How Can I Cook With This: User Experience Challenges for AI in the Home Kitchen

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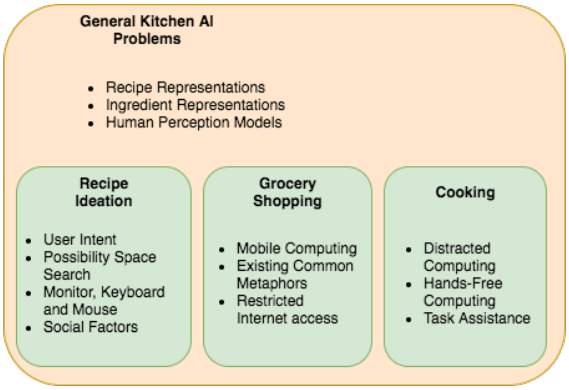
Abstract

Artificial Intelligence has had an outsized impact on our daily lives, from curating the movies we watch to recommending the books we read. There has been an interest in bringing AI techniques to the kitchen since long before the modern resurgence in AI interest. This is a domain filled with potential victories, with technologies and techniques that are applicable to nearly everyone. In planning a meal, grocery shopping, and even meal preparation, computational systems can assist and empower people to make healthier choices. However, this domain has a unique set of UI and UX challenges that need to be considered that separate it from other applications of artificial intelligence.

This position paper is a proposal for a 20 minute presentation.



Introduction

Artificial Intelligence systems have been creating new recipes since CHEF(Hammond 1986), a case-based planner that designed new schezwan recipes. Today, recipe recommendation engines (such as Yummly[1]), databases (such as CocktailDB [2]), and AI platforms (such as Wellio[3]) demonstrate a sustained interest in trying assist and augment cooking tasks.

Using AI to promote home cooking and working in the kitchen has high potential health benefits. Eating healthier has been identified as a core component of American wellness by the US Office of Disease Prevention and Health Promotion (ODPHP). Nutrition and good diets are a key component to healthy living(US Department of Health and Human Services and Office of Disease Prevention and Health Promotion 2010). Encouraging people to cook at home has had them feel more in control of their diets and connect with others(Simmons and Chapman 2012).

I'd like to motivate research by discussing three potential application areas of culinary AI, some user interface challenges in each each area as well as some cross-cutting problems. The three that I want to focus on are meal planning, shopping, and cooking in a kitchen.

[1]https://www.yummly.com/

[2]http://www.cocktaildb.com/

[3]https://wellio.getwellio.com/

Cross-Cutting Problems in Food AI

There are a number of unsolved and open problems that need to be solved at the intersection of AI and food. These problems are linked to all three highlighted sub-domains, and affect even more potential interactions between the culinary realm and AI. Furthermore, this is only a sample of the crosscutting problems, there are likely even more that haven't even begun to be investigated.

Ingredient Representation. How can we represent an ingredient to a computer? Ingredients are more than just plain text list items in a bill for a recipe. They have rich ontological properties (for example, is a Tomato a fruit or a vegetable, and if it is a fruit, does that mean it belongs in a fruit smoothie?). Ingredients have key sensory properties, such as aroma, taste and mouthfeel that need to be represented to an AI.

Recipe Representations. A recipe can be thought of as a plan, and there is a long history of planning research. Or perhaps, a recipe is a set of rules, which also has a rich tradition of research in AI. However, we need plans to be adaptable, able to be modified on the fly when you've realized you've forgotten a key ingredient in the store. We also need to adapt these existing bodies of research to culinary constraints, such a difficulty to prepare, preparation time and if part of the plan or rules can be done the night before.

Perception Models. Unlike graphics or acoustics, we don't have an easy numerical representation of aromas or tastes. We need to build models of how humans perceive these

things, and how these perceptions change around various contexts and under various chemical interactions. Perhaps starting at high levels of abstraction, to keep the computational complexity down, we need to to teach computers how humans interact with food.

Food Availability / On Hand Ingredients. Keeping track of the state of a user's pantry is non-trivial. Not all ingredients at the point of purchase will end up in the buyer's pantry, not everything bought at grocery stories is for meals, and food is not stored in a single location. You can arm a fridge with sensors, but what about kitchen cabinets, pantries and counter spaces?

Recipe Planning

Planning what to eat tonight is a significant task, as a meal planner needs to balance personal desires (what do I even want to eat?), on-hand food items (what's in my fridge?), and other concerns (what's the healthy thing to have?). From a UI/UX perspective, it's not unreasonable to expect meal planning to happen in an environment similar to where a laptop might be used. It's a significant task, and users are likely to devote their full attention to figuring out what to eat tonight.

However, meal planning is often not done alone—some discussion with family members, friends or roommates is key in figuring out what to eat tonight. Integrating these communication channels is key to an AI designed to assist with meal planning. Users also need easy ways to search through a vast possibility space of meals, slicing away parts with various constraints. In this, a meal planning AI can almost be thought of as a casual creator (Compton and Mateas 2015), as average users don't need sophisticated design or planning tools to come up with a meal. They just need simple interfaces that make exploration and experimentation easy, with rapid feedback and an easy way to share what they've made.

Grocery Shopping

AI can also assist in shopping tasks, and the logistical complexity around going from a plan (the recipe we'd like to make) to a collection of ingredients, ready to be prepared in a kitchen. The interface challenges here are somewhat different than the free-form, focused space exploration of meal planning.

While shopping, users are likely to only have a mobile phone on them. Furthermore, grocery stores are not hotbeds of Internet connectivity, and a shopper may not have a connection to a remote server to offload processing tasks or access a database. Users may be shopping for single meals, or maybe getting a large amount of groceries for multiple meals. Although there is a rich history of metaphors for grocery shopping (e.x: shopping lists), do those same metaphors make the most sense when developing an AI to assist with shopping?

Meal Preparation

Can an AI help someone actually prepare a meal? Although there is a push for robotics in the kitchen[4], we'd like to think of how a digital assistant can interact with a home cook to successfully prepare a meal. This environment is hands free, as a cook has their hands full with cooking utensils, ingredients and tasting a bit of what they're preparing. Furthermore, this is a distracted environment, as a cook's attention is focused on successfully making a meal.

Conversational AI interfaces seem like a potential huge win here, but some of the current interaction paradigms are very limiting. It's a not uncommon paradigm in current conversational interfaces to stop listening for user input after around 15 seconds. This is a smart security concern, as people are uncomfortable with an 'always listening' device in their homes.

However, for cooking, it's not uncommon for the next request to happen well after those 15 seconds are up (because a user was doing something else for 15 seconds), which often means a user needs re-prompt the conversational interface to have it 'remember' where they last were.

Balancing these concerns is paramount to finding an interaction paradigm that works well in the kitchen.

Conclusions

Culinary AI is fertile ground for new problems in AI interaction. From the many contexts that users may interact with such a system to the interesting constraints within each of those contexts, if we want to bring artificial intelligence to the kitchen, these problems need solutions.

There are very large victories if we can build these sorts of AI assistants. From being able to promote healthier meals, to giving people a sense of empowerment and control over their food intake, culinary AI has the potential to make both physical and mental wellness improvements in a home chef's life.

Author Biography

Johnathan Pagnutti is a Ph.D candidate in Computer Science at the University of California, Santa Cruz with the Augmented Design Lab. His research primarily focuses on developing algorithms that can create new recipes, with the aim of helping more people cook in the kitchen.

References

Compton, K., and Mateas, M. 2015. Casual creators. In *ICCC*, 228–235.

Hammond, K. J. 1986. Chef: A model of case-based planning. In *AAAI*, 267–271.

Simmons, D., and Chapman, G. E. 2012. The significance of home cooking within families. *British Food Journal* 114(8):1184–1195.

US Department of Health and Human Services and Office of Disease Prevention and Health Promotion. 2010. Healthy people 2020.

[4]With companies like Moley Robotics: http://www.moley.com/