front-end

We are using ***React*** framework for the front-end system, this framework is simple, flexible, and efficient. In addition, React provides multiple components that can be reused, making development logic clearer and reducing the difficulty of project development and modification.

5.3. Back-end

The basic language we want to use is ***Python*** and the basic framework we chosen is ***Flask***, Flask is very flexible and lightweight, and integrates useful third-party libraries, as well as customization database object-relational mapping, template engines, conversational middleware, and other components that needed for the projects to make back-end development easier.

5.4. Conclusion

The total software architecture is shown as below.

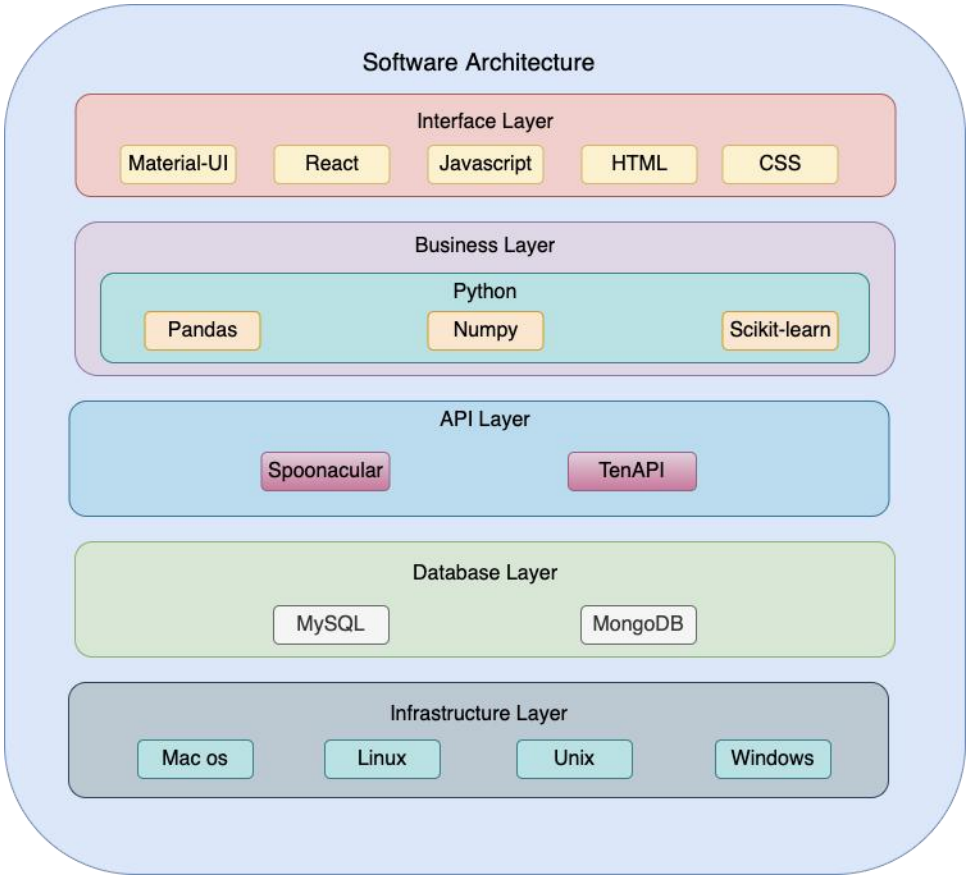

Figure 5.4.1 software architecture graph

5.4.1. External actors

Since it aims to make the web app a recipe recommendation system for users, users will post good recipes or search for ways to make a delicious meal. Therefore, the user is the only external participant in the system

5.4.2. Interface Layer

The user will always communicate directly with the interface layer. There are ***HTML***, ***CSS***, ***JavaScript*** three languages. Apart from that, some other external packages are used in this project. ***HTML*** acts as the backbone of a web page, rendered by different kinds of components. And when it comes to ***CSS***, it's an important component for building page layouts and decorations. About ***JavaScript***, it is to add a variety of dynamic functions to web pages to provide users with a smoother and more beautiful browsing effect. In addition to this, some packages will be used to improve the efficiency of project development. Regarding ***Material-UI***, it will add more styled components to web applications.

5.4.3. Business Layer

The ***Python*** coding language will be used for all functions planned for the web application. In particular, it analyzes the recipes of user preferences, and recommends recipes that users may like. When using ***Python*** practice, we will use ***NumPy*** and ***Pandas*** to process data, and we will also use various models in ***Scikit-learn*** to predict user's preferred recipes

5.4.4. API Layer

The API layer provides us with all the data provided in the core and innovative functions. ***Spoonacular*** will provide the system with the calories of the food in the recipe, and ***TenAPI*** can assist in generating posters and QR codes to share recipes with users more conveniently

5.4.5. Database Layer

MongoDB and ***MySQL*** will be used for the database layer. ***MySQL*** will be used to store recipe related data and ***MongoDB*** will be used to store user data.

5.4.6. Infrastructure layer

This web application will run on all popular platforms including ***Windows***, ***Unix***, ***Linux*** and ***Mac OS*** platforms for ease of development. Finally, the web application will be tested and deployed in ***Linux***.

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