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How to Visualize Food Quantities to Prevent Food Waste? Examples and Challenges

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Abstract

Food quantity management involves planning and predicting in one's daily life. One has to estimate how much needs to be bought, how much the people eating together will want to eat, and how much needs to be prepared to have enough but not too much either. Wasting food raises sustainability and financial challenges. We present some of the issues linked to poor food management and then suggest two ways in which visualization may address two of them: over-buying and over-preparing. Finally, we discuss current limitations in order to identify future directions and research questions.

Index Terms: Human-centered computing—Visualization—Visualization design and evaluation methods

1 Introduction

Food is embedded in our everyday lives: we need it to survive. Whether consumed out of necessity or pleasure, poor food management leads to poor consequences. Throwing away food wastes money and resources, resulting in both financial and ecological repercussions. In 2011, the FAO reported that one third of the food produced ended up wasted. In 2016, the European report of the FUSIONS project indicated that 53% of food waste came from households. Reducing this waste thus appears relevant to address the problem of climate change. Here we focus on small individual actions by supporting a better food management to reduce food waste at the household level. We introduce two cases in which such visualizations could be used to help manage food quantity and discuss the existing challenges of designing such solutions.

2 Food Waste

Many individual behaviors lead to food waste. For instance, **over-provisioning**, i.e., when purchases exceed needs, is a common behavior [5, 8, 10, 15, 16] when grocery shopping. However, food is also wasted after being cooked due to **over-preparing**, i.e., too large portions are prepared. While leftovers may be put aside, some people report a aversion towards them, also leading to waste [10, 16].

What solutions then? Ens and Irani [4] described a scenario in which someone wants to compare prices to their budget, and ElSayed et al. [3] studied a system that would help people make faster comparisons and decisions while grocery shopping. Even though, these researches were not motivated by food waste, they could be applied to the **over-provisioning** issue. We build on the latter example in the next section to illustrate how visualization could benefit our research's focus. Regarding **over-preparing**, some approaches have suggested community involvement. For instance, apps can connect individuals to share leftovers or other food items that would otherwise be lost [6]. However, food sharing also requires trust: do we want to take food from strangers [12]?

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3 Visualization Examples for Food Quantities

We focus on the management of food quantities because it can be difficult to gauge how much food is needed for a meal, especially when trying out a new recipe, or when cooking for multiple people. Our goal is to highlight opportunities for visualization to assist in food management and ultimately in reducing household food waste. We use the example of Julia, a woman who lives alone but regularly has guests for whom she cooks.

She invited three friends over and is thus going to the grocery store in order to buy the necessary food items for a specific recipe she has in mind. Similar to the system studied by ElSayed et al. [3], the goods written on her shopping list are highlighted while she looks at different shelves so as not to be tempted by special offers and buy unnecessary items. When several products of the same type are available, she can compare them: the overall quantity expressed as the number of average meals for one person is displayed for each item she holds. Having 3 guests, Julia selects the one that shows 4 portions to avoid over-provisioning. However, in the next aisle, several products share the same quantity. In that case, the price and the composition are put forward instead and Julia can make a choice according to her budget and the diet of her guests.

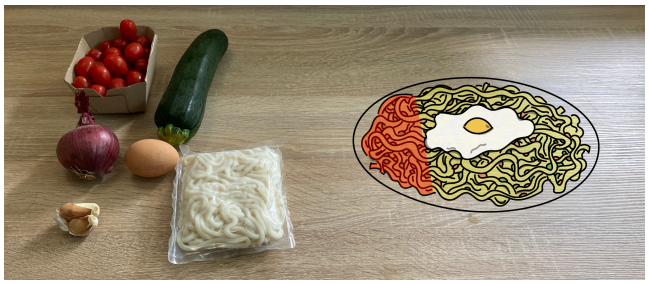

Figure 1: On the left are the ingredients and on the right is a realistic representation of the predicted amount of food that would be produced with a red overlay to designate the surplus amount compared to the recommended quantity.

Once back home, Julia starts preparing the meal and only has access to the products she just bought along with those already in her cupboards. She wants to avoid generating leftovers since she knows that she likely will not eat them later. She puts all the ingredients that she intends to include in her recipe on her counter and checks the predicted final quantity (see Fig. 1). The prediction is based on data from her previous inputs, that is, how much she actually eats on average, but other criteria can also be included such as calorie counts or specific amounts of a given nutrient. With the current parameters, the system has already learned from her eating habits, so Julia is confident that the recommended amount is reasonable. She thus removes a zucchini from her work surface to meet the recommended goal. Julia notices over time that her predicted quantities are getting closer to the recommended quantity. As such, she believes she will soon be able to prepare suitable amounts of food without it, although she prefers to use it when inviting guests because she finds the task more difficult and more uncertain.

4 Current Challenges

The rise and constant development of new technologies opens new doors, but which one to adopt? We described two types of use in the previous section, omitting the visualization system: is it augmented reality? Is it virtual reality? Should we stay on a screen with a 2D representation? Should we make use of the convenience of smart phones? Understanding the effects of these different technologies on the effectiveness of the visualization is essential in order to select the most appropriate one. This raises the question of how food quantities should be represented. While the perception of classic 2D shapes have been studied in detail [2], food quantities may require different representations, possibly using concrete scales [1] or more abstract 3D shapes. In the previous scenario, for example, we could choose between a realistic or an abstract representation of food quantity (see Fig. 1 and Fig. 2). Moreover, the computation of the final food quantities given raw ingredients would produce uncertainty (because goods are transformed, because some weight is lost when peeling or cooking vegetables for instance). We thus may need predictive visualizations, which are "uncertainty visualizations that show plausible outcomes" [14]. We can take inspiration from existing work on how to represent uncertainty [7, 9, 11, 13], but studies investigating specifically how to display uncertainty for food quantities are still needed. Figure 2 presents potential designs.

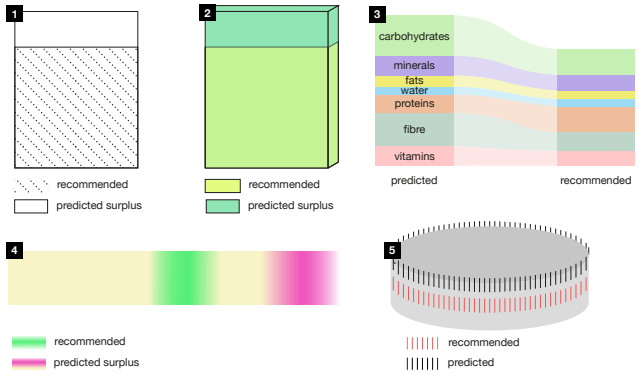

Figure 2: Examples of abstract visualization representing predicted and recommended food quantities: (1) simple 2D bar chart ; (2) colored 3D bar chart ; (3) detailed diagram with nutrients ; (4) horizontal bar with uncertainty ; (5) cylinder with uncertainty.

Finally, when designing for sustainability, one must take into account the system's impact on the environment: even if we manage to waste less food thanks to new technology, what is the net environmental cost? Would it be preferable to still waste some food? Or is the impact of such a system insignificant compared to food waste?

5 Conclusion

Food waste plays an important role in the current ecological crisis. We have described two everyday-life situations in which visualization may be able to assist in the management of food quantities, first during shopping and then when preparing a dish, but these could also apply when ordering at a restaurant or through food delivery apps. However, for such a system to be effective, issues such as what technology to use and how to appropriately represent these food quantities must be addressed.

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