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Project Paper: Ratatouille, the Food App

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Abstract

In the era of digital transformation, meal planning should be feasible for dorm student life, often challenged by time constraints, limited resources, and unhealthy eating habits. This paper introduces "Ratatouille" -- a food app designed to address these challenges by providing innovative features mentioned in the topic description. This is why a comprehensive literature review was done by the researchers to include qualitative analysis and technological developments in the related field. The literature review signifies how the Ratatouille application has the potential to promote healthier eating habits and enhance the dining experience for dorm students. Key findings from various research papers highlight the prevalence of food insecurity among students, the demand for personalized dietary advice, and the effectiveness of mobile applications' integration in improving nutrition and culinary experiences. The incorporation of advanced technologies such as image recognition, persuasive technology, and cloud computing underscores the app's potential to revolutionize the way students plan and prepare meals. Finally, there is a categorization for all the research papers reviewed, and how they are related to each other.

I.   Introduction

Meal planning is a significant aspect of any dorm student life, especially when they are busy with different classes, extracurricular activities, and social engagements. For many dorm students, the convenience of campus food courts or fast food options may seem like an easy solution; however, with some planning and discipline, dorm students can enjoy nutritious meals that satisfy them in terms of time and quality.

Such meal planning can help students save time and money; by taking the time to plan the meals for the week, students can make a better use of the ingredients they have available. This can also help reduce food waste, saving the environment and reducing the student expenses. The software technique assigned to target this area is computer vision using FirebaseVision, which is a deep learning AI model.

Another advantage of meal planning is that it can lead to healthier eating habits. When students have the meals planned for the rest of the week, they are more likely to make balanced and healthy choices to avoid the temptation of having unhealthy snacks. By enjoying a variety of fruits, vegetables, whole grains, and lean proteins into their meals, students can ensure that they are getting the nutrients they need to stay healthy and energized. The software technique assigned to target this area is special prompting and using ChatGPT API or Gemini API

Meal planning can also be a great way for dorm students to experiment with new foods and recipes. With the help of online resources and cooking apps, students can easily find inspiration for healthy and delicious meals that can be prepared in a dorm room. Thus, developing their cooking skills and passion for cooking.

However, meal planning for dorm students does come with its challenges. Lack of experience, ignorance of available ingredients, and food allergies can all make it difficult to prepare meals. To overcome these

challenges, we are introducing "Ratatouille", which is a food app that has incredible features such as ingredients scanning, recipe generator, cuisine and allergens filter. The software technique used for this is mobile app development using Flutter, integrated with the aforementioned AI prompting and computer vision model. These tools can successfully help dorm students prepare a variety of meals, from simple dinners to juicy and loaded tables.

Ratatouille, saving the time and effort to plan out meals, putting AI and Computer Vision in action, can help students save time and money, improve their eating habits, and expand their culinary experiences. With a little bit of curiosity, dorm students can enjoy delicious and nutritious meals that fit their busy lifestyles.

UML Class Diagram
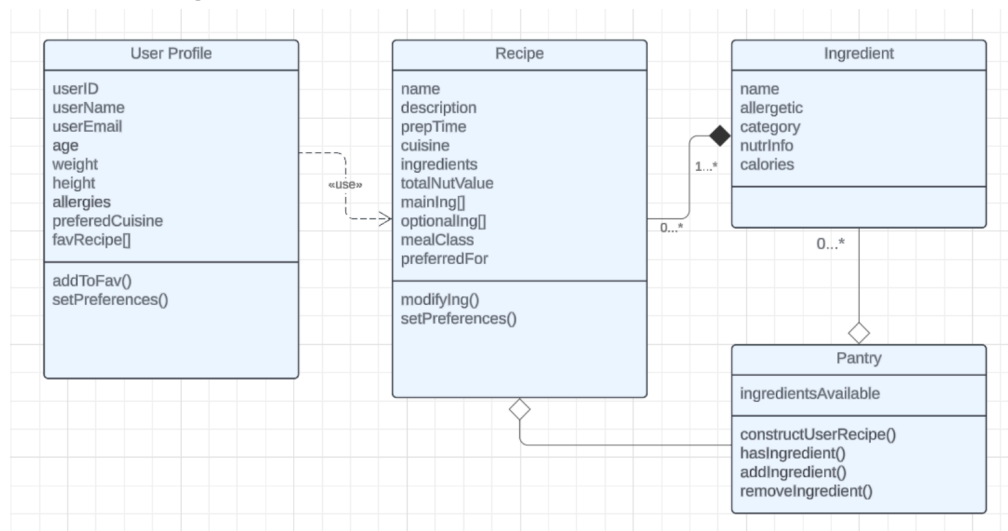
Use Case Diagram
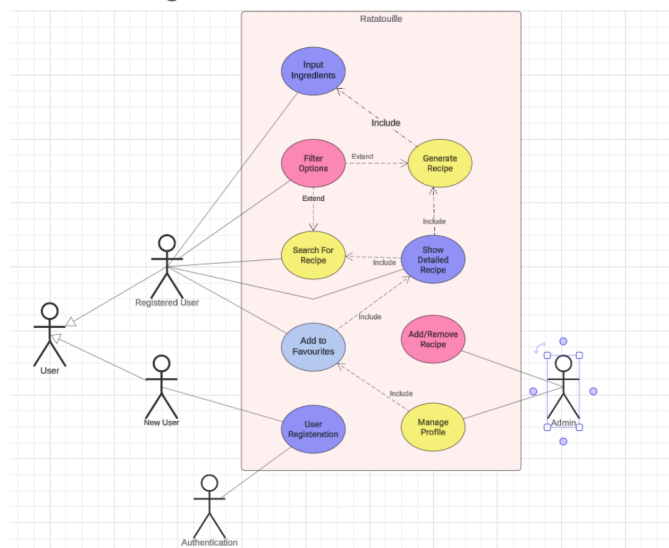
II.   Problem Statement

After highlighting the significance of meal planning, we get to find that many dorm students face significant challenges when it comes to planning their own meals. Limited time, busy schedules, and lack of cooking experience often lead to unhealthy eating habits and unbalanced diets. Without proper guidance and resources, students may resort to convenient but nutritionally unhealthy options such as fast food, pre-packaged meals, and high-calorie snacks. This can have serious implications for their health and well-being, including weight gain, vitamin deficiencies, and increased risk of chronic diseases. Moreover, the stress and pressures of college life can further empower these issues, making it difficult for students to to lead a healthy life with healthy eating habits. Addressing these challenges requires a comprehensive approach that provides students with the knowledge, skills, and resources they need to make healthier food choices and prepare nutritious meals, which is simply a perfect description of what Ratatouille is going to provide.

III.   Literature Review

Paper 1:

Heying, E., & Bickler, E. (2023). Qualitative Analysis of Student Experiences With Food Access Over Academic Breaks. Journal of Nutrition Education and Behavior, 55(7, Supplement), 12. https://doi.org/10.1016/j.jneb.2023.05.027

The paper discusses that the challenges that face students preparing or having food on campus include food court closures or limited hours, the financial burden to purchase extra food, and limited personal kitchen access. The paper informs that 54% of the participants lived in dorms with a shared kitchen while 46% of them had their personal kitchens. The solutions mentioned as coping mechanisms included collaboration with students who had personal kitchen access. Another important piece of info is that 42% of participants in the study were food insecure. Food insecurity means not knowing when and where the next meal will come from, which is very distressing. The study highlighted the need for universities to consider opportunities on how they can support students who rely on eating on campus.

Overall, judging using the given statistics and percentages, it is very evident that meal-planning is a challenge for dorm students, and that Ratatouille can help them dominate their food insecurity problem.

Paper 2:

Khan, I., Junk, M., Carmine, A., Khan, I., & Mohd, T. K. (2022). College Health and Dining Application. Preprint. https://doi.org/10.20944/preprints202212.0470.v1

The research paper titled "College Health and Dining Application" focuses on the development of a mobile app by a group of Augustana College seniors to improve the dining experience on campus and promote healthier lifestyles among students. The key points addressed in the paper include:

- Problem Statement: The primary issue identified was the lack of easy access to daily menu information at the college dining center (CSL), leading to student dissatisfaction and inconvenience.

- Project Goals: The main goal of the project was to create an app that displays the daily menu for different stations within the CSL, allowing students to plan their meals in advance and check the menu at any time.

- Features of the App: The app includes features such as a simple design for ease of use, calorie counters for food items, push notifications for reminders, and a search function to find desired food items.

- Database Implementation: The team chose to use a relational database, specifically MySQL, for the app due to its speed, reliability, and ability to handle multiple users and data efficiently.

- User Interaction: The app allows users to track their meal swipes, receive push notifications for healthy behaviors, and access specific information related to campus dining options.

- Development Process: The team divided the work into different areas, including framework design, database creation, data importation, and page design. Challenges were faced during the integration of these components.

- Intellectual Merit: The development of the app aimed to provide a unique solution tailored to college dining centers, offering a curated experience for students and promoting healthy eating habits.

- Future Considerations: The paper discusses the potential for expanding the app to other platforms, such as iOS, and highlights the importance of creating a standout app in a competitive industry.

Overall, the research paper emphasizes the importance of leveraging mobile technology to enhance the dining experience on college campuses, promote healthier lifestyles, and provide valuable learning experiences for students involved in app development.

Paper 3:

Nelson, M. C., & Story, M. (2009). Food Environments in University Dorms: 20,000 Calories per Dorm Room and Counting. American Journal of Preventive Medicine, 36(6), 523-526. https://doi.org/10.1016/j.amepre.2009.01.030

This study worked on assessing the food and beverages available in students' dorm rooms. Participants had an average of 22,888 calories of food in their rooms. An interesting piece of information is that items purchased by parents had the higher calorie and fat content. This is the solution introduced by the family, and it implicitly shows that families are worried that their students may not be eating well or receiving enough nutrients, which advocates our Ratatouille project. The study also found that the most common items in dorm rooms were salty snacks, cereal bars, desserts, and sugar-sweetened beverages, which are all unhealthy food items. The study strongly emphasized the need for health care, and obesity prevention efforts targeting dorm students. It also highlights the importance of improving campus food environments for more healthier eating habits among dorm students.

This paper is important because it highlights the worries of the families about their students, and their belief that they might not be eating well enough.

Paper 4:
S. -W. Chen, D. -L. Chiang, T. -S. Chen, H. -Y. Lin, Y. -F. Chung and F. Lai, "An Implementation of Interactive Healthy Eating Index and Healthcare System on Mobile Platform in College Student Samples," in IEEE Access, vol. 6, pp. 71651-71661, 2018, doi: 10.1109/ACCESS.2018.2881996.

The provided research tackles designing a mobile healthcare system for Taiwanese college students. The goal is to leverage technology to help them manage their diet and physical activity. This is achieved by creating an interactive system for evaluating healthy eating habits and overall healthcare.

The system capitalizes on the widespread use of smartphones, allowing users to conveniently record dietary content, nutrients, and exercise details anywhere. It incorporates two modules: diet and exercise. Based on the user's age, gender, preferred foods, and exercise habits, the system offers personalized suggestions. Students can monitor their nutrient and calorie intake, enabling them to adjust their diet and exercise routines. This, in turn, aims to prevent chronic diseases that could develop in the future.

In essence, the research focuses on a broader mobile health platform encompassing diet and exercise management, while your project specifically targets recipe generation for dorm room cooking using a mobile app.

Paper 5:
G. Pangestu, A. A. Supianto and F. Utaminingrum, "Food Recipe Finder Mobile Applications Based On Similarity Of Materials," 2018 International Conference on Sustainable Information Engineering and Technology (SIET), Malang, Indonesia, 2018, pp. 156-161, doi: 10.1109/SIET.2018.8693218.

This research introduces a mobile application called "Recepiece" designed to help users find recipes based on the ingredients they already have. Here are the key points:

- Problem: Limited cooking experience and ingredients can restrict recipe options.

- Solution: Recepiece allows users to search for recipes based on a list of their available ingredients.
- Technology: The app utilizes the Ionic framework and Euclidean distance calculations to find recipes with the most similar ingredients to the user's input.
- Development: Agile development methods were used, with user feedback incorporated throughout the process.
- Evaluation: A small user survey (20 participants) indicated positive user reception and a high (>80%) approval rating for the core recipe search functionality.

This research is highly relevant to your Ratatouille application concept. Both projects aim to address the challenge of limited resources and cooking experience by providing recipe recommendations based on available ingredients. Recepiece offers valuable insights into:

- Technical feasibility: The use of the Ionic framework and Euclidean distance calculations demonstrates a viable approach for ingredient-based recipe search within a mobile app.
- User needs: The positive user response highlights the demand for such a solution among college students with limited cooking experience.

Further considerations:
- Recepiece's user survey was conducted with a small sample size in a specific region. A broader user study with your target audience (dorm-dwelling college students) could be beneficial.
- While core functionality received positive feedback, explore ways to potentially improve upon Recepiece in terms of features or user interface.

Paper 6:
Schäfer, U., Arnold, F., Ostermann, S., Reifers, S. (2013). Ingredients and Recipe for a Robust Mobile Speech-Enabled Cooking Assistant for German. In: Timm, I.J., Thimm, M. (eds) KI 2013: Advances in Artificial Intelligence. KI 2013. Lecture Notes in Computer Science(), vol 8077. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-40942-4_19

The paper titled "Ingredients and Recipe for a Robust Mobile Speech-Enabled Cooking Assistant for German" describes Kochbot, a smartphone and tablet application designed to be a voice-controlled cooking assistant. This app focuses on users who speak German and offers three main functionalities:

1. Recipe Search: Users can search a large recipe database using voice commands.
2. Step-by-Step Instructions: Kochbot reads recipe instructions aloud, allowing users to follow them hands-free while cooking.
3. Answering Questions: The app can answer questions related to the recipe during the cooking process.

The research team's primary goal was to explore the effectiveness of voice assistance in a practical, hands-free scenario within the kitchen environment. They also investigated methods for rapid adaptation to the specific domain of cooking recipes. This was achieved by utilizing natural language processing techniques like part-of-speech tagging and morphological analysis on a dataset of 32,000 German recipes.

The paper concludes that Kochbot is fully functional and can scale well to accommodate a growing user base and recipe collection. While the focus is on German recipes and voice interaction, it demonstrates the potential benefits of voice-controlled cooking assistants and hands-free recipe guidance.

Paper 7:

Guan, V., Zhou, C., Wan, H., Zhou, R., Zhang, D., Zhang, S., Yang, W., Voutharoja, B. P., Wang, L., Win, K. T., & Wang, P. (n.d.). A novel mobile app for personalized dietary advice leveraging persuasive technology, computer vision and cloud computing: Development and usability study. JMIR Preprints. https://preprints.jmir.org/preprint/46839

The research paper presents a comprehensive exploration of the development and usability study of a novel mobile app designed to offer personalized dietary advice. Led by a team of researchers from the University of Wollongong, the app integrates persuasive technology, computer vision, and cloud computing to deliver evidence-based support for individuals seeking to manage their food choices in real-time. The primary motivation behind this initiative stems from the suboptimal adherence to the Australian Dietary Guidelines (ADGs) among the population, despite the potential benefits of a healthy diet in reducing the risk of chronic diseases.

The study outlines the objective of creating a prototype mobile app tailored to the dietary needs of adults in Australia, with a focus on enhancing user experience and promoting positive behavior change. By applying the design science paradigm and leveraging Amazon Web Services Elastic Compute Cloud services, the researchers iteratively developed the app, incorporating elements of the Nutrition Care Process, cognitive behavioral theory, and the ADGs. The Persuasive Systems Design model guided the translation of these principles into app features, emphasizing a gain-framed approach to encourage healthy eating habits.

Key features of the prototype include image-based dietary assessment, gamified food choice tracking with immediate feedback, personalized goal setting, and access to recipe ideas aligned with the ADGs. The study employed the Mobile Application Rating Scale and conducted semi-structured in-depth interviews with a convenience sample of 15 participants to evaluate the app's usability. Results indicated an overall acceptable quality score for the prototype, with users perceiving a positive impact on their adherence to the ADGs, particularly highlighting the gamification elements and innovative image-based dietary assessment as key drivers of user satisfaction.

The collaborative effort behind the development of this evidence-based mobile app underscores the potential of interdisciplinary approaches to address public health challenges related to nutrition and chronic disease prevention. By harnessing advancements in computer vision and cloud computing, the researchers have demonstrated a promising avenue for delivering personalized dietary advice through mobile technology. The study not only enhances transparency regarding the app's creation but also serves as a valuable example of leveraging technology to promote healthier food choices and improve overall well-being.

Paper 8:

Li, S., & McAuley, J. (2020). Recipes for Success: Data Science in the Home Kitchen. Harvard Data Science Review, 2(3), 1-11. https://doi.org/10.1162/99608f92.05852aa8

The research paper "Recipes for Success: Data Science in the Home Kitchen" by Shuyang Li and Julian McAuley delves into the evolving landscape of cooking in the digital age, where data science is revolutionizing how individuals engage with recipes and culinary experiences at home. The authors explore the profound impact of the internet on the accessibility of recipes, enabling individuals to explore a vast array of culinary creations from diverse cuisines and cultures. They discuss how recent advancements in data science have facilitated the searching, reconstructing, and personalizing of recipes, allowing for a more tailored and enriching cooking experience.

Moreover, the paper sheds light on the innovative applications of data science in recipe generation, nutritional analysis, and cross-lingual recipe understanding. By leveraging cutting-edge technologies, such as neural process networks and cross-modal retrieval systems, researchers are able to simulate action dynamics in cooking, analyze cooking instructions at scale, and enhance the diversity of generated or suggested recipes from multi-lingual collections. These developments not only empower home cooks to explore new culinary horizons but also contribute to the preservation and dissemination of traditional recipes across different languages and cultures.

Furthermore, the authors highlight the challenges and opportunities in recipe writing and generation, emphasizing the importance of producing coherent and user-friendly recipes that can be easily followed by individuals in their home kitchens. By incorporating user input on desired recipes and ingredients, researchers have developed mechanisms to track ingredient usage and improve the fluency, grammaticality, and relevance of generated recipes. This user-centric approach to recipe generation aims to enhance the overall cooking experience and empower individuals to unleash their creativity in the kitchen.

In conclusion, "Recipes for Success: Data Science in the Home Kitchen" offers a comprehensive exploration of how data science is reshaping the culinary landscape, empowering individuals to discover, create, and savor delightful dishes in the comfort of their homes.

Paper 9:

Rodrigues, M. S., Fidalgo, F., & Oliveira, Â. (2023). RecipeIS—Recipe Recommendation System Based on Recognition of Food Ingredients. Applied Sciences, 13(7), 7880. https://doi.org/10.3390/app13137880

The research paper "RecipeIS: Recipe Recommendation System Based on Recognition of Food Ingredients" introduces an innovative system designed to tackle the global issue of food waste by offering personalized recipe recommendations through the identification of food ingredients. By leveraging advanced technologies such as convolutional neural networks, specifically the ResNet-50 model, the system achieves a high accuracy rate of 96% in classifying a dataset comprising 36 classes of vegetables and fruits. This robust image recognition capability enables users to simply upload an image of an ingredient, which is then used to retrieve relevant recipes from the Edamam API.

The primary objective of the RecipeIS system is to empower users to make informed cooking decisions based on the ingredients available to them, thereby reducing food waste and promoting sustainable consumption practices. By utilizing deep learning models and libraries like TensorFlow, Keras, and Numpy, the system ensures efficient implementation of food ingredient recognition and recipe recommendation functionalities. Through the integration of these technologies, users can seamlessly identify ingredients either at home or in a supermarket using their smartphones, facilitating meal planning and minimizing unnecessary purchases.

Moreover, the research emphasizes the importance of selecting appropriate implementation methods, software tools, and model architectures to enhance the accuracy and effectiveness of food recognition and recipe suggestions. By exploring various models employed in similar studies, the paper sheds light on the diverse approaches within the field of food recognition systems. The successful implementation and validation of the RecipeIS system underscore its potential to revolutionize how individuals approach cooking, making it easier to create delicious meals while making the most of available ingredients.

In conclusion, the RecipeIS system represents a promising solution to the challenges associated with food waste and meal planning, offering users a convenient and sustainable way to explore new recipes and make the most of their culinary resources.

Paper 10:

Salvador, A., Hynes, N., Aytar, Y., Marin, J., & Torralba, A. (2019). Inverse Cooking: Recipe Generation From Food Images. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. https://openaccess.thecvf.com/content_CVPR_2019/html/Salvador_Inverse_Cooking_Recipe_Generation_From_Food_Images_CVPR_2019_paper.html

The research paper "Inverse Cooking: Recipe Generation From Food Images" introduces a novel system that leverages deep learning techniques to predict ingredients and generate cooking instructions directly from food images. By simultaneously considering the visual information and inferred ingredients, the system can recreate complex recipes with titles, ingredients, and cooking steps.

The study highlights the significance of modeling ingredient dependencies without enforcing a specific order, leading to more accurate ingredient predictions. Through extensive evaluation on the recipe dataset, the system demonstrates superior performance compared to traditional retrieval-based approaches in generating coherent and realistic recipes. Additionally, the paper emphasizes the challenges of generating recipes from images and the importance of reasoning about both visual and ingredient modalities for successful recipe generation.

IV.   Categorization
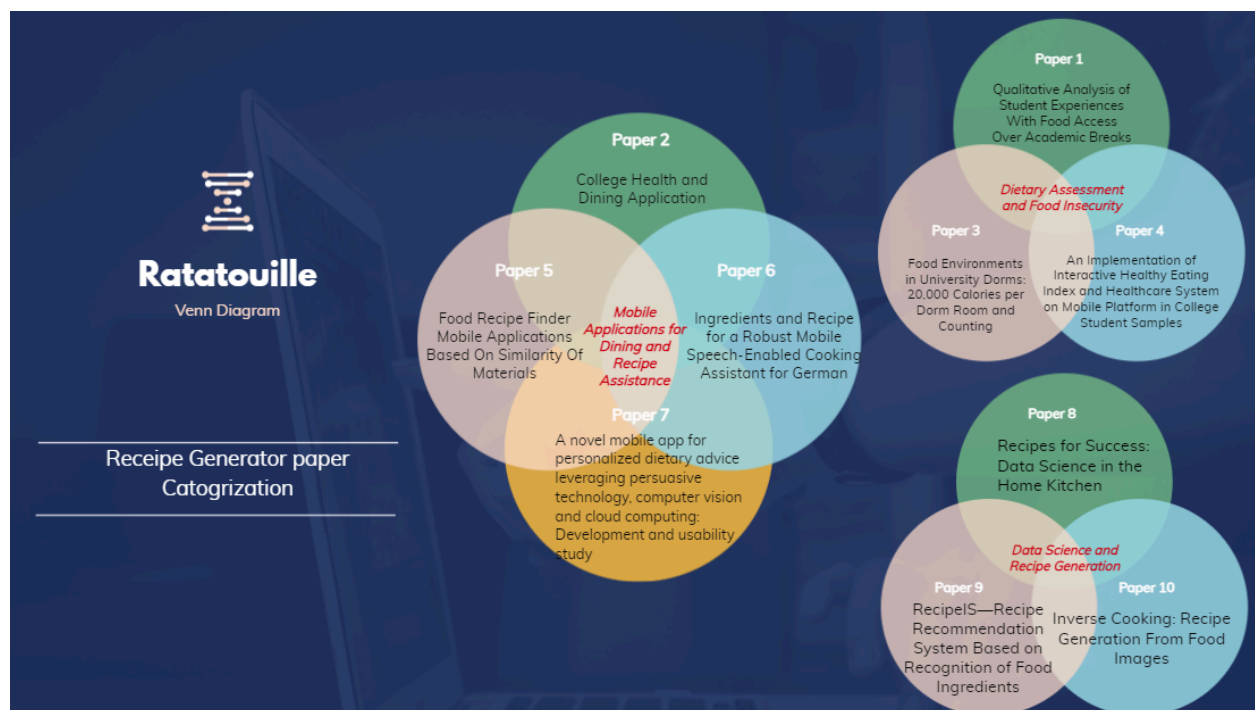
V.   References

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