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Sociable Kitchen: Interactive Recipe System in Kitchen Island

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Abstract

Kitchen as a space for social interaction and communication has been neglected in current HCI design. Most researches on kitchen mainly focus on cooking activities, so to correct human's frailties become main development in HCI research. Here instead of creating some artifact to improve working activities in the kitchen, we direct our study to design a system that aims to increase social interactions and communications among people. A tangible interactive recipe system embedded in kitchen island was introduced and evaluated. The results indicate that visual representation of dishes could facilitate people's share of experiences and positive responses toward each other. A record of people's favorite foods could also make food preparation easier and understand others' preferences. Moreover, people enjoyed the intuitive way of the system's interaction. Nevertheless, although people made some flavor changes in their final decision, people commented on lacking of personal creativity in current system. Further implications on sociable design are discussed in this study.

Keywords: *Kitchen, Island, Interactive Recipe System*

1. Introduction

Home is a space that people living together and sharing experiences in their everyday life. Spaces at home have their functions for certain activities that people can fulfill their needs and further have their inner emotions satisfied. Analyzing the activities and routines at home, Crabtree and Rodden [1] indicated that kitchen is one of the most used spaces by people that future HCI design could implement. Nevertheless, current HCI studies in kitchen mainly focus on design some tools that could make kitchen works efficiently [2][3], perfectly [4][5] or healthily [6]. The development of technology products may solve some problems that people have in the kitchen; however, treating people's problems with corrective technology [7] considers only part of user experiences. A research on domestic communication [8] which utilized tablet PC for visual text message also found out that kitchen is the place where family members regard situated technology as affective. In Taylor and Swan's ethnographic research on information technology for the home [9], they also found that families collaborated and kept their activity and social information mostly in kitchen, whether in kitchen table, refrigerator, or recipe notebook. Thus, this could infer that kitchen acts as not only a place for cooking, but also a place of family communication where technology artifacts could play to lubricate social relationship. That is, while kitchen functions as a place of cooking where technology is introduced, the communication, family connectedness and pleasure that people have in the kitchen do not seem to be fostered through HCI design.

With the concept of kitchen as the center where home communication involves, we should endeavor to shape HCI design in kitchen to not only in functional level, but also to a social level that could fulfill human's needs [10]. Terrenghi et al. [11] in their *Living Cookbook* project had tried to emphasize this concept by setting up a camera and a recipe system in kitchen counter to share live cooking videos with friends. Nevertheless, expecting effects such as communication and social interaction between two groups were still unapparent since people mainly responded to its usability in results. Therefore, to develop a technology system in the kitchen that would support social interaction, we need to know in what stage of food consumption process is probable for sociable technology implementation. If we analyze the stages of cooking activity, there are three main stages: preparation, cooking, and eating. As we have examined current trend of human-food interaction, most researches emphasize on the cooking stage which involves mainly individual activity. Thus instead of creating interactive system to assist or correct human activity in cooking, we would direct our study in the preparation stage. Since a hedonic dining time is the goal of food consumption, the preparation of food is a good starting point which people can talk and communicate food preferences with others. Previous research on food also indicated that preparation is a time of sharing, listening, getting to know each other more. It could serve as a powerful bonding mechanism among people [12]. The idea of preparing food together in its fundamental form actually matches the concept of co-experience [13]. Battarbee and Koskinen in their research on co-experience addressed that user experience has to consider its social interaction with others. For pervasive technology nowadays that people involve in some activities and create experiences together, either physically or virtually, needs to be investigated with more research. Therefore, kitchen as a social place where smart home system will play in to enhance not only life quality, but also human relationships, system's or product's design of social aspect needs to be considered more carefully. Hence, our research will focus on an interactive design for kitchen that aims to increase communication and co-experiences among people.

In this paper, we would present an interactive recipe system embedded in kitchen island that was designed with sociable feature in food preparation stage. The design concept, interface, and hardware requirements are described in the following section. An experiment was conducted to evaluate users' experiences and the last section would discuss its impact and implications for future design.

2. Interactive Recipe System

2.1. Design concept

The decision on what kind of medium to use and where the implement would apply to in the kitchen space has to meet the goal of being pervasive into human's life and environment [14]. So instead of placing a display in cooking counter [3][5], a surface that people could use on and interact with others is more appropriate for implementation. Therefore, we chose kitchen island as the place for interaction. There are two reasons for this decision. First, since preparation of food is a time for communication and social interaction, island is what people would use to place ingredients and stay around to talk to family members or friends. Second, without showing an intrusive object in the kitchen, the surface of island is ideal for table-based interaction and ordinary usage.

To enhance the communication atmosphere in the kitchen, we employed *reacTIVsion* [15] system which is suitable for multiple people interaction. The original application of reacTIVision is for the creation of sounds and music. The implementation of the system is *Reactable Experience*, which is a musical table that is designed for collaborative and multi-user capabilities. Users could play with tangible tags and mix at their likes to not only visualize multimedia elements but also sounds. The intuitive feature and its physically gathering people to participate around the table, make this system a potential medium for social interaction. Hence, with its interactive visual features and its table-based characteristic, we transformed the system into an interactive recipe on the surface of island.

Since our study planned to focus increasing communication through food preparation, we designed the system that enabled users to manipulate tangible ingredient disks to create dish variations. Through this design we hoped to foster people to discuss their choices of dish and further create new dishes. This idea is supported by previous research indicating that people got meal inspirations from one another informally [16]. Besides creation of dishes, understanding people's liking is also important when someone prepares and cooks for others. Therefore, the system also contained a favorite function that users could add in their favorite foods for later reference. The other feature that would enrich people's social experience is the connection with online recipe community. Svensson et al. [17] in their study of Kalas, a food recipe system, indicated that people had pleasures and positive experiences when navigating recipes with social trails. The sense of bonding is conveyed through recipes provided or commented by other food lovers. With this concept, we want to extend the design for social relationship into kitchen space where family members or friends could personally experience and interact. Therefore, in the system we planned to make it connect to web recipe data; so interaction could take place within domestic place as well as virtual community.

2.2. Technical attributes

The hardware of the system contained a CCD camera, an IR pass filter, several infrared lights, a projector, a semitransparent glass, Lee filter and a dual-core computer. Figure 1 is the construction inside the island. The characteristic of open-source reacTIVision is its table-based tangible interaction. The camera recognizes tangible objects with fiducial symbols at the bottom, which are tracked by reacTIVision algorithm. With the system's own communication protocol called TUIO [18], it encodes and transmits the attributes, such as presence, position, and rotation, of tangible objects on the table surface to client applications such as C++, java and Processing. Messages are then decoded and graphical/musical results are presented onto the table glass. Besides fiducial symbols, latest version of reacTIVision also contains finger tracking component. More detailed descriptions of reacTIVision framework can be found in Kaltenbruner's research [19]. In our recipe system, to achieve quick and simple effects in visual and aural presentation, we employed Processing as the application program.

2.3. Recipe interface

The main page of the system's interface as described in design concept had My Favorite, Recipe and Web Video (Figure 3). The system was embedded in the kitchen island and Figure 3 shows the actual placement of the prototype. Internet connection to web data had not been established but the idea of social bonding with virtual community will be developed in the next version of the system. Thus, except Web Video, My Favorite and Recipe are fully

functioned. The objectives of the design are to have people communicate in the food preparation stage and further increase their understanding of each other's preferences. So the island acts as a medium that people can stay around and discuss.

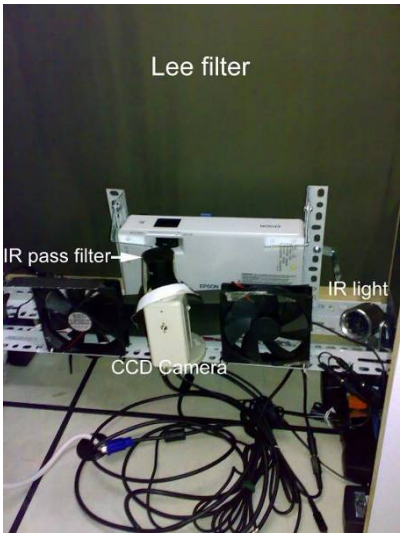

Figure 1. Construction inside the island

Figure 2. Prototype of the system embedded in island

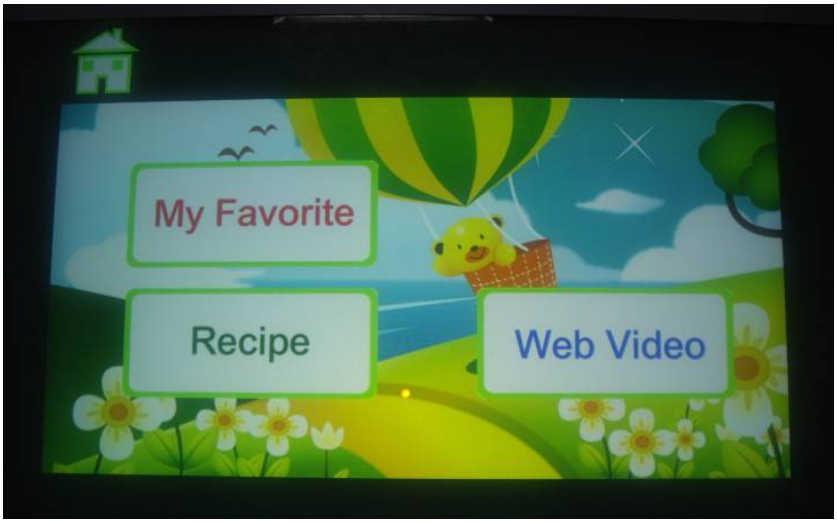

Figure 3. Interface of the interactive recipe system

When users enter the recipe option, they can manipulate the disks with fiducial symbol attached, which represent ingredients to see possible combinations and dishes. Ten ingredient disks with over 70 dishes are provided by the system. Eight dishes had cooking video and users could play/stop video by placing/removing the disk. Nutrition facts of each ingredient are shown around the disk with interactive rotation response. Currently the recipe data is retrieved from local server and will get from remote archive in the next version. Figure 4

shows the interactive recipe interface that had pork and egg as ingredients. Besides creative recipe that could facilitate communication, a record of people's love food can be added into the system as well. When in creative recipe menu, users can easily add their favorite foods by just touching the food picture and selecting a character (finger tracking) that represents himself/herself (Figure 5). Hence, this could be a reminder or a recommendation for the one who has to prepare meal for the family or friends. Figure 6 shows the record of a participant's favorite dishes.

Figure 4. Interactive recipe with dish suggestions

Figure 5. Add favorite food to a person

Figure 6. My favorite dishes

3. Design Evaluation

3.1. Experimental design

Since the goal of the interactive recipe system is to encourage communication among people and create a pleasant atmosphere in the discussion process, here we adopted qualitative method to understand more of people's experiences and thinking.

To see whether the system is effective in influencing people, two groups of participants were invited to join the research. The island system is designed for people with certain relationships that could gather together at home, such as family members and friends. In this

experiment, we chose friends as research start to eliminate potential generation gap within family. Future research shall examine whether the system is effective for family members. Hence, here each group contained 3 people of friends who had known each other for a while and had at least one person know how to cook. Test group would use the system to solve the problem while control group would simply brainstorm for solution. The scenario given for them was: *"You're planning to cook and eat at home tonight. What's for dinner?"*. This is a very common situation for groups of people to gather around and spend time together. Both groups were provided with an ingredient list as shown in Figure 7 to prepare for the meal. The average age of participants was 25 years old.

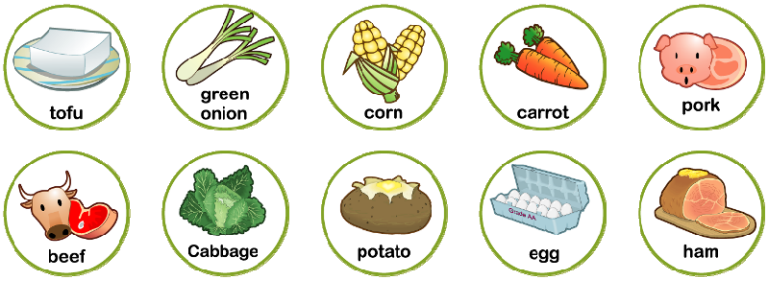

Figure 7. Ingredients for food preparation

3.2. Procedure

With the given scenario, participants in test group would use the system to assist their preparation. Their interaction process was observed and videotaped for later analysis. After they finished and decided dishes for dinner, an in-depth interview was conducted to further understand their experiences and emotional responses. Same procedure was executed for control group except that they simply solved the problem with discussion.

4. Results

4.1. Observation of people's interaction process

The total length of time for test group to decide the meal is 20 minutes and they came up with six dishes selected from the system. On the other hand, control group spent 30 minutes in deciding and had 5 dishes in conclusion. In surface condition speaking, there seems to be rarely differences between the two groups. In a simple *t-test* examination, the result also showed no significant difference between the two groups ($p= 0.783>0.05$). Since there were not enough participants, the quantitative result is simply suggestive. Although the outcomes are insignificant in quantification, the experiment circumstances were quite different for two groups.

Overall of test group's interaction was positive and pleasurable; while control group was often in a difficult situation. During their discussion, with the system's interactive visual support, participants in test group enjoyed the process of creating and deciding what to eat. When they made some combination of ingredients, suggested dishes shown on the right raised their talking topics and past memories. They tended to share how they felt about some food, why they loved it and certain people and occasions that they thought of. By playing around

the ingredient disks for different possible dishes, these feedbacks not only stimulated participants' reactions, but also made the decision process joyful and short. This could explain the reasons for the shorter duration of experiment. One thing to notice is that even though they chose dishes from the system suggestions, they made some modifications to them by varying flavors to their preferred taste. Agreement on the flavors and dishes was smoothly made in test group.

On the other hand, control group spent more time and had less agreement in deciding dishes. In the beginning, when they brainstormed based on the ingredients, participants tended to generate dish combinations that they thought of at first glance. Thus one may say a dish made of pork and green onion, while the other mentioned another one with beef and carrot. There was not a flow of conversation that all of them could follow for meal solution. This could explain why it took control group longer time to settle down a satisfying menu. Another situation that they had difficulties in was that different opinions often occurred in deciding certain dishes for dinner. When one participant suggested a dish, another one may disagree and consider it too time consuming or not fulfilling everyone's taste. Hence, a common assent among people could not be easily achieved. During their discussion, things that they talked about were more dish focused. That is, they mainly commented on the dish itself, such as its calories, ingredients, preparation process and flavor. Related personal experiences with the food or memories of certain people were rarely mentioned in their interaction.

4.2. Interview of people's experiences and attitudes

In the interview with test group, participants indicated that a record of people's favorite foods was beneficial for understanding others' liking. They enjoyed the intuitive way of touching and adding pictures of food as their favorite, even though this was not a required task for them. As the participants mentioned:

"I like adding dishes to the system because it's like collecting your love things into a treasure box. You can relish the foods in your imagination or make it come true."

"The record is a good reminder for me to prepare a meal. I can simply come here and know what I should cook that will satisfy most of the eaters."

Thus, people's preferences of food can be regarded as a self-satisfaction collection or a treasure map that someone could follow. Another common response from them was the image based presentation of creative recipe. They enjoyed watching those delicious pictures and cooking videos. They thought image was more attractive and would be willing to spend time trying out the dishes. Here is the transcript from interview.

"The food pictures look so tasty. They make me drool and hungry. When we are talking which one to choose, I can't stop thinking of why not try more dishes."

As we can notice, image of food is a visual stimulus for people to engage in certain atmosphere. Images could serve not only as a representation for recipe suggestion, but also a stimulus which makes people emerge in a joyful mood and pleasant interaction with each other. Drawback of the system as participants mentioned in interview, is the limitation of their own creativity. Since dishes were suggested according to the combination of ingredient disks, they need not to think about other dishes that were not included in the database. This could be a convenient and fast solution but on the other hand, it restricted human's imagination. As one participant mentioned:

"I like the quick and various suggestions from the system. It can save you time when preparing a meal. But the robust solution also lets me think much less for other possible dishes. This could be good for restaurant menu though, since we only have those fixed choices."

Regarding interview with control group, as we had observed, there was not a fluent communication among the participants. Discussion from scratch based on an ingredient list was not an easy task for them. Different opinions may occur and thus a compromise on dishes that all of them accepted was difficult. They explained this situation in the interview.

"It's not that we don't understand each other and be picky about the dishes. It's because we want to have more choices before we settle down. "

"The disagreement we had in the discussion can't go so far as to hurt our friendship. We are quite open to different opinions. However, we would be happier if a good interaction goes among us in deciding dishes."

"This task is like choosing which restaurant to go to. Very often it takes us some time to settle down on a restaurant that we all want to go."

Therefore, we may say that people in a pure face to face communication may need more time and have some disagreement in their interaction. This may not be harmful to social relationship, but a smooth and cheerful experience is desired. Another phenomenon that control group had is their higher creativity in making new dishes. Since no recommendations were provided, they could design their own meal with more freedom. They could come up with many new dishes. As the participant mentioned in the interview:

"I feel like being a chief. Looking at the ingredients I kept thinking what I can make for people to enjoy. "

"I named several new dishes in the discussion. It's a pity that they didn't select my creation at the end. I think people want to be safe when it comes to eating. "

"I'm not sure whether it's feasible to make new dish when none of us had ever had them before. But it's fun to have this experience in designing dishes together."

The creation of new dishes is more like an art for people. Although they had problem in deciding what to be cooked, they enjoyed the opportunity of designing and showing their creativity and affection in culinary art. Nevertheless, participants were conservative in choosing their final dishes. Familiar foods surpassed new ones in people's resolution.

5. Conclusions

In this research we designed an interactive recipe system in the island and expected to bring human-food interaction into the realm of improving human's experiences, interaction, and communication. The system design contained features with social factors [20] that aimed to facilitate interactions among people. Two groups of friends participated in the experiment in which was task with/without the interactive system.

The results indicated that people in test group had pleasant atmosphere in their interactions with each other and they tended to share their past experiences regarding certain foods or people. This result also matched with Locher's [12] finding, which pointed out that in food preparation people shared experiences with each other. For the favorite foods option in the system, it played as a reminder for participants to understand others' liking and they liked the

intuitive way of touching and adding pictures of food into their favorite. For an interactive interface embedded in kitchen island, the space offered a natural environment for people to immerse in and interact with each other. They agreed that visual presentation of dishes increase their interests and would like to spend time on trying out to cook. Similar findings also showed in prior study. Novak et al. [21] in their research indicated that interactive large display with natural touch and multimedia resources could improve collaboration and emotional user experiences. In general speaking, participants enjoyed the time creating food together but one drawback was the robust solution from the system, which was automatically derived from database. They appreciated the quick responses that could save some time in preparation, but on the other hand, this also reduced their creativity and imagination of new dishes. As we can see that they mainly adopted suggested dishes in final decision. Previous research on interactivity in human-computer interaction [22] also suggested that HCI was more influential in decision making than face to face interaction, which was good for interpersonal relationships. Nevertheless, participants in test group made some modifications of flavor in their dishes to meet their desire.

The results of control group, compared with test group, had less agreement in their discussion. This does not mean that they were in unpleasant atmosphere, but the communication did not go positively among them. They raised different opinions about food creation and it took them longer time to settle down on the final decision. Thus disagreement appeared more in pure face to face communication without computer-mediated technology involved [23]. Regardless of the disagreement, participants actually enjoyed the experience of creating dishes from ingredients. They regarded this as a way to show not only creativity [24], but also expectation to a joyful meal for each other. This is corresponding with Lupton's [25] study which stated that preparation of meals is a means of symbolic gift giving whereby individuals express their love and sense of caring. Nevertheless, it is noticeable that in their final decision, new dishes were not selected; instead, normal food that they had eaten before surpassed creative ones. Participants were conservative in choosing foods. Probable explanations for this phenomenon could be: first, since participants created dishes from ingredient list, there were no visuals for them to communicate and understand well. Second, it was a meal that everyone would share together, so it was safe and better to have food that they were familiar with.

From this preliminary study on an interactive recipe system in kitchen space, the results presented here could provide some implications for future development and related design for social interaction. As we can see, phenomenon of test group's positive attitudes and control group's opposite opinions in their discussions, visual elements of interactive design is the main factor. With pure text or verbal communication, an understanding gap may happen and this could result in different opinions and restrained decisions. People's co-experiences [26][13] could be reinforced by visual assistance and tangible interaction with the system. Same circumstance also applied to visual records of people's favorite foods. Communication flow and understanding of each other could be smoothly achieved with visual representation. However, nutrition facts of ingredients were not mentioned or paid attention to by the participants. This does not mean that texts around disks are unnecessary since they are not meant to be memorized but to augment people's cognition of food nutrition [27]. What we should think is whether there is a more appealing way to reinforce people's experiences and pleasure. With the design goal of social interaction, or, as what Norman [28] proposed the concept of *sociable design*, the island system would continue to reform its design to be more communicative, understandable and pleasurable.

Concerning people's attitudes towards the creativity of dish, it is comprehensible that on the one hand, they thought system's automatic matching constrained their further thinking; on the other hand, they appreciated the easy and fast recommendations from the system. If we compare the final decisions of both groups, although control group was more creative in designing new dishes, both groups settled down on an ordinary meal decision. From communication point of view, the process of their interaction was more pleasant and smooth in test group. Agreements on dishes with minor modifications of flavor were smoothly made. Hence, it is practicable to apply this design function to the system. With regard to enhance people's creativity in human-computer interaction, further feasible development shall include social affordance [29][17] from outer space, such as web 2.0. Thus, with the convenient support from virtual community, the system could not only provide quick solutions to food preparation, but also could inspire people [16] to create and share their secret home recipes. Therefore, a sociable kitchen with technology support would enhance both human's inner fulfillment and interpersonal relationships within and beyond domestic space.

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