
Interactive Cutlery: A Gustatory Designer for Fine Grain Seasoning

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Abstract

Course of French cuisine is a sophisticated method to amuse customers. Serving plates one after another changes gustatory (complex taste) for each plate along the course. However, gustatory changing requires seasoning tasks. Seasoning, or gustatory designing, is costly because they are based on chemical materials that we cannot move or change by current methods to manipulate pixels or bits. In this paper we propose Interactive Cutlery which realizes gustatory designing for each bite. The gustatory designer can program gustatory changes with GUI. We conducted a user study to confirm its advantages.

Author Keywords

French Cuisine; Cooking; Gustatory; Food; Design;

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

General Terms

Design; Performance;

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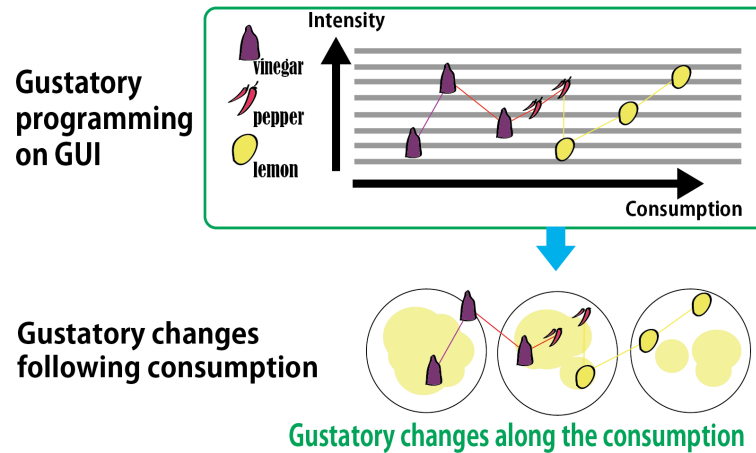


Figure 1. Interactive Cutlery is programmable by a simple GUI. The GUI is composed by a music score-like pallet and flavor icons that represent available seasoning cartridges. The horizontal shaft is linked to the process of consumption, in other words the amount of food left on the plate.

Introduction

In the history of gustatory designing, chefs have been seeking methods to amuse customers. Course [1] is a traditionally determined result of the pursuit. French Course [1] is a traditional and representative example of gustatory designing. It begins with appetizing "amuse bouche" to tasty main dish "viande" and ends with refreshing "dessert". The main role of course is to construct each gustatory on a plate so that they afford the best satisfaction by cuisine. Thus it contains planned gustatory changes.

Some Japanese style food has flexibility on the gustatory designs. They allow customers to commit the

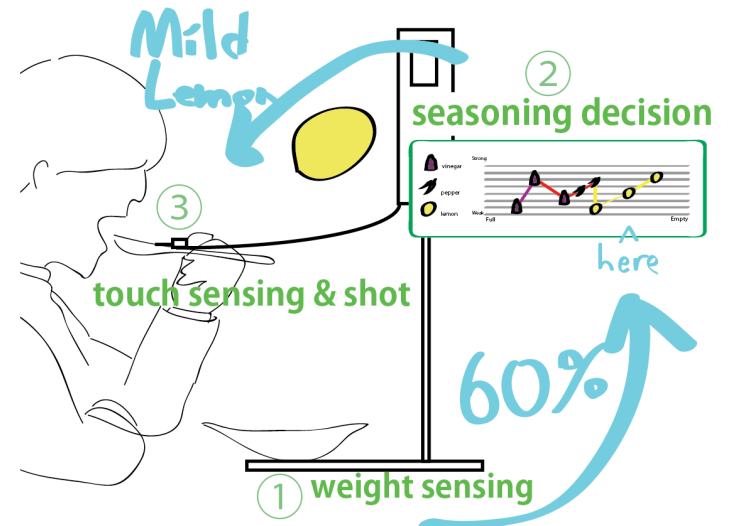


Figure 2. The process of seasoning: The weight sensor value determines the consumption rate, then decide which and how the system shot seasonings. Pumps shoot programmed seasonings as the spoon touches on the tongue.

gustatory design so that the customers can adjust the gustatory on demand. For example, they prepare some

sources such as soy souse or peppers on tables in front of customers. It often includes several sources not only dressings for salads. Customers can freely commit the gustatory designing by adding extra seasonings to adjust saltiness or sourness.

Another example appears in a food called Hitsumabushi. It is one of the most popular Japanese country foods. It is usually served with different bowls including rice, some kind of pickles and soup on a board. It contains several types of deliberately separated foods.

Customers first enjoy rice, and puts pickles to change the taste. As they enjoy Hitsumabushi, the gustatory changes along the time. At last, they pour soup in the rice to change the taste. The gustatory is designed not only for fullness, but also the gustatory changes amuse customers and afford emotional satisfactions.

There are also approaches from state of the art to the modern cuisine. These approaches are called molecular gastronomy and being on the cutting edge of cuisine. elBulli [2], one of the most famous restaurant in Spain, has created various new gustatory by assigning chemical approaches on cooking. For example, they invented a cooking method called "spherification" which turns a liquid into spheres like caviar. Using this technique, new type of gustatory designing is possible. For example, different types of soups compose a soup, but they are separated by spherification and first mixed in the mouth. The customers can enjoy the mixing taste of soups.

While the gustatory changes bring rich experience by amusing customers, it has limitations because changing gustatory is costly. For example, course has difficulty on increasing the stages. Additional separations of each stage in French course would realize the desired gustatory designing for each bite, but it makes the kitchen too busy. Japanese style seasoning on demand may be capable of designing gustatory for each bite, but it requires customers to move their hand for each bite.

Interactive Cutlery is a spoon enhancement that shoots sources. It realizes gustatory changing by shooting different type of sources on the food. The type, order and the amount of sources are programmable. The

program works as the customer eats food. A weight sensor continuously measures the eating process.

The system contains seasoning cartridges, sensors and needles connected to each cartridge with nozzles. Needles are attachable on ordinary spoon or fork. The pump shot seasonings from the needles when the customers have the spoon in mouth. Gustatory designers can program the type, order and the amount of sources by a simple GUI.

Interactive Cutlery

Gustatory designing for each bite

French course satisfies the customers by changing gustatory. Chefs create variety of gustatory by designing gustatory on each stages of the course. However, having variety of gustatory requires different types of ingredients. This means that as the variety of gustatory increases, the seasoning task makes kitchen busy and thus gustatory designing for more accurate gustatory such as gustatory for each bite is impossible.

Japanese style allows customers to season their food on demand, but this style disturbs customers' dining and sacrifices the accuracy of taste instead of business in kitchen. Thus seasoning is costly and difficult.

Interactive Cutlery can change gustatory for each bite. Figure 2 shows the image how gustatory changes with the system. The weight sensor under the plate is continuously sensing the amount of food left on the plate. The sensor value is used to determine the process of the consumption and decides the type and amount of seasoning according to the program. As the customer have the spoon into mouth, the pump contained in the cartridges shoots seasonings from the

needle into the mouth. The type and amount of seasoning change according to the program.

Controlling the taste intensity

Even if the cuisine satisfies customers, it's not preferable if it's unhealthy. Salt is one of the most important seasonings, and most of recipes contain salt. However, excessive salt can be factors of many diseases.

Interactive Cutlery increases the saltiness using the same amount of salt. F3 shows how the system makes saltiness more intensive. Ordinal foods contain salt mixed in the ingredients. On the other hand, Interactive Cutlery add salt directory on the surface of the tongue by the needle attached behind the spoon.

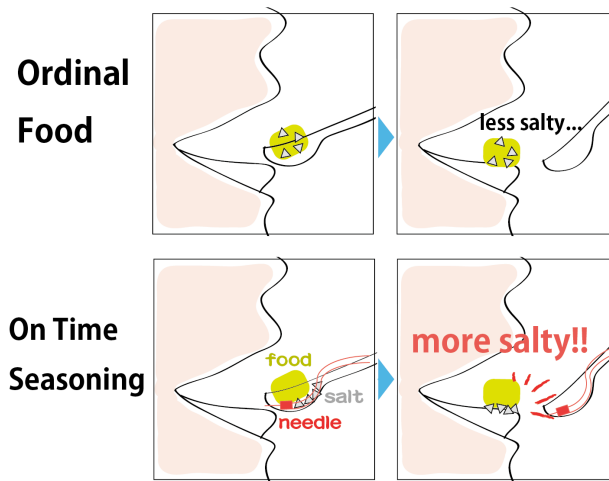


Figure 3. The system can afford more saltiness compared with the ordinal food by directory seasoning on the surface of the tongue. On time seasoning makes it possible.

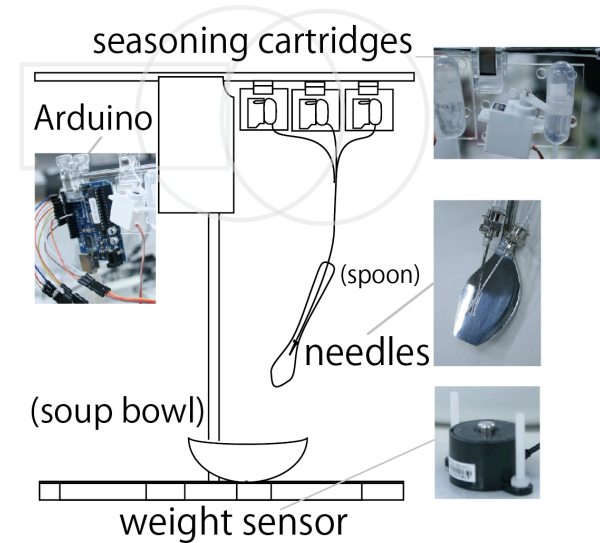


Figure 4. The system contains seasoning cartridges, sensors and needles connected to each cartridge with nozzles. Needles are attached on an ordinal spoon.

Seasonings are first touch on the surface of the tongue leaving intense saltiness, and mixed gradually in the mouth. In the both case of Figure 3(ordinary seasoning and on-time seasoning), the amount of salt is same, but the on-time seasoning afford more intensive saltiness. To confirm the on-time seasoning effect, we conducted a user study.

Gustatory Programming

Interactive Cutlery is programmable by a simple GUI. The GUI is composed by a music score-like pallet and flavor icons that represent available seasoning cartridges. The horizontal shaft is linked to the process of consumption, in other words the amount of food left on the plate.

Thus, shooting seasoning changes to the next seasoning when the customers eat the food and the left amount of food decreases. Designers of gustatory drag and drop icons, and set the amount of the seasoning (intensity).

Prototype

The system contains seasoning cartridges, sensors and needles connected to each cartridge with nozzles. Needles are attached on a ordinal spoon.

Cartridge contains seasoning tank and a pump actuator. The capacity of the seasoning tank is 4.17ml. It is capable of shooting seasonings with 0.23 ml and 0.4 push/sec resolution. The system contains two sensors: a weight sensor and touch sensor. The weight sensor is placed under the plate and measures the amount of food left on the plate. The touch sensor is placed on the needle and sense the encountering timing of the tongue.

User Study

The main functions of Interactive Cutlery are 1) avoiding the tiredness of simple seasoning by changing the gustatory for each bite, and 2) increases the perceived saltiness by pushing seasonings directory on the tongue. We conducted a user study to confirm the

system capability and perceptual effects for each function.



Figure 5. Prototype of Interactive Cutlery

Gustatory designing for each bite

To confirm the effect of the gustatory changing, we conducted a user study. We prepared a risotto without seasoning and three seasonings in cartridge: salt, pepper and lemon.

Each seasoning is mixed into water and shoot in order when the amount of food left on the plate is changed: it shot salt when the amount is three-thirds(full), pepper when it's two-thirds and lemon when it's one-thirds. 3 subjects experienced gustatory changes and commented feedbacks.

Controlling the taste intensity

We conducted a user study to investigate how on-time seasoning directory on the tongue changes the intensity of the saltiness. Participants were not made aware of the true purpose of the experiment.

The study consisted of 8 subjects (including different nationality). The subjects' ages ranged from 22 to 28 and the average age was 26 years-old. No subject has tasting experience.

We prepared a spoon that is enhanced by the system. The system is configured to examine the effect. Two needles were attached on each side of a tasting spoon. The needle attached on the upper side shoots pure water. On the other hand, the needle attached on the other side shoots a solution of salt (20 g/ml). The system shoots pure water and salty water same amount and time when the subject have the spoon in their mouth.

Thus, the shooting of the upper side taste nothing, and the other side taste salty. Turning the up side down of spoon changes the part that touches directory on the tongue, but the amount of shoot salt is same in both case.

Subjects were asked to taste shoots two times and compare them to determine the saltier shoot. When the first tasting is over, the subject was asked to clean their mouth to avoid aftertaste effect, and turn the up side down of the spoon (thus it changes the salty side). The order of the two shootings (salty side first or pure water side first) may effects to the result, so we changed the first side for each subject.

Results

Gustatory designing for each bite

Gustatory changes are positively perceived with all subjects. One subject commented, "Gustatory changes are amusing when eating food because it makes me to expect what next, what next, and cannot help taking one more bite". On the other hand, two subjects commented "Expecting taste is difficult because I cannot see the color or shapes of ingredients I'm going to eat. I was little scared first, but I think I can be used to". This result suggests that coloring food according to the gustatory changes would be helpful in case unknown gustatory changes will be a factor of anxiousness.

Fundamental difficulty of gustatory designing is that it requires chemical material manipulations. Differ from the pixel-based computation, programming chemical materials requires energy and large containers. However, the user study results that the largeness results in additional qualities such as amusement.

Controlling the taste intensity

Figure 5 shows the result. 5 out of 8 subjects perceived more saltiness in case the solution of salt directory was shoot on the surface of the tongue, than the case the pure water was shoot. The 2 subjects out of 3 subjects who perceived more saltiness in case of the pure water was directory shoot on the surface of the tongue took time to decide compared with other subjects. This result suggests that we tend to perceive saltiness more when salt was directory touched on the surface of the tongue, compared with the case when salt was mixed in food.

Potential Applications

Download seasonings: new recipe interface

Cooking at home is important for our health and family relationships. However, less family cooks at home as fast food industries are developed enabling them to buy tasty and cheap foods. One of the difficulties of cooking at home is seasoning. Precise seasoning is important to cook tasty foods, but realizing gustatory written in recipes is difficult.

Watanabe et al. argue that one of the difficulties is measuring process [3]: we have to carefully measure the amount of ingredients written in recipes. The main difficulty is based on the interface of recipes: we communicate complex ingredients and proceedings of cooking by words and numbers which is usually difficult to read and understand quickly enough to realize the food in the busy kitchen. Showing the process of cooking like cooking programs on TV is more useful because it doesn't include slow input media. Thus, words and numbers are not proper interface for recipes.

Allowing cuisines to describe the gustatory as digital proceedings, and realizing the taste with Interactive Cutlery will make cooking easier and open new creation fields of gustatory designing. Interactive Cutlery provides both input and output interface for recipes. There should be a scenario that professional chefs design gustatory and ordinary people download them to season their home made foods. The increasing interests of SNS may also help recipes in each community and country.

Mood Maker: gustation effects to mental conditions

The social aspect of dining is also important. Tasty foods make us feel ease and play an important role in conversation. Recent study [4] shows that ingredients contained in foods affect human mood: subjects who were injected with the fat solution reported feeling less sad than those who were with saline infusion.

This suggests that the system enables customers to taste different gustatory for each bite may contribute to adjust their mental condition. This is important particularly in case of important discussion over foods.

Related Work

Our work is strongly motivated by modern cuisine and traditional techniques for the gustatory designing especially explored in the French cuisine.

Course [1] is typical and traditional way to control gustatory so that the customer can enjoy the dining. Before A. Escoffier invented the course, all dishes had been served at once and so it was a mix and chaos of gustatory. The course is a strong way to realize chef's intended gustatory because it forces one dish at a time.

Some studies suggest computational approaches for the gustatory designing. MetaCookie [5] creates pseudo-gustatory leveraging cross-modal effect by presenting scent. Although MetaCookie suggests possibilities of programmed gustatory, it does not reach to the rich aspects of food such as texture, temperature and gustatory changes. In addition, it requires heavy headset that is not practical especially in restaurant.

Dining presenter [6] creates story of dish by visual augmentations of dining environments. Projections enhances the dining experience by various ways such as adding colors on foods, eating utensils and blank plates after the dining.

Difficulties of the gustatory designing are based on the fact that it requires chemical signals. This means an ideal technology for the gustatory designing should provide methods to convey atoms. Food-SFF [7] is a practical approach to print food by 3D printer. It produces highly designed structure of food and gustatory. However, it creates only static materials, and cannot leverage amusing aspect of dining by gustatory designing.

Augmented gustatory using electricity [8] proposes electric taste that emerges by electric simulations to tongue. Electric taste suggests a way for the gustatory designing without manipulating chemical materials. However, electric taste is difficult to merge into the current gustatory designing because the tastes created by chemical materials are too complex and fundamentally different from the electric taste.

Conclusion

Gustatory changes helps customers to enjoy dining. French cuisine has been seeking the way to amuse customers. The course is one of the results of the pursuit. Other examples are available in other countries. For example, some Japanese style restaurant offers extra seasonings to customers. Customers can change the gustatory on demand, not being tired with simple and plane seasonings.

However, seasoning is fundamentally difficult. Course is not capable of designing the gustatory for each bite because the variety of seasoning means additional tasks of seasonings. Japanese style can be capable of designing the gustatory for each bite, but it requires customers to move their hand. This is not only simply disturbing, but also not practical. Thus, while seasoning plays important role in dining experience, it is costly and difficult.

To address this issue, we propose a spoon enhancement to season foods each bite. Interactive Cutlery is a spoon enhancement that shoots sauces. It realizes gustatory changing by shooting different type of sources on the food. The type, order and the amount of sources are programmable. The program works as the customer eats food. A weight sensor continuously measures the eating process. The system contains seasoning cartridges, sensors and needles connected to each cartridge with nozzles. Needles are attachable on ordinary spoon or fork. The pump shot seasonings from the needles when the customers have the spoon in mouth. Gustatory designers can program the type, order and the amount of sources by a simple GUI.

We conducted a user study to confirm the system capability and perceptual effects for two main function of the system: 1) Gustatory designing for each bite, and 2) Controlling the taste intensity.

References

- [1] H. L. Cracknell, R. J Kaufmann, Georges Auguste Escoffier, *Escoffier: Le Guide Culinaire, Revised*, Wiley, John & Sons, 2011.
- [2] elBulli. <http://elbulli.com/>.

[3] smoon: A Spoon with Automatic Capacity Adjustment. <http://www.persistent.org/smoon.html>.

[4] Van Oudenhove L, McKie S, Lassman D, Uddin B, Paine P, et al. (2011) Fatty acid-induced gut-brain signaling attenuates neural and behavioral effects of sad emotion in humans. *J Clin Invest* 121: 3094–3099.

[5] Narumi, T., Kajinami, T., Tanikawa, T., and Hirose, M. Meta cookie. In *ACM SIGGRAPH 2010 Posters*, SIGGRAPH '10, ACM (New York, NY, USA, 2010), 143:1–143:1.

[6] Mori, M., Kurihara, K., Tsukada, K., and Siio, I. Dining presenter: Augmented reality system for a

dining tabletop. In *Supplemental Proceedings of the 11th Ubicomp 2009* (Sept. 30–3 2009), 168 – 169.

[7] Lipton, J.I., Arnold, D., Nigl, F., Lopez, N., Cohen, D.L., Noren, Nils., Lipson, and H. Multi-material food printing with complex internal structure suitable for conventional post-processing. In *21st Solid Freeform Fabrication Symposium (SFF'10)* (2010).

[8] Nakamura, H., and Miyashita, H. Augmented gustation using electricity. In *Proceedings of the 2nd Augmented Human International Conference, AH '11*, ACM (New York, NY, USA, 2011), 34:1–34:2.