Kitchen Assistant 2.0

A Grocery Management and Recipe Recommendation Application

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ABSTRACT

As the pressure of life continues to increase, the importance of diet and healthy keeps on declining in our daily lives. More and more people have started eating fastfood, junk, and take-outs. They have become too lazy to cook at home and they even have no idea about what to eat every day. This kitchen Assistant application mainly concentrates on those students and office employees who live independently. Based on the results of the previous group, we have added a new section for users to actively search the recipes. In addition to, recommending recipes to users by scanning items on bill, we added a search feature, which users can actively use to search for their preferred recipes. They can determine whether the ingredients in the fridge/inventory are sufficient or do they have to go to the market to purchase depending on the required ingredients as well as the quantity.

Keywords – kitchen, ,android application, recipes, recommendations, ingredients, search, share

1. INTRODUCTION

There are a lot of students studying abroad just like us, we live on our own, everyday we have to buy many kinds of food and commodities, but due to the heavy academic load, we rarely care much about ourselves, in most cases, even if we buy lots of stuff, but after sometime we may forget about it, and this leads to the unnecessary wastage of food and money. So generally speaking, we cannot get a clear idea about how to use those ingredients in an optimized way. We have little to no idea on how to cook the dishes out of the routine with the ingredients we bought. Also it will take a lot of time to find the optimized use of the existing ingredients, besides it will be less efficient and eventually lead to waste of time and effort.

Everytime after buying groceries, we never care about the bill, or even throw it in a trash can as we go out, but if we make the best use of the bill, it will be better for us to cook in the kitchen, otherwise it will be tough to follow the items we bought, every time we may realize the food inventory needs to be restocked only when we open the fridge to cook something.

Even if we already got enough web resources right now, which allows us to search the recipes based on the ingredients. But we have less time to spend on going through the recipes, or to be familiar with the frequency of the stuff we need to buy.

Now there is no one-shoe-fits-all solution to cover all these troubles. We all can purchase the groceries, but what we need is an application to tell us what we can cook by using these ingredients. We may need other applications to check out the exact recipe, at the same time there will also be another one to maintain the list of food, this is really a boring and cumbersome process, and never allows us to try different recipes.

The previous team has already finish the 'Suggest Recipe' part with scanning the bill and lay out the recommended recipe depends on the items, our idea is to develop a new part on 'Searching Recipe', for those people who already got clear idea about what they want to eat but have no idea about how to cook or what are the required items. Moreover, we can check whether the we have the ingredients in sufficient quantity in our inventory, and then prepare a shopping list for missing items. Furthermore, the fridge management can give us a clear information about what is stored in our fridge, this is important as many people often forget what they bought, which leads to spoiled food. Also, after we cook or shop the fridge management will automatically update the inventory without manual addition or deletion.

2. PREVIOUS WORK

Based on the consideration of user experience and technology stack, the previous team have developed an Android mobile application that achieves most of their plan. The application adopted the MVC architecture and they involved Node.js to take charge of the server end. Also, they used RESTful APIs for client server communication which helps in maintaining a good Separation of Concerns between the

client and server, making the application easy to scale. They deployed their server on Amazon Web Services Platform running Linux, with platform support for Node.js.

The app works as a kitchen assistant and helps the users manage their ingredients, kitchen supplies and feeds them recipes based on their inventory. The following are the 2 main features that they have incorporated into the application:

1) Inventory Management
2) Recipe Recommendation

2.1 Inventory Management

There are three ways to keep the inventory updated:

A. Manually add/delete/edit items and quantity
B. Using the phones camera to take a scan the paper receipt and convert them to electronic inventory.
C. Deleting ingredients automatically based on item cooked.

Options B and C enable quick and convenient inventory management. They have used image analysis and character recognition to convert the receipt users upload of their grocery purchases through the application. They have utilized Google Vision API (Image Content analysis) to extract the food items and their quantity from the receipt. Google Vision API (Image Content Analysis) was their choice for conversion of hard copies. Even they handled the case that the receipt is obtained as the electronic version of the text when groceries are bought online. They send the electronic version of the receipt as an image/pdf to Google Vision API to convert the receipt to text form which is then used to build up the inventory. They have stored keywords (food items and quantity) on their end and perform a loose string match on the results returned by the API to compare and update the quantities of ingredients. The user is then navigated to an editable list of groceries extracted from the receipt. Once the user is satisfied, the user clicks on submit and the inventory is saved successfully on the server. The user can now log in using the same credentials on any android device to view and edit the saved inventory. The inventory is also updated when the user cooks a particular suggested item. The user only has to press a button for the same, and the ingredients required to cook the item are deducted from the inventory appropriately.

2.2 Recipe Recommendation

Now that they have the users inventory and a large database of recipes that could be sent to the user, they will filter all the recipes that the users can cook. The application queries the database and searches for recipes using the users current inventory. If all the required ingredients are present in the users inventory, the item is shown to the user along with the recipe including instructions to cook the recipe. The application does not show the items that the user cannot cook, and thus avoids any confusion.

3. DATA COLLECTION

User Survey is an important part of planning and developing an application. We have conducted an on line survey of six questions and gathered response from various user bases like students and working professionals of varied age-groups. This user study was conducted to judge the feasibility and adaptability of kitchen assistant different from its previous implementation.

Question 1: How often do you search for a recipe?

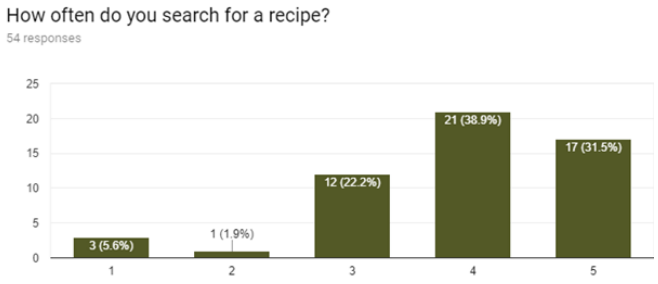

Figure 1: 1 - Never search online, 5 - Quite a lot

The primary purpose of this question is to check the functionality that we can add to the kitchen assistant based on the user request for an online search of a recipe. The chart shows that around 70% of the user group searched for recipe online. The application would be targeted for these users which brings ingredients, recipes and inventory management together in a single application. The user would receive recipe suggestions based on the preferences and ingredients the user has.

Question 2: How comfortable are you in cooking without a recipe?

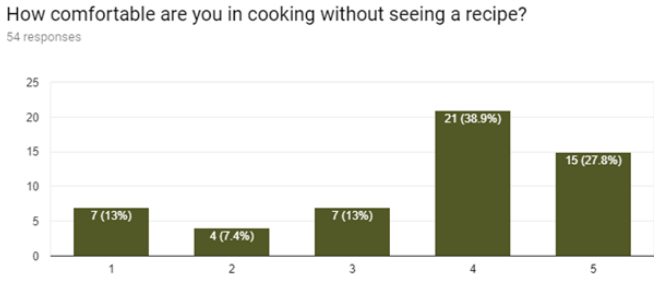

Figure 2: 1 - Very comfortable, 5 - Check the recipe a lot

This question further advances based on the input given by user in question 1. The main purpose of this question is to check if the user regularly checks for the recipe that he/she has prepared dishes on. This would help us in determining is the feature to integrate video/text recipe would be a good functionality in the kitchen assistant. Chart below shows that 66.7% of the users feel that they check the recipe online. It can be inferred that majority of the people who check for

recipes online also constantly re-assert themselves on the recipes they are trying out. It has helped us to understand that recipe should be available to the user in a very user friendly way and that it should also be the primary highlight of kitchen assistant where user can easily navigate to the desired recipe.

Question 3: How often do you forget what you stored in the fridge?

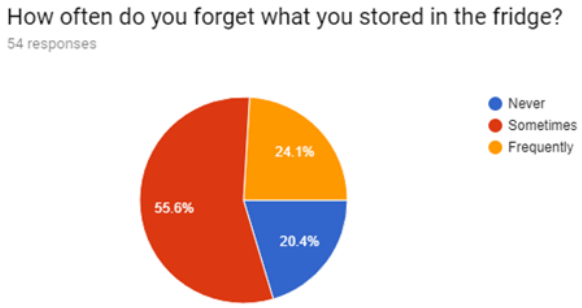

Figure 3: How often do you forget what you stored in the fridge?

We asked our users in the survey how frequently do they forget the things they kept in the fridge. Majority of the user base i.e. 55% of the users felt that they sometimes did forget the ingredients/food they stored in the fridge. 24% of the users felt they constantly forget what they keep in their fridge. Kitchen assistant can help the users to track their inventory of food items, ingredients they have already purchased so that they can make better judgment on what other things to buy based on some recipe and also to help them in utilizing their inventory before it reaches their expiry date. Various ingredients have a varied range of sustainability. This can be an important aspect of our application.

Question 4: How often do you start cooking and realize some ingredient is missing?

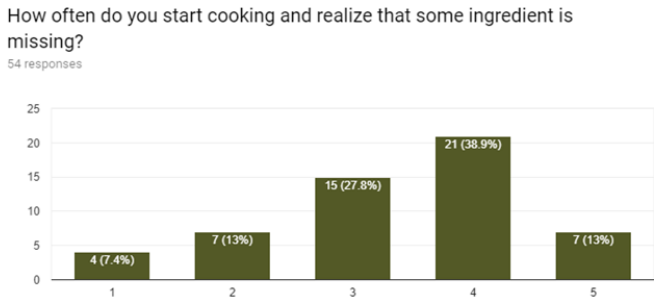

Figure 4: 1 - Never, 5 - Quite often

The chart shows that more than 50% of the users felt that they missed out on ingredients when they started cooking a recipe. This can be frustrating for users to realize after starting on preparing an item to miss out on ingredients due to lack of update or knowledge on the ingredients at home. This has given an insight of the core functionality for our application.

Question 5: Would you like to use a tool to manage the things you bought?

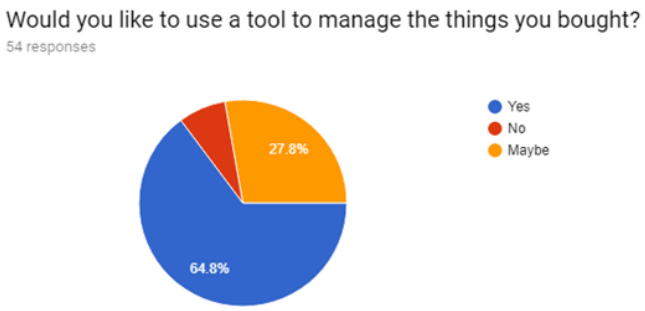

Figure 5: Would you like to use a tool to manage the things you bought?

This question helps us in determining the feasibility of our application. Almost 65% of the users responded they would really like an inventory management tool of some kind. The responses have helped us determine the functionality of our application.

Question 6: Open Ended Question

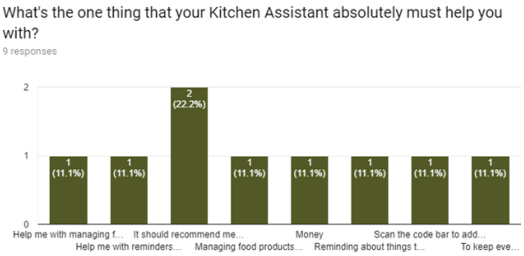

Figure 6: What's the one thing your Kitchen Assistant must absolutely help you with?

At the end of the survey we asked our surveyors as to what they would really like from a kitchen assistant they would use. We got quite a varied number of responses. A few responses were based on inventory management and notifications regarding the same. A few responses also suggested to scan either the bar code or image of things bought so as to elevate the burden on user to input each item. This question has helped us in determining new ways to improve the existing application.

4. IMPROVEMENT AND PROPOSED PLAN

4.1 Scanning Receipts

Right now the application uses Google Cloud Vision API to scan the receipts and extract relevant information form it, but we plan to search for some substitutes for it like Project

Oxford, Vize.ai, CloudSight, etc. and compare their performance to deliver a better user experience.

Also, the biggest roadblock is that this whole system isn't generalised and works on the receipts from a particular store. We would like to use some algorithms and methods to overcome this problem and make our system independent of this impediment. We also propose on looking for some machine learning techniques which would help us in accomplishing this task.

There could be multiple possible ways to achieve this and we need to check feasibility of each way individually. As suggested by the previous team, we can:

4.1.1 Make a customized algorithm for different stores

1) Analyze the receipt heading and identify the store.

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Clearly, this solution is limited in scope as it is not practical to do on a large scale. This could be done for a city or just few major stores but not for all the stores.

4.1.2 Use sophisticated text analytics along with entity detection and classification

We can utilize reinforced learning or some other machine learning techniques to adapt to various receipts that a user might frequently scan. This, however, is a costly process as it will take a lot of time and will affect the system performance.

4.1.3 Integrate with grocery stores

This seems like a good idea but is still far-fetched at this point of time, as once we collaborate with all the stores we can access their product codes to generate desired result, but doing this will take a lot of time and effort. We might still need to tweek the algorithm a bit but that won't be as hard as the previous solutions.

4.2 Recipe Recommendation engine and database

Currently, the recipes database has been manually populated and contains only so many hand-picked recipes. We plan to build a "Pinterest" like database which would contain recipes from all around the world. We would mimic the "MyFridgeFood.com" kind of functionality and use our already acquired knowledge on food inventory to suggest recipes to the user.

Also, we would improve the performance of model-based collaborative Filtering and the content-based algorithms that are being used to make suggestions. The current algorithm performs continuous learning to calculate the weights using ANN, Decision Trees, Bayesian classifiers and Cluster Analysis to predict future interest of the user for recipe recommendation. It also uses approaches like K-nearest neighbors and Pearson Correlation Coefficient to predict relevant recipes for the user. We plan on learning more about these algorithms used and try to improve their functionality.

4.3 Preference Based recipe Filtering

The current application doesn't take user's eating preference into consideration before making recommendations. We plan on taking ask for user's preference(Veg/Non-veg, Vegan, Eggs, Fish, Gluten, etc..) at the time of Sign-up and store it in our database along with other user information. Using these stored preferences we can recommend recipes that are suitable for a particular user and avoid making redundant suggestions.

4.4 Search Existing Recipes

We realized that it is not necessary that the user would want the application to suggest some recipe based on their inventory, sometimes they might want to look for a particular recipe that they want to cook. This gave rise to the new feature we are planning to add. This new search feature would allow the user to search our database for known recipes and get to know about required ingredients and the steps to cook a recipe. It will be connected to the inventory database as well. This will let the user know about the missing/insufficient ingredients, if any. The user can then add those to the shopping cart from the same screen. This will help in preparing a shopping list of only the required products and the required quantity, which, in turn, will help avoid unnecessary shopping. This can help the user to save both their time and money.

4.5 Support for shared one inventory

As suggested by the previous team, this would be an interesting feature to add in our application as it would be more sensible for users living in the same household and share a single inventory. We should support a group feature that allows multiple people to be a part of a specific group and share the same inventory. We would try to accomodate following features:

The inventory will be refreshed for the entire group once a particular user in the group updates it. An option to add individual ingredients along with the group inventory.
It should also act as a social platform to let the group members discuss what they want to cook/eat. Also, they could share their shopping lists with members and ask them to buy groceries collectively.
Moreover, it should also be able to adjust the quantity used in the recipe and update the quantity used in the inventory based on the number of servings.

4.6 Existing Bugs

4.6.1 Updating Inventory Database

Currently, the inventory list database isn't getting updated correctly, as it doesn't remove an item once its quantity becomes zero. Also, it makes a new entry for an existing item rather than just updating its quantity. We plan into looking into these bugs and remove them in the best possible way.

4.6.2 User Login

Apparently, the users who have Facebook application already installed in their device faced problem during the login due to a clash in the access token. This seems to be a seri-

ous bug and should be our priority to tackle as it hinders a smooth user experience. We plan on looking into the while logging-in implementation to get to the core of this problem and find a feasible solution for this bug.

5. EVALUATION PLAN

Evaluation plan for our project for the second phase of Kitchen Assistant relies on various parts that are similar to the previous implementation.

5.1 Testing various receipts from different stores

This would give us a fair idea on the improvements that we have made on detecting food items compared to the previous implementation. Things that are similar to previous implementation would be to track if the user is satisfied with ingredients generated by the algorithm from the receipts.

5.2 Preference based recommendation

Our application should be able to give personalized recommendation based on the ingredients that the user searches for or from the users' inventory list. A combination of recipes based on various mix and matches of items that the user has. It should also consider the time to cook for various recipes as it is an important factor.

5.3 Users should be able to log in

Previous application suffered from a drawback that many users faced issues when the logged in to the system. Our application will focus to overcome that issue.

5.4 User purchases v/s suggested purchases

We would keep track of the items we suggested to the users to purchase. It is similar to the previous implementation plan.

5.5 Performance Evaluation

We will determine key performance indicators for various API calls, the response time of the application server and load time of graphical interface as well as user experience of the entire application.

5.6 Number of times user chose a suggested recipe

This would also be a key indicator about the success of our application and is similar to the previous evaluation plan by the previous group.

6. CONCLUSION

The previous team implemented several basic functionalities of their proposed application - kitchen assistant. However, given the limited period of time they got to work on their idea gave us a lot of room for improvements. Once we are done with our proposed plan of actions we hope to achieve the following:

- To work and improve the accuracy of the algorithm for scanning receipts and supporting receipts from various stores.
- To improve the recommendation engine by including eating preferences, and even take their health and balanced diet into consideration.
- To add a new feature to let the user search a recipe of their own choice, and make a shopping list of the missing or insufficient ingredients
- To make the application support multiple user/group shared inventory, which would provide better user experience for users of a single household.
- To adjust the quantity used and update the inventory for multiple servings of the same recipe.

We believe that once these functions are successfully implemented, the application will have a more complete workflow and cover most of the proposed basic use cases. If implemented to its full capacity, this application would become popular in no time.

7. FUTURE SCOPE

7.1 Allergy Considerations

Currently we are just taking eating preferences into consideration but not the allergies. We can also include detailed information of all the food products and ingredients so we can notify user if any particular recipe can cause some sort of allergic reaction upon consumption. This way the user can rely on our information and doesn't have to manually go to check all the contents of each product/ingredient.

7.2 Dietary Suggestions

We can add a new feature that could monitor the users dietary and eating habits. We can then use this information to suggest a healthy and balanced diets on a timely basis. To further build on this idea, we can ask user if they want their diet to be rich in a particular vitamin, protein, carbohydrates, etc.. or should not contain gluten, fat, etc.. I guess this could be really helpful for people who go to gym or aim at building muscles.

We can also notice the eating patterns for each day of the week and make similar suggestions on a daily basis.

Moreover, we can maintain a list of favorite dishes which the user can access directly whenever they feel lazy or want to eat something special depending on the occasion.

7.3 Web and iOS Platform

Currently, our application is just on the Android platform and could be easily expanded to create a web application as well as an iOS application. Provided with right resources this part won't be that difficult.

Furthermore, it'll help us in cater to an even larger database.

7.4 Expiry Date

This is a really interesting and useful feature, but a bit tricky to implement. We can include the expiry date of each product in our database. We can notify the user if any item is

about to go bad so that they can use it first. Also, they would be notified if an item has already expired they can remove it from their inventory/fridge.

Moreover, we can think of some algorithms that can make update recipe suggestions based on the items expired.

7.5 Monthly expense budget

Now this is something that is different from the central idea of our application, as our application mainly focuses on optimal and quick use of resources to cook food and find recipes online. But we feel that this could be a good addition to our application, if we let our users monitor their monthly expenses and also see the types of products that were more expensive than others, then we can allow them to make an informed decision next time they go to buy groceries.

Additionally, they could have the option of setting a planned budget for their shopping so that they could get recipe and shopping cart suggestions accordingly.

7.6 Integration with smart digital assistants

As suggested by the previous team, we definitely think that this would be a good feature to include in our application in the future. Google Assistant and Amazon Alexa are some interfaces that would make our application more convenient to use while cooking and also, would attract a larger user base.

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