
fridgeTop: Bringing Home-like Experience Back to Kitchen Space

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Abstract

Owing to cultural and time zone differences, international students studying far away from their homes struggle to re-create home-like experiences. Living in a shared accommodation with new people further adds to this struggle, since common spaces become non-conducive to home-like activities. We study kitchen space in this context, and offer a solution called fridgeTop, which seeks to reduce the threshold of a kitchen's perceived public space in a shared accommodation by fostering familiar family interactions on a smart fridge surface.

Author Keywords

Home-like experience; shared kitchen space; interactive touch-based fridge surface

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g. HCI): Miscellaneous

Introduction

Home-making has always been a collective experience. Moving away from home and loved ones can be hard, particularly for individuals who are leaving home for the first time, and subsequently trying to re-create home-like experiences while living with strangers. We focus on a subset of this population - international students who recently moved to the US. We relate to this



Figure 1: Building Affinity Wall from interview notes

"The things my mom bought for me before I went abroad are very precious to me. Even if I didn't use it, by placing them in the corner will make me feel like home."
- Interviewee, U02

"Eating is a big thing, because it goes back to nourishing yourself. And the experience of cooking, using your own utensils and the food you bought. That's an intimate experience to get in touch with your food."
- Interviewee, U10

"I'll call, chat, or leave offline messages when the times don't match. Or write e-mails."
- Interviewee, U15

dilemma as international students, which further motivated us to explore this problem space.

Between 2010-2011, over 700,000 international students came to the US [1]. For these students, rebuilding home-like experience primarily involved maintaining connections with their families. We learned from our interviews that the existing methods of digital communication and interaction are perceived as deliberate and premeditated, also an established CSCW finding [2]. We also discovered that preparing food and performing related rituals in kitchen space are some subtle methods used by students to re-create home-like experiences.

HCI studies have explored the kitchen as a central place for home-activity and family exchanges [3], with the refrigerator as the most versatile surface, lending itself to a variety of interactions [4]. In our project, we worked to determine and address the needs of a specific population in a different context - international students living in shared space with strangers - which is currently unexplored in the HCI kitchen studies. We offer fridgeTop -an interactive smart fridge surface, to help re-create home-like collaborative and communicative aspects of a kitchen in a shared space.

Research: Related Work

Prior work done on remote office collaboration, including "MessyBoard" [5] and "Notification Collage" [6], are closely related to our goals of supporting asynchronous communication. The "Family connectedness" [7] project uses shared pictures and calendars to encourage distant familial interactions. Our solution fridgeTop aims to foster a similar remote collaborative environment in kitchen space.

Kitchen space has received much attention in the field of HCI. According to Swan and Taylor [4], the fridge is a unique space due to its physical properties and location. The fridge surface can be used in a variety of ways, including hosting notes, lists, schedules, and other memorable objects. Non-verbal communications like these support emotional expression between closely bonded people, as in a tightly-knit family [8].

Research: Interviews

We interviewed sixteen international students from India, China, Japan, Taiwan, Thailand and South Korea. All of the interviewees had lived in the US for less than two years after leaving their country for the first time. We focused on the challenges they faced while settling into a new environment, and on comparing and contrasting the different coping strategies they employed in their home re-creation process.

Design Process

We analyzed the interview data by creating an affinity wall (Fig. 1). The most prominent categories in regards to how students approached remembering their homes were: food-related rituals, communication with family, and memorable objects (see side quotes). To further elicit insights about our users' perceptions of home re-creation, we designed a home-making model (Fig. 2).

Home-making Model

This model shows the three main phases involved in building home-like experiences. The first phase highlights the different factors that shape perceptions of home. The second phase illustrates the different ways in which users try to re-create home-like experiences when they first move out of the home. The



Figure 3: The 10 dummy items used in the Kitchen Study

third phase shows the redefinition phase where people extend their definition of home.

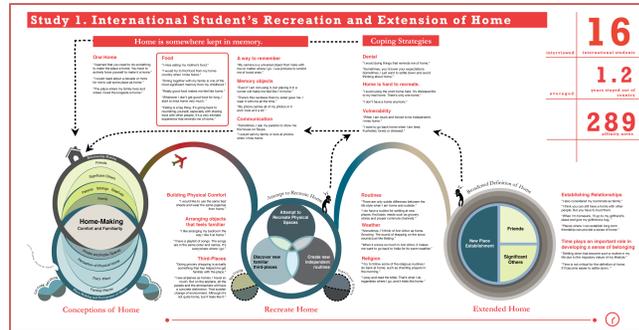


Figure 2. The Three Phase Home-making model

We discovered that the process of home re-creation is challenging and sometimes fails. When faced with stress, people try to increase communication with their family. Despite using modern communication methods that rely heavily on direct communication, our user group still felt vulnerable and disconnected. This prompted our interest to focus on less deliberate methods of connecting family members which could be established in passing. We also learned that people keep special objects around their environment to create familiar spaces (see side quotes). Since food was mentioned multiple times during our interviews, we asked our users more specific questions to understand how they viewed food in relation to their home. We discovered that serving rituals, dining styles, and home-like cooking were examples of interactions around kitchen space that people regularly used to re-create home-like experiences. This led us to the Kitchen Study to explore whether or not the kitchen

"First thing I do when I move, I will take out all the objects, even if it is an empty room, I place those objects just to make it feel like home."

- Interviewee, U04

"I will decorate the wall with my family's photos, drawings from my hometown, and the accessories from my friends in my own room."

- Interviewee, U08

could provide further opportunities to re-create home-like experiences through building familiar spaces.

Kitchen Study

In order to understand how people interact with kitchen space, we conducted a study through home-visits with 4 users. We asked participants to place 10 generic dummy items, which included: pictures of parents and siblings, letter from a close friend, birthday card from a sister, recipe sent from mom, to-do list of homework, reminder note to pick-up friend from airport, memo from apartment leasing office, Internet bill for the month, class-schedule for the semester, and a small toy cat gifted by a close friend (Fig. 3).

In the first part of the study, we asked participants to place these items anywhere within their home space. Personal items like photos, letters, and cards were tucked safely away from sight. These objects seemed to have sentimental value, resulting in people being reluctant to place them in public spaces. Other more general items were either placed randomly or not placed. Users mentioned that these items could be managed more efficiently using digital tools rather than paper copies. In the second part of this study, we asked participants to place the same items within kitchen space, but maintained the option to not place an item. Users now placed a few general items on the fridge surface, but left out personal items.

We discovered three main insights from this study which informed our design decisions: (1) Bills, post-it notes, memo, and class-schedules are better managed through online digital tools; (2) The fridge serves as the most inviting interactive surface in the kitchen, even in shared spaces; (3) Personal items like photos



"Being an international student, I like the life in the states but I miss being with my family. What I missed the most is the home-cooked food and dining together with my family."

Figure 4: Primary Persona



Figure 5: Image showing the placement of fridgeTop on the fridge

and notes cannot always be permanently displayed in a shared space comfortably. This suggested that there is a shift in the perception of kitchen space between actual home and shared home.

Personas

We created personas to help us better understand typical user behavior and their needs and goals (Fig.4).

Yu-Ming Chen is an international graduate student, who finds it strenuous to adjust to home life here in the US. She misses the care of her family and the good food. They, as a family, would put up pictures and notes on the fridge for one another. Every time she is in the kitchen here, she wishes she had some company or some way of connecting with her family.

Our Solution

We propose a touch-based fridge surface application, fridgeTop, which aims to create a home-like experience within kitchen space in shared accommodations (Fig. 5). This solution allows family members living in separate locations to engage in the familiar home-activity of placing items on a fridge surface. The proposed system consists of three separate platforms: fridge, desktop, and smartphone. Fridge is the core interactive and collaborative surface, while the other two components primarily help with content uploading.

fridgeTop Family Circle (FFC): Users can create an FFC with their own family members. All members of an FFC will see the same fridgeTop main screen (Fig. 6). Users of a single fridgeTop system can create either shared (e.g. same surface shared between mom and dad) or separate FFCs (e.g. different surfaces for all roommates). With an embedded camera and facial

recognition software, the system can detect which users are in the vicinity of the fridge, and display content on the surface accordingly.



Figure 6. Prototype of the fridgeTop main screen

Photos and Notes: Each user can upload photos through smartphone or desktop components and access those in the 'fridgeTop Photos' folder (Fig. 6). From here, users can select the photos they wish to share with their FFC. Users can write and place notes on the fridge surface using a stylus or keyboard. The user closest to the fridge surface will be detected and tagged automatically as the author of that note. Once a photo or note is placed, users can move, resize, or rotate them on the interactive fridge surface to form different arrangements. All photos and notes adopt a metaphor of physically posted items. They will develop worn edges if no one interacts with them over time, and will eventually "fall" off into a shared archive named as Memory Box. This acts as an auto-cleaning mechanism for the surface, whilst encouraging engagement. The



Figure 7: Paper prototype (Top) and Portion of our Storyboard (bottom)

"We also post photos and notes on the fridge at home! This makes sense."

- User 2

"This is super convenient. I can just check the fridge to see the notes and photos while I am in the kitchen."

- User 2

application also offers a "taping" feature that prevents items from developing worn edges and falling off.

Avatars and Presence indicator: Users can create a cartooned avatar in the system using their own pictures. Members in the same FFC can modify each other's avatars, which fosters playful family interactions. On the top band (Fig.6), a glowing avatar on the left side indicates the user who is currently controlling the application, while a glowing avatar on the right indicates FFC members who are currently within their fridgeTop space. The presence indicator serves as an additional prompt for instigating spontaneous communication among family members.

Privacy and Sharing Concerns: By default, the placed photos and notes are only shared among FFC members, but users have the option to make notes and photos public. In the latter case, if a non-FFC user is detected, the system switches to public mode. This feature caters to the privacy concerns of our users, and at the same time facilitates social interactions between roommates.

The strength of our concept is how directly it recollects already established family interactions. The conventional interactions observed on a traditional fridge can be mimicked through the notes and photo features. The asynchronous and casual nature of the interactions reduces the stress of communication that accompanies living in different time zones and having to rely solely on deliberate forms of communication.

Implementation: We researched different technologies to understand implementation feasibility, including user detection and identification, and cross-platform collaboration between heterogeneous devices (fridge,

desktop, mobile). OpenCV 2.0 [9], a free image-processing library equipped with facial detection algorithms, could support user detection in our system by outlining the contours of their figures and faces. OpenCV's face detector algorithm could be joined with the eigenface algorithm for calculating distance between facial images [10], to support user disambiguation. Cross-platform collaboration can be handled through cloud technologies similar to iCloud [11].

User Testing

We gained valuable feedback by conducting four user-testing sessions with international students (two Chinese, one Taiwanese, and one Indian). The testing was done on a mid-fi prototype of the fridgeTop application developed from paper prototypes and storyboards (Fig. 7). These prototypes were refined using Adobe Photoshop and Illustrator to generate an interactive PDF. Since we are proposing a new concept of using fridges as a non-deliberate communication device, the main focus of our user testing was to verify user acceptance of the design concept. We also performed task analysis using three tasks to identify high-level usability issues with our designs.

The main concept of remotely sharing notes and photos on the fridge surface with distant family members whilst addressing the shared space constraints was universally applauded. Users reacted to the fridgeTop application with excitement and expressed that they would like to use it in their temporary kitchen space. Another highly appreciated part of fridgeTop was its non-deliberate nature of use. Users mentioned that compared to traditional sharing technologies, fridgeTop would make it significantly easier to connect with family

"This is fantastic! I can use it to post my mom's recipe, and upload photos of the food I make."

- User 3

"If photos and notes are shared on the web, I probably won't check it everyday."

- User 4

when they had spare time in the kitchen. High-level feedback was also provided for improving the usability of our interfaces that were included in design iterations.

Discussion

A potential limitation related to fridgeTop implementation lies within the accuracy of eigenface [10], which is shown to work well only in constrained environments. We envision future technologies to reduce this limitation through optimized algorithms. The initial versions of fridgeTop could use alternative technologies, like RFID [12], embedded in smartphones to detect and identify users.

Since we recruited participants via our social networks, the collected data and research is inclined towards Asian international students. With further research, the applicability of our findings could ideally be extended to other populations. Also, due to the limited scope of our user testing, the interactions in the application would need to be refined through further usability testing.

Conclusion

By conducting interviews and home-visits, we identified a specific need of international students to foster home-like experiences through non-deliberate methods. We hope that fridgeTop will be able to ameliorate the struggle of the home re-creation by nurturing familiar home-like activities, and by allowing non-deliberate and casual conversations between remote family members.

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