COOKBETTER: A Bot for Personalized Recipe Recommendation

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ABSTRACT

Recommendation systems have become quite an integral part for majority in the 21stcentury. This paper intends to focus on the Recommendation System for Personalized Recipes. Current websites and applications incorporate the factors of ingredients available to the user, rating of the user and the recipe, but not on preferences and requirements of the user. We concentrate on a Personalized Recommendation System that takes into account the health conditions and dietary restrictions over and above what the present Recommendation Systems offer.We propose to deliver recipes engineered to an individual preference level by means of a slack bot with an aim of providing users with a convenient and easy-to-interact-with interface.

Categories and Subject Descriptors

H.2.8 [**Database Management**]: Database Applications — Data mining; H.3.3 [**Information Storage and Retrieval**]: Information Search and Retrieval—Information Filtering; D.2 [**Software Engineering**]

General Terms

Slackbot, Algorithms, Performance

Keywords

Recommendation System, Ingredients, Personalization, Recipe

1. INTRODUCTION

Busy schedules and hectic lifestyle has led to numerous conditions on the health front. Moreover, time as a resource has become more constrained than ever. Relating the aforementioned factors with everyday meal selection and preparation poses quite a dilemma. With an increased number of people concentrating on balancing body weight, taking precaution towards heart related ailments and maintaining a healthy physique in general, it becomes essential for recipe recommendation systems to consider these preferences at an individual level. "Allrecipes" website with 1.5 billion visits per year and 95 recipe views per second and "Supercook" website with a recipe database of over half a million recipes indicate the popularity of recipe recommendation systems. However, these sites solely depend on the ingredient data that the user inputs ignoring the constraints of health and time.

The culinary domain is extensive and complex which increases the difficulty for the Recommendation Systems. The number of ingredients and their possible combinations coupled with the number of techniques to prepare them results in a considerably large amount of data to be handled. As a consequence, user's opinion on food items can vary quite significantly depending on whether he/she likes savoury to sweet, if they have specific allergies, prefers protein to carbohydrates etc. We try to incorporate such preferences and few others into our application thereby giving a more personalized experience to the user.

Plenty of work and research has been carried in the sector of recipe recommendation on making the system more exclusive and individualistic to the user. The Paper by Mino et al.described a method considering the schedule of the user and calculating the calorie intake or release in each event which determined the next meal of the user[1], or the study by Yajima et al. on what a user will consider an easy recipe taking into account numbers of ingredients and seasoning in the recipe and its cooking time[2]. Paper by Freyne et al. entails the results of their investigation by comparing three main recommendation strategies: content-based, collaborative, and hybrid[3].

Under this scenario, we have proposed a recipe recommendation method based on the user's food preferences and dietary restrictions.The method first creates the profile of the user based on their health conditions, health goals and allergies they presently have. So for every session that the user begins, he/she is asked for the ingredients they possess and only those recipes that help them maintain their health goals are displayed for them.And this is all done by means of a slack bot for the ease of use. The user will not be required to navigate through a large number of complicated website pages instead it will be interfaced in form a chat which makes the system quick and efficient.

2. PROBLEM DESCRIPTION

All the current recipe recommendations systems emphasize on the ingredients and their suitable combinations but with more people putting their focus on health, it becomes

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Figure 1: Results from Google Ngram Viewer.

a mandate of sort for recommendations systems to consider their health and diet preferences. This is the problem we are trying to bring a solution to in the form a slack bot which uses the Microsoft Bot framework and gives personalized recipe solutions.

3. LITERATURE STUDY

3.1 Methodology

For the purpose of our literature study, we made use of 2 tools: Google Scholar and Google NGram Viewer. We used Google Scholar for searching scholarly literature and finding papers relevant to our work. We made use of Google NGram Viewer for charting the frequencies of our search keywords mentioned in the vast amount of books available in the Google Books library.

3.2 Summary of papers

After perusing various research papers, we discovered that a lot of research has been done in the area of recommendation systems, including recipe recommendation, and that there is a growing interest in this field. With the advent of machine learning, it has become possible for the system to learn the preferences of the user and improve the recommendation results. Although most of these papers proposed systems that solved one particular purpose, the methodologies adopted in each were significantly different. Although we gained useful insights from these papers, we decided to try a different method to solve this problem - using chatbots.

In 2011, Ueda et al proposed a personalized recipe recommendation system based on the user's preference[4]. This system is personalized in the sense that it recommends recipes that are similar to recipes the user has browsed in the past, in terms of ingredients. While this is a good way of personalizing the recommendation system, we have chosen to prioritize the user's health conditions and dietary restrictions over past preferences.

In 2012, Kuo et al investigated a menu planning mechanism based on user-specified ingredients[5]. This experiment obtained positive results for the effectiveness of a recommendation system based on ingredients.

3.3 Results of n-gram viewer

We chose the following keywords for our study: recommendation system, personalized recommendation and chatbot. The frequencies of mentions of these keywords in books published between the years 1900 and 2018 are shown in Figure 1. This time frame was chosen as there was either negligible or no mentions of our keywords in books prior to 1900.

We observed that the concept of recommendation systems was written about as early as 1902, and has been on a steady increase since 1992. However, we can see that personalized recommendation has only been mentioned since 1992, and has the least number of mentions among all our keywords. This indicates the need for further research and works on this subject. We found that chatbots, although researched upon ever since the 1960s by MIT professor Joseph Weizenbaum, have been popular in books only since 1996. We observed that the work on chatbots increased rapidly since then, hitting a peak in 2003.

4. USER RESEARCH

4.1 Survey

In order to understand this particular problem and if our proposed solution will be perceived well by the wider public, we conducted on online survey which comprised of 6 questions. The questions and the reasoning behind them are discussed below.

Question 1: How often do you look for recipes online?

This question was asked to get an idea about how many people look for recipes online, as these people would be our user base.

Question 2: Would you like to find recipes that you can make using only the ingredients that you already have?

This question was asked to determine if people would like one of our features - searching recipes based on available ingredients.

Question 3: Would you like recipe recommendations that are personalized for your dietary restrictions?

This question was asked to determine if people would like an important feature of our project - personalized recipes based on dietary restrictions.

Question 4: Do you find Slack user-friendly?

Since the chatbot proposed in this project is used through the Slack app, this question was asked to find out if the users found the application user-friendly and like using it, as the users of our chatbot are all going to be Slack users.

Question 5: Would you prefer using a chatbot over a conventional website?

This question was asked to find out if users will adapt to our new proposed system of using a chatbot over the existing systems that use websites.

Question 6: Will you use a Slack bot for personalized recipe recommendation?

We finally asked a direct question to figure out how many people were inclined to use our Slack bot based on the proposal, even before trying it.

4.2 Results

The survey received close to 40 responses and the participants were mainly students. We targeted this user base as we felt that students would be the ideal users of our bot, considering that they spend a lot of time on messaging applications and have more restrictions when it comes to cooking, in terms of ingredients, time available to cook, etc.

Figure 2 depicts the frequency of searching for recipes online. 41.7% of the participants responded that they search for recipes online all the time, 50% of the participants said they look for recipes online sometimes and only 8.3% of the participants said they never look for recipes online. We found these results to be favorable as the 91.7% of participants who look for recipes online are more likely to use our bot.

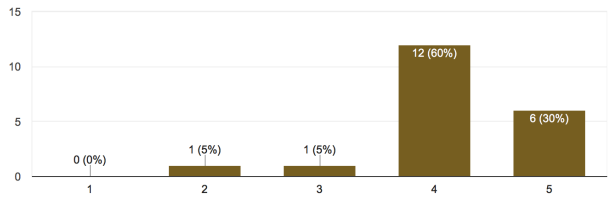

Figure 2: How often do you look for recipes online?

Figure 3 shows that 94.4% of the participants would like to search for recipes based on the ingredients that they already have. This indicates a problem with the current systems to look for recipes, which may display recipes with ingredients that the user may not possess, making the recipes unacceptable for the user.

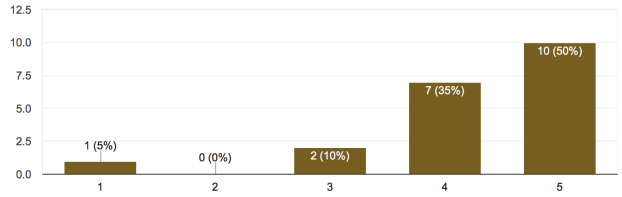

Figure 3: Would you like to find recipes that you can make using only the ingredients that you already have?

Figure 4 shows that 88.9% of the participants require recipe recommendations that take into account their dietary restrictions. We assume that the remaining 11.1% do not have any strict dietary restrictions or are not particular about this feature. However, majority of the participants have indicated their approval of a system that considers their health factors.

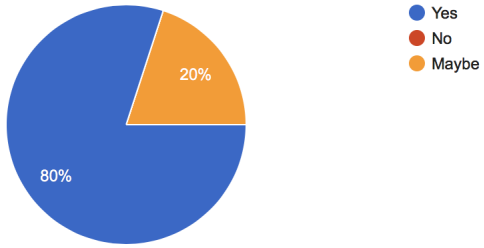

Figure 4: Would you like recipe recommendations that are personalized for your dietary restrictions?

We find from Figure 5 that 69.4% of the participants find the application Slack to be user-friendly. 30.6% of the participants have said that Slack is not user-friendly. This indicates the need to extent our chatbot to other messaging platforms which support chatbots in the future.

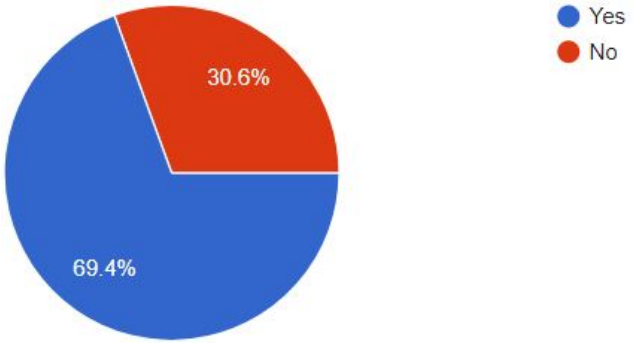

Figure 5: Do you find Slack user-friendly?

Figure 6 depicts the percentage of users who would prefer using a chatbot over a conventional website that is available in most existing systems. 72.2% of the participants responded positively to this question.

This final question, asking the participants if they would use our proposed chatbot, received a mixed response. 41.7% of the participants indicated that they would use it, 47.2% indicated that they might use it, while only 11.1% indicated that they will not use it.

5. WHY SLACK BOT?

We decided to go ahead with Slack bot instead of traditional websites and an application because from a user point of view an application would be just another software to download on their devices. With Slack being used in majority enterprises and universities. It just adds a new feature to an already use full application which is well spread. User

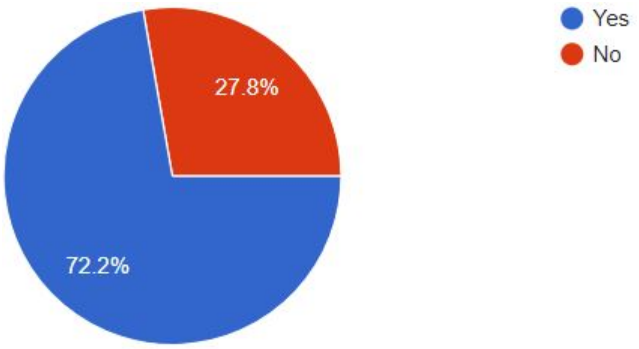

Figure 6: Would you prefer using a chatbot over a conventional website?

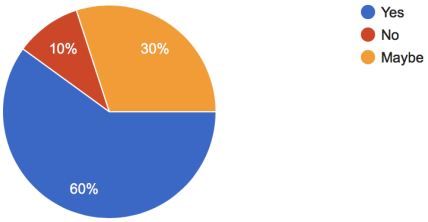

Figure 7: Will you use a Slack bot for personalized recipe recommendation?

wouldn't need a learning curve as they'll be familiar with slack.

From developing prospective, developers can focus more on the back-end logic and implementation side rather than worrying about application design and User interface.

6. PROPOSED PROJECT ARCHITECTURE

In this section we have shown the proposed architecture of our project. Proposed model is shown in Figure 8.

From figure 8 we see that this project uses Slack API for creating application bots. User uses slack and chats with slack bot to interact with in the application. User will use slash commands to enter into recipe recommendation function. At this point user will have to put in the filters he/she intends to use for the desired recipe. The bot then puts the desired request to the database. When the request is processed user will receive step by step instructions on how to cook the recipe.

The database connected to slack bot comprises on integration of a recipe database with our application which sorts out all the filters for the recipe recommendation in database for rendering the results to get personalized recipe recommendation for the user. We intend to use MySQL and Amazon Web Services for all the database applications purposes.

User initially will need to fill up a form which will create the basis of recommendation module will set up. User will also have to option to negate these presetting and search for a recipe he desires by just typing its name. User can also

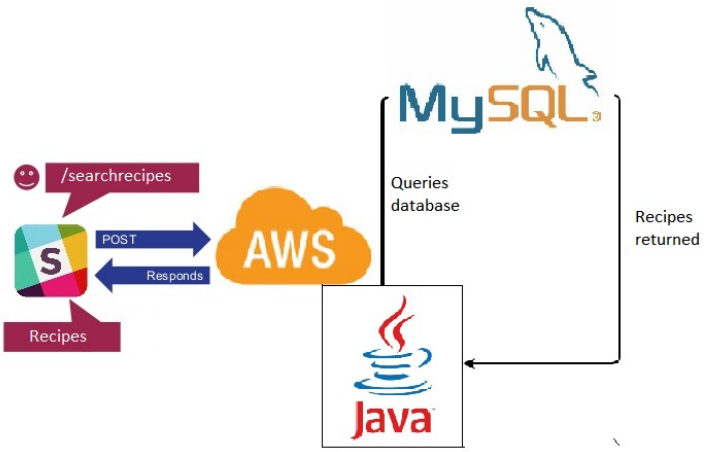

Figure 8: Proposed Model

search for recipes based on parameters like Time Constraint, Occasion or ingredients presently available to the user.

The two factor recommendation setup takes in global parameters Health, Allergies, Restrictions and Goal. These parameters will be one time fill ups and would be by default applied while user searches for a recipe. Here, Health is if the user is healthy or suffers a disease like diabetes or not.Restrictions include dietary habits like vegan, non- vegetarian, etc.Goal indicates what user wants to achieve with the diet like reduce weight.

The second layer would be the session filter which would include local parameters like time taken to cook, occasion, type of food, ingredients, etc. Here, occasion includes suggestion recipe for Halloween, Diwali, etc. Type of food corresponds to cuisine of choice of user. Ingredients indicate the list of available ingredients by the user.

All these parameters together constitute in fetching a recommended list of recipe for the user.

We are hosting our application on Amazon AWS. We decided to use a cloud server instead of hosting it on our own server taking into account reliability and security. We chose AWS over other cloud services because of the features offered like auto scaling, elastic load balancing.

7. TIMELINE

This section shows the projected timeline of how to project is going to be worked upon:

TimeLine	
Month	Progress
Jan 20, 2018 title	Finalized project idea
Jan 25, 2018 features	Decided basic project architecture, use cases
Jan 29, 2018	Conducted user survey
Feb 1, 2018	Report 1 submission
Feb 9, 2018 built a RESTful web service	Created database
Feb 25, 2018	Deploying on AWS and constructed search options
March 07, 2018	setting up personalization filter and setting queries for database
March 10, 2018 conducted evaluation survey	Tested application
March 12, 2018	Report 2 submission

8. APPLICATION REVIEW

This application was build using the slack API, where we have set slash commands to call in the slackbot application. Through this API and command user interacts with the application.

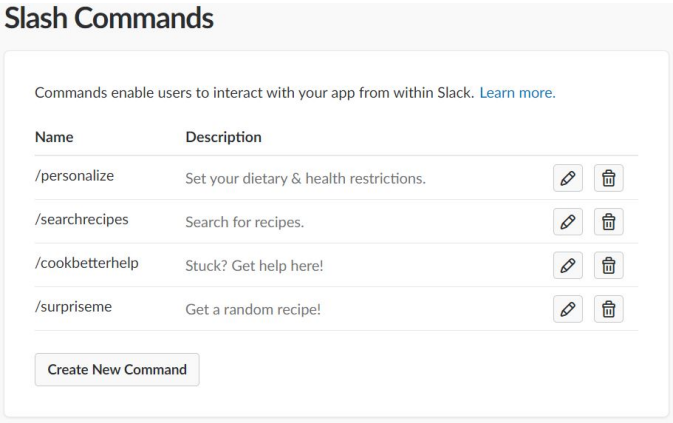

Figure 9: Slack API commands

This section also shows the use cases of the application. These are the main 4 commands used in the application as shown in figure 10:

- ***/searchrecipes:*** This is the command which starts the application into the next step of filters for the recipes user needs
- ***/personalize:*** This is the one time filter command user can use in order to have a basic set of recipe filter ingrained for all the future searches on the account. This command opens a menu for personal filters to select from or update.
- ***/cookbetterhelp:*** This command returns user to the help screen where it describes all the commands user can use to get a recipe recommendation.
- ***/surpriseme:*** This command suggests a random recipe every time it is invoked, while keeping in mind the user's dietary and health restrictions.

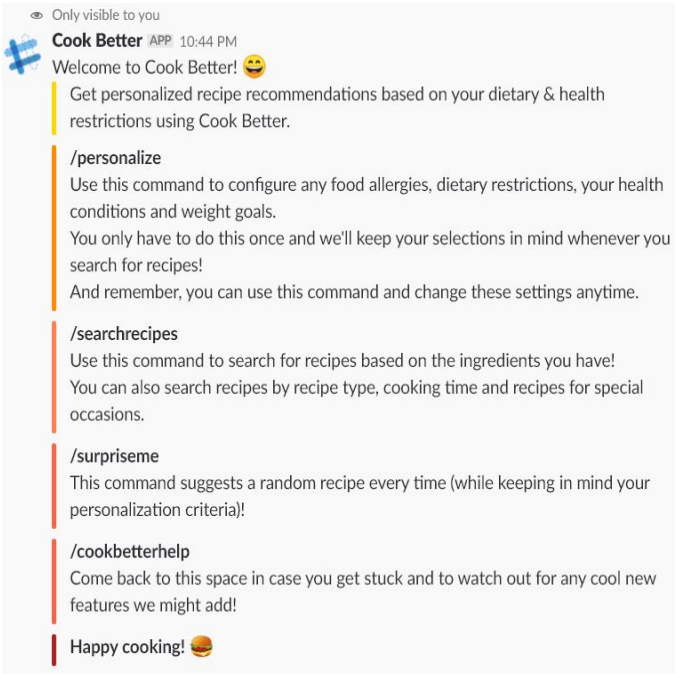

Figure 10: Slash commands

8.1 Personalization

Our application gives user to modify his or her personalized needs to receive a recipe.This is a one-time process for the user which takes in account the factors like age group, allergies , dietary restrictions, any ailments user might be suffering from along with the a goal user has in mind. User can access this by /personalize slash command and select the preferences from the drop down menu that opens. Figure 11 shows the visual of the application when the /personalize command is run.

These parameters help filter out the ingredients based on the preferences and present recipes which do not involve these parameters. These give user more control over what diet he or she wants to eat. If in future user wishes to change these preferences, user can update these with /personalize slash command.

For personalization, the filter that is used for the selecting the recipes include selecting recipes which follow a certain threshold for the respective conditions user wishes to have.

- For user with cholesterol restriction the application will search for the recipes with fat content less than or equal to 20 mg.

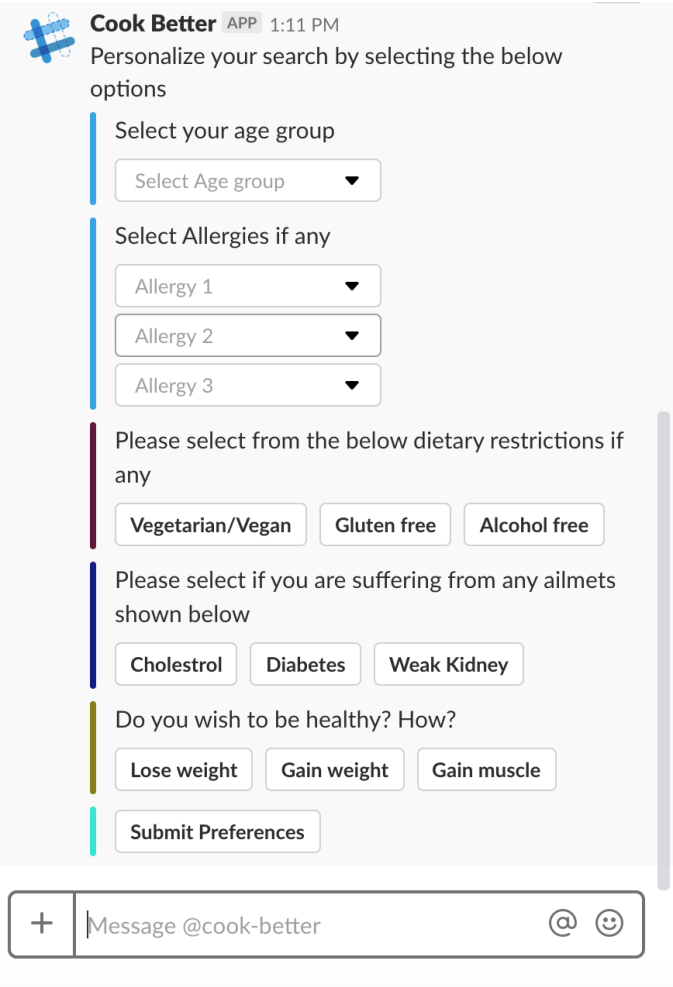

Figure 11: Personalization Menu

- For user with diabetes the application with filter out recipes with sugar content of 0 grams.
- For weak kidney disorder the recipes which have the protein content smaller or equal to 7 grams are taken into consideration.
- Similarly, for a user who is trying to lose weight, the application shows recipes with less than 500 calories and for gaining weight it is equal to or greater 700 calories
- For users who wish to bulk up and gain muscles application presents with recipes greater than or equal to 20 grams.

8.2 Recipe Finding

This part of the application is where user enters his/her requirements for the recipe user is looking for. This provides user with the drop down and toggle menu for selecting the ingredients he is looking for. It also provides user with an option to select type of recipe user is searching for, along with an option to get a quick meal (meal under 30 minutes). User also has an option to select recipe occasion wise like Diwali, Halloween, etc. User can access this by /searchrecipes slash command and select the preferences from the menu that opens. Figure 12 depicts the menu that opens up after running the command.

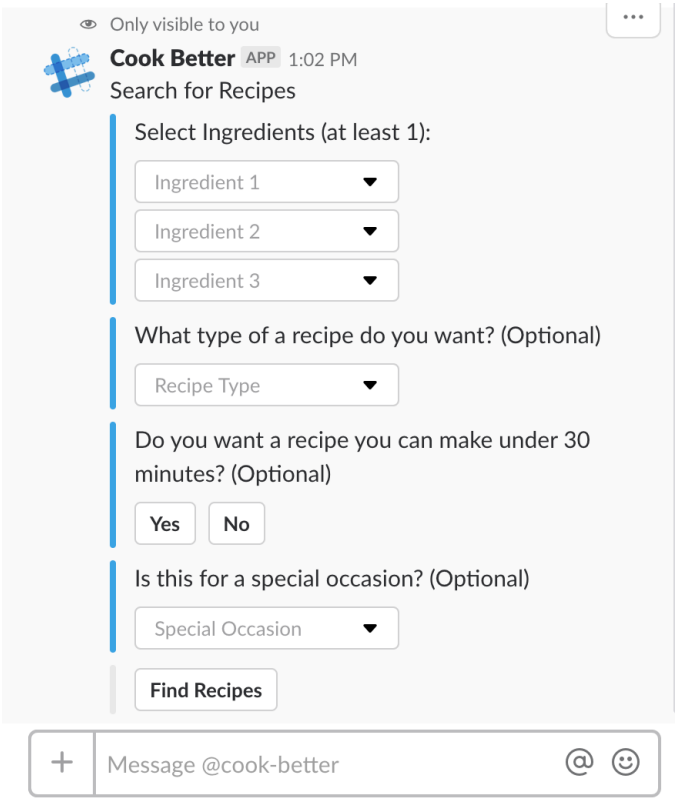

Figure 12: Recipe Finding Menu

These ingredients and other requirements given by the user are then queried in the database along with the personalized parameters to give the recommended recipe to the user. If user is not satisfied by the result user can again run the /searchrecipes again for a another result of recipes.

8.3 Results

The result obtained after all the personalization and search parameters are entered provides user with the dish name and a link to the epicurious website with the instruction on how to cook it directly.

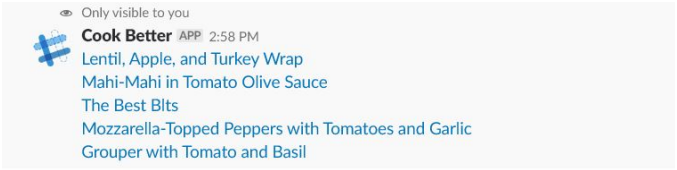

Figure 13: Recipe Result on Slack

Figure 13 shows how the recipe result looks on the slack

chat after user has given all the required input. These are the names and user can select any of these links which open up the epicurious website where the dish is given along with the proper instruction as shown in figure 14.

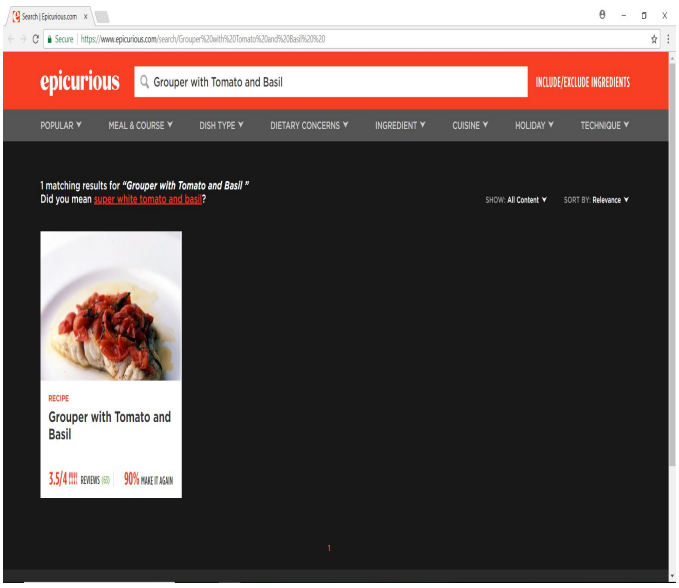

Figure 14: Recipe Result to epicurious

In case user fails to enter any of the required values, for example user needs to have selected atleast 1 ingredient. Otherwise the application throws an error and user needs to run the command again as shown in figure 15. These warnings signs trigger whenever a false input is given by the user.

Figure 15: Search Warning

Since the recipe database is exhaustive, there may occur a scenario where for the given needs of the user and parameters entered might result in no recipe i.e. there maybe no such recipe existing in the database. In that scenario the application throws a error message to the user as shown in Figure 16. These is one of the issues with the application as it needs extensive database to have all the required needs for the user.

8.4 Database Modelling

Recipes data is obtained from the website Epicurious. Epicurious is a website which provides recipes, their rating, nutritional content, and categories. The data for Epicurious website was downloaded from the following link - https://www.kaggle.com/hugodarwood/epirecipes/data. We used the file epi_r.csv for the table 'data' in our database. The

Figure 16: No Recipes Found

column names in that file represent ingredients, nutritional content (calories, fat, etc.), and categories (dessert, breakfast, etc.). We extracted the ingredients from the column names and created a table 'ingredients' in our database, to display the list of supported ingredients to the user in a select drop-down list. We also created a table 'personalize' which stores the dietary and health restrictions for each user. The current user's user ID is obtained from Slack and stored as the primary key in this table, along with his ailments, allergies, weight goals, diet restrictions.

8.5 Limitations

This application is dependent on database list for recommendations and need a website for displaying the instructions to user about how to cook the recipe. This limits the result prediction of the application. It is likely that user will encounter No recipe found error. And also any maintenance work with the website might also result in error for the application result.

9. EVALUATION PLAN

9.1 Parameters

We plan to evaluate this application by giving users a taste of the application workspace on their slack application and take in their ideas about the application on the basis of following metrics:

1. Reliability
2. Scalability
3. Cooperativity
4. User Satisfaction

9.1.1 Reliability

Our model needs to be reliable with the prediction of the recipe which user has entered or using the parameters user is filling. It is imperative that user correct option of recipe is shown to the user, otherwise user might end up getting improper results which in worst case could be life threatening for the user, in case user has allergies or some disease. Recommendation module needs to function properly.

9.1.2 Scalability

This application is not limited in scope and can be expanded to involve many more use cases and functions. We could use the data and recommendation module to give recommendations of food with what friends of user are having

and the same database could be used to add complexity of cooking a specific recipe.

9.1.3 *Cooperativity*

The slack bot is connected to databases which is connected to the recommendation module, which in turn modifies the database from which the slack bot will be accessing the data to give to the user. Hence, the the cooperation between the recommendation module and both the modified and original database need to be proper otherwise the resulting recipe suggestion to the might be faulty.

9.1.4 *User Satisfaction*

One of the major parameters for the evaluation of the application is how comfortable user feels with the application and is exited about development of this idea. User interface and result prediction by application is upto users standards. This will be tested in an evaluation survey.

9.2 Evaluation Survey

To test the how the application adapts with the users we tested application with survey based on the following questions which give us the general idea about our application might work in the public.

Question 1: How helpful did you find this application?
This question is put forward to get an idea about how user finds the overall application in terms of usability and gives us a estimate of how successful this application was in solving the problem statement.

Question 2: How reliable did you find the application with the output?
This question was used to test the accuracy of the recipe that user receives when the application is run. It provides with how reliable the application is and if there are any bugs hindering the solution.

Question 3:Would you recommend this application to your friends?
The question gives us the estimate for user satisfaction. Higher the recommendation more likely a users are themselves satisfied with the application.

Question 4: Suggestion to change an existing feature?
This shows how useful every feature is for the application and what feature was working as expected by the user. This also gives us scope for changes in the application.

Question 5: Any new feature you would like to see in this application?
This question takes in user answer and gives us an idea about the scalability and future scope of the application.

Question 6: After using the application, would you prefer it over a traditional website?
This question summarizes whether the application has the scope to replace traditional options being used to currently.

9.3 Evaluation Results

The audience for the evaluation of the project consisted of 20 students as that is the main demography for our application and would give us a comprehensive evaluation of our application. Students use messaging applications and almost everyone is familiar with slack. Moreover this user base is the one that constantly searches for variety of recipes and try to maintain a proper diet and are concerned about their health.

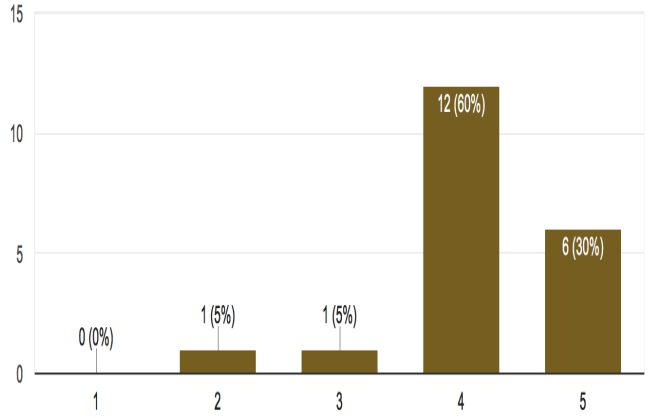

Figure 17: How helpful did you find this application?

From the response for the first question as shown in Figure 17 we observe that out of our 20 participants in survey, 18 found the application to be helpful in the search for their recipe which makes 90% of the participants. This indicates that application does have a practical use and a great potential grow.

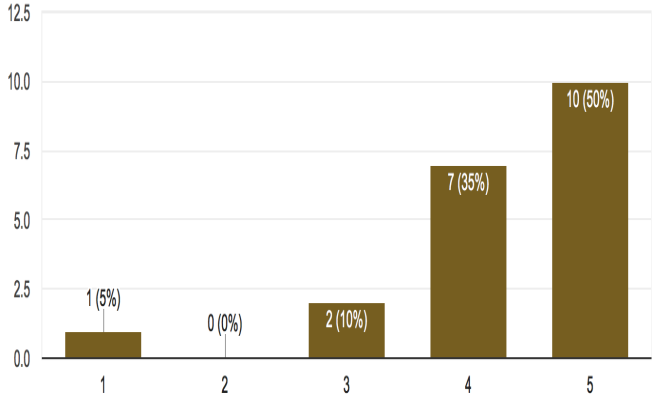

Figure 18: How reliable did you find the application with the output?

To the second question,response to which is shown in figure 18, we determined the reliability of the answers our application produced and for 85% of the users found it to give

accurate responses i.e. getting proper recipes which filtered out results using all the input parameters. This shows that our application produces sufficient positive responses and in other rare cases result because of lack of full strength database of recipes.

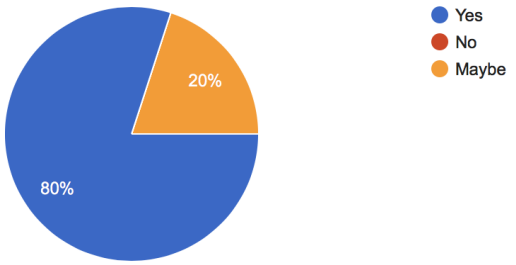

Figure 19: Would you recommend this application to your friends?

In figure 19 we see that 80% of the users would recommend the application to their friend which gives an indication about user satisfaction with the application. This also gives an idea about the reliability of the application and low number of bugs encountered by the users.

Further two questions asked were subjective user answers which gives clever insights on what would've helped this application to be better. These ideas are executable and were fine polishing on the current application. Most users raised a point about having a text-box instead of a drop down menu which is possible but is limited by the database and can be put into future work. Thus this application is scalable but in current state it is limited by the data we have in the database.

The fifth question asked about the new features that could be added to the application, to which the response included a common theme of using machine learning algorithms to user the search history to get make for better prediction of recipes for each specific user. One very unique feature suggested was to return a random recipe to surprise the user, much like feeling lucky feature of google search. We added this feature to the model as suggested by the evaluation from a user. More features like diet chart recipe, recipe-ingredient reversal model, and dietary regime where ideas thrown by the testing users.

The last question in our survey targeted in knowing whether the application could be used to replace the traditional models like websites and application, from the figure 20 we see that 60% agree that the application could be used in place of traditional models and with more features about 30% could be compelled to switch to switch this application.

9.4 Evaluation Analysis

Through the survey it gave us the idea that this application is certainly reliable for the output and has tremendous scope for further development. It is something that tries to solve the problem statement defined to a great degree, providing a good user satisfaction of the application. The bugs are limited and mostly occur due to exhaustive database for the testing, which could increase to good degree.

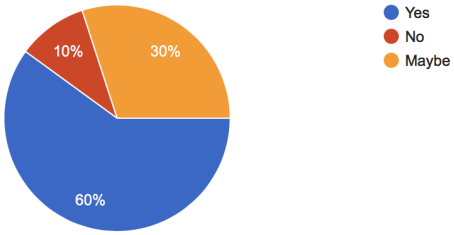

Figure 20: After using the application, would you prefer it over a traditional website?

Testing also gave an idea about development of features and development of further use cases for the application, which could make a compelling case for this application to be primary recipe source for a lot of users. Only constraint has been the database limitation for this application.

10. FUTURE SCOPE

Our proposed model only contains itself to domain of recipe, ingredients and at home cooking. This has a lot of potential for future work. Some of the future work to extend this application to have these features:

- Non-relational database can be used instead of relational database.
- A feature to allow the user to rate the recipes can be added.
- Additional search filters can be added where user can select the maximum number of search results that should be displayed, minimum rating of the recipes that should be fetched.
- A feature to sort the search results by rating, cooking time, etc. can be added.
- Natural language processing can be implemented in order to get the ingredient list as text from the user instead of from select drop-down lists.
- It can be updated to add features like looking for nearby restaurants for the input parameters by user.
- Adding functionality of mood recipe, which could suggest recipe to cook for a given mood of user.
- Make the bot learn user habits and create a healthy diet schedule for the user.
- Have friend-recommendation feature which could suggest on recipes which user friends or workspace buddies recommend
- Have user-suggestions for recipes that could be added to the database thereby increasing the database.

- History based recommendation for future recipe suggestions by tracking the more used ingredients or recipes by the user in past
- Location based cuisine specific suggestions to the user for exquisite recipes.
- Tracking calories burnt with application and setting push notification for reminding to eat user set calories.

Given the database this application can amass and the recommendation module scope of this application to perform multiple features is high and could be developed.

11. CONCLUSION

In conclusion our project aims at improving the lifestyle of the users by giving them options to find a healthy meal using a simple chat bot. The slack bot is easy to use and is great for quick searching. Finding the right meal to cook using only the ingredients you have and tailored for your health conditions is a tedious task, and this application aims to solve that using technology.

The application proves to be useful for the target user base. It has great potential to expand and have more features which can greatly enhance the usability of the application. But the only limitation this application had was the exhaustiveness of the database and that needs to be constantly updated for user the get a result every time.

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13. REFERENCES

[1] Yoko Mino, Ichiro Kobayashi. (2009, December). Recipe recommendation for a diet considering a user's schedule and the balance of nourishment. In IEEE International Conference

[2]Asami Yajima, Ichiro Kobayashi.(2009, October). Easy Cooking Recipe Recommendation Considering User's Conditions. In IEEE/WIC/ACM International Joint Conferences.

[3]Jill Freyne, Shlomo Berkovsky.(2010, February).Intelligent food planning: personalized recipe recommendation. In 15th international conference on Intelligent user interfaces.

[4] https://books.google.com/ngrams

[5] Ueda, M., Takahata, M., & Nakajima, S. (2011, October). User's food preference extraction for personalized cooking recipe recommendation. In Workshop of ISWC (pp. 98-105).

[6] Kuo, F. F., Li, C. T., Shan, M. K., & Lee, S. Y. (2012, November). Intelligent menu planning: Recommending set of recipes by ingredients. In Proceedings of the ACM multimedia 2012 workshop on Multimedia for cooking and eating activities (pp. 1-6). ACM.

[7] https://www.allrecipes.com

[8] http://www.supercook.com

14. CHIT NUMBERS

1. YGB
2. PMQ
3. TWX
4. HWT
5. XTO
6. CPR
7. HFU
8. VBN
9. QBO
10. QJW
11. NQZ
12. OPL
13. LGJ
14. QJM
15. LSG
16. HEK
17. PBP
18. WRM
19. PMW
20. JHC
21. AAK