A TIME HOME PUB

An alternative communication of human-computer interface approach to smart space

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Abstract. This paper describes how humans can communicate naturally with spaces in our daily lives by using instruments of daily life, such as whiskey glasses, cups, and MP3 players. We provided a smart space, which can not only adjust the environmental atmosphere by human activities, but also solidify connections between human feelings/memories, and record what happens inside it. The challenge of this work lies in how to create an alternative communication channel which can solidify family ties by using a natural and unobtrusive interface. The space is also able to automatically adapt to human feelings by changing the atmosphere, such as by changing the background lighting, music, and appropriate feedback.

Keywords. Smart space: human-computer interface.

1. Introduction

The invention of CAD/CAM technology has had a profound influence on architectural design. With the appearance of new technology, some people have applied new media to space design to create a new lifestyle for human beings. Therefore, the new term of “smart space” has emerged in space design. The
new technology will manifest itself in the product of architectural design—the building—through enhanced “intelligence” of the materials from which buildings are made, and by facilitating their responsiveness and adaptability to changing needs (Kalay, 2006).

Researchers have begun investigating how to improve the interface between humans and space. To enable people to interact with the space they live in by detecting their daily activities, such as drinking a cup of coffee, watching TV, eating at the dining table, drawing, or writing on the desk, the designer tries to integrate HCI technologies into objects which are related to their daily lives. Some researchers have found that almost every event happens on tables, and that we perhaps could not live in a space without tables. iBar (2006) created a specific bar-counter that detects all objects touching the surface by using an intelligent tracking system. It could also display a social network of human relationships.

Additionally, Jorda et al. (2005) designed an electro-acoustic instrument called reacTable*, which supports a flexible number of users and allows simultaneously additive (users working on independent audio threads) and multiplicative (users sharing control of audio threads) behaviors. Furthermore, Patten et al. (2006) created an audio electronic controller on a tabletop tangible interface. This system is able to track the positions of objects on a tabletop surface and translate their motions into commands for a musical synthesizer. Although several products provide alternative interactions between human and machine, we found the devices were not easy to control and few studies were conducted about links between human needs and the spatial functions. Our primary concern is creating a space that is not only convenient and comfortable, but also interesting and touching.

2. Problem and objective

In order to interact with the living environment naturally, the developments of sensor devices were created, from switch, remote control, and infrared sensors to motion sensors, motion capture, and eye-tracking. Sometimes designers have overused HCI devices while forgetting the essence of smart space—creating a safe, comfortable, and economical space for humans (Gross, 1998). Therefore, the problem of this research is how to appropriately combine the HCI device into real space to enhance the emotional interaction. How can we solidify the links between people and between spaces by using HCI technologies?

To create a smart space which can provide adequate feedback and strengthen the relationship between human beings, we designed a future-like space called the “time home pub”, which embeds different interactive devices, transforming between three modes (normal mode, bar mode, and music mode) to satisfy the
user’s emotional demands. An interactive table was used as the main component of the smart space since people can hardly live without it. Users can interact with the space using the daily instruments as well as to get close to the user’s emotions linked with their memories.

3. Methodology and steps

The largest difference between this work and previous research is that the system has specific emotional interactions in order to melt the distance between people and space. The significance of the system is that it can not only record the events but also recall user’s memories in different times and places. The methodology of this research is divided into four steps:

Firstly, the analysis of HCI in smart space: we tried to find out which HCI devices are the most important elements and which can alter the traditional architecture into the new style architecture. Therefore, our challenge lies in which furniture to use in our daily lives and how to organize a smart space around such HCI furniture. Secondly, scenario demonstration (Figure 1): in order to apply the Time Home Pub system into a real space, we create a scenario to demonstrate the system process. Third step: system concept: to illustrate how the system works, we separate the system concept into three modes: normal mode, bar mode, and music mode. The transaction among different modes are discussed and integrated together as a cycle. Fourth, the system framework is composed of three main components: (1) the interactive table and whiskey glass; (2) the time-mark and Liveframe; (3) the environmental atmosphere control and music hotspot.
4. Results

4.1. THE ANALYSIS OF HCI IN SMART SPACE

First, this work explores a new vision of smart space which can not only provide a comfortable and convenient life but also solidify the relationship between family and friends by using HCI technologies. Thus, we consider HCI to be an important media which refines a traditional architecture into a new lifestyle space. With the implementation of an HCI system into the space, traditional architectures can evolve into future style ones. Abstractly, we can say that HCI consists of certain design elements that decorate the space and transform a simple and pure space into one that accommodates a lifestyle. Therefore, the systems were separated into three parts: Physical space enhancement (sofa, table): The design of HCI elements is combined into physical elements, such as sofas, tables, or lighting, that are close to our lives, and feedback is given according to human emotions. Records of human activities and events (moving the whiskey glass): The interactive table records which friends have previously been to the space and presents time-marks with individualized styles. This means the space can memorize events which have occurred in the room. This adds some measure of artificial intelligence to the space, making it seem more human.

![Diagram](image)

Figure 2. Pictures and events trigger memories.

The connection between vision, feeling, and memories (Liveframe): As indicated above, the interactive table can record which people have come to the space before. Liveframe is also connected to the interactive table. Through this system, people are triggered into memories attached to the time-marks or photos (Figure 2). This process is able to solidify the connection between vision, feeling, and memories.

4.2. SYSTEM CONCEPT

In order to make people interact with a space more naturally, the space senses the changing events and activities by adjusting the background lighting pattern
to provide a suitable ambience. The “time home pub” we create is able to adjust the environmental atmosphere naturally according to human activities. We use the whiskey glass as an atmospheric control switch and install the control into a real living room. This system consists of three main devices: interactive table, whiskey glass, and Liveframe (Figure 3).

In order to create a space that can adequately provide dwellers with feedback and satisfy their daily needs, we provide three modes in the system: normal mode, bar mode, and music mode (Figure 4). The modes are able to interchange according to human behaviors.

**Normal mode:** It presents a traditional and general living room with an ordinary space look. The photo frame serves as the traditional frame, which displays a static family photo (Figure 4-normal mode).

**Bar mode:** The environment changes to bar mode when the user puts the whiskey glass on the interactive table. The environmental wallpaper also changes to animated patterns at the same time, with the time-marks gradually emerging from the table. When the user moves the whiskey glass onto someone’s time-mark, Liveframe is triggered and related photos are shown (Figure 4-bar mode).

**Music mode:** When
4.3. SCENARIO

Sean has just finished work and returns home at midnight. To take a break, he lies down on the sofa, takes out a bottle of Islay Island Whiskey, and puts a whiskey glass on the table. The space senses Sean’s glass on the table and changes to bar mode. The environmental lighting slowly becomes darker, and the wallpaper switches to an animated pattern. A tracking mark is illuminated around the whiskey glass (Figure 5-B). Simultaneously, time-marks emerge on the table to stand for Sean’s friends and family who visited the space in the past few years (Figure 5-C). Different patterns and opacities on the time-marks represent the time flow. The more time has passed since one of Sean’s friends has been to the place, the darker the time-mark appears. While enjoying his single malt whiskey, Sean unexpectedly catches sight of Sasada’s time-mark pulsing on the table (Figure 5-D). Sasada is one of his best Japanese friends, and he realizes that they have been apart for a long time. Therefore, Sean moves the glass onto Sasada’s time-mark, and the Liveframe presents the photos in slides (Figure 5-E). Thus, the photos trigger recall of memories which are deep in Sean’s mind. Sean then wants to listen to music, so he moves the whiskey glass onto the music hotspot. The place gradually becomes filled with Sean’s favorite music.

4.4. SYSTEM FRAMEWORK

The time home pub consists of four components (Figure 6): interactive table, whiskey glass, and Liveframe and environmental atmosphere control. The interactive table is composed of an array of LED chips and a magnet switch array. The table is covered with white acrylic and is connected to the main server computer (PC 1). Once the interactive table detects a whiskey glass on the
interactive table, PC 1 connected to projector 01 display the time-marks on the
surface of the interactive table. At the same time, through the networking system,
the server sends a signal to PC 3, another computer which is connected to
projector 02, and displays different wallpaper on the wall. In addition, PC 1 also
sends a signal to PC 2 to control the Liveframe. Basically, the interactive table
is controlled by PC 1 and is the main control server of the time home pub system.

4.4.1. Interactive table and whiskey glass

The interactive table is the main controller and is connected to PC 1. The
interactive table has two layers (Figure 8). The first layer is composed of an
LED chip array and can show the glass tracking mark; the second layer is
designed to recognize the position of the whiskey glass.

The first layer: LED chip array: In order to show the tracking mark for the
whiskey glass, we put the LED chip array (Figure 7-C) on the first layer. To be
more colorful, this interactive table is composed of three different colors of
LED chips: pink, blue, and white. A total of 8192 LED chips (64 x 128) were
planted on the second layer and divided into 32 units. Each unit consists of 16
x 16 LED chips. Each row has 8 units and is manipulated by a controller board
(Figure 7-A) to which PC 1 can send signals. To enable the interactive table to
render a tracking mark from the back of the surface, we put a sheet of white,
three-millimeter-thick rectangular acrylic above the LED chip array. This kind of acrylic is translucent and shows a diffuse glow on the surface of the interactive table (Figure 7-D) only when LED chips are very close to it (middle of Figure 8).

The second layer: magnet switch array: The magnet switch array is put in the second layer, under the LED chip array, to detect whether the whiskey glass is on the interactive table and assess its position. This magnet switch array (Figure 7-B) can recognize the position of the whiskey glass by sensing the strong magnet at the bottom of the glass. When the whiskey glass is moved, the magnet will switch on each of the magnet switch arrays, sending a signal to PC 1 through the RS232 serial port to give the position of the whiskey glass. Eventually, PC 1 sends a signal to the controller board (Figure 7-A), which will switch on the LED for the glass tracking mark (Figure 8 right). The glass tracking mark thus follows the whiskey glass.

![Figure 8. Section of interactive table.](image)

4.4.2. Time-mark and Liveframe

Time-marks (Figure 3 and 6) stand for people and are recorded when they come to the place. For example, when your friends come, the interactive table records the event by stamping a time-mark on the table with an individual pattern. These time-mark patterns are projected through projector 01 controlled by the server. As time passes, the person’s time-mark becomes fainter if he does not return, which means that the user and the guest may be out of touch for a long time. Therefore, through the changes in the time-mark, one may be reminded to keep in touch with his friends and family.

Liveframe is a digital frame, connected to PC 2 that can display photo slideshows or present static photos (Figure 6). The functions of the Liveframe include photo browser (Figure 9 Left-B), drawing sketch (Figure 9 right), and webcam. In the normal mode, users can browse photos by touching the screen directly. Also, you can draw or sketch on the Liveframe with your finger (Figure 9 right). However, when the environment is changed to the bar mode, the Liveframe is controlled by the user’s behavior. For instance, if the user moves the whiskey glass to each of the time-marks, he may be thinking of someone, so
the person’s photos are displayed in the Liveframe. PC 1 senses the position of the whiskey glass and sends a signal to control PC 2 and trigger the Liveframe to display relevant photos. Although the user cannot meet his friend or family member immediately, he can reminisce about him through the photos on the Liveframe.

Figure 9. Liveframe (left: Liveframe diagram; right: drawing demonstration).

4.4.3. Environmental atmosphere control and music hotspot

PC 3 cooperates with the environmental control, which includes lighting adjustment, wallpaper, and ambient music. In the normal mode, the environment is in its general state. When the user puts the whiskey glass on the table, the environmental atmosphere will change into the bar mode. When the interactive table receives the commands, it sends a signal to PC 1, which then notifies PC 3 (through network) to change the environmental atmosphere. Simultaneously, the animated wallpaper (Figure 4) will be projected onto the wall by PC 3 (Figure 4-bar mode). As the user drags the whiskey glass to the music hotspot, the music mode is switched on and the space is filled with the user’s favorite music. Meanwhile, the rhythm of the music is displayed on the interactive table (Figure 4-music mode).

5. Conclusion

With the emergence of computers, the opportunity to integrate HCI software with spatial design becomes a reality. Since users wish to live a different lifestyle, the design of a smart space has recently attracted great attention. Thus, in order to enable the space to be more intelligent with a human touch, we explored a new vision of smart space design that includes not just one device or a specific controller sensor, but also communicates with the environment, other devices, and user memories.

We created a system composed of three HCI devices—interactive table, Liveframe, and environmental atmosphere—to solidify the relationships between families and friends. The greatest difference between traditional and intelligent architecture is that the HCI system can enhance the function of
space in which people can not only interact with the space naturally, but can also communicate with their memories and emotions. Moreover, the emotionless and unfriendly technology we use today can be improved by the system. This means that the space must adjust to the user’s activities and give appropriate feedback, e.g., in background music and wallpaper. With the design of the time-marks, the user is reminded to keep in touch with his friends and family. By connecting to the Liveframe, we provide consolation to those who are not living together. Basically, the system enables the space to follow the user’s feelings by transforming the ambiance.

Although the system makes a unconventional living space, it is just a prototype and needs improvement in several ways. To make the system work, three computers, two projectors, and an interactive table are required. The installation is tough and complicated. On the other hand, to trigger the system, the user needs to use the specific whiskey glass to interact with the interactive table. However, this research makes HCI devices “more human” and breaks the unfriendly boundary between human and space. Also, this creation visualizes the feedback of sensation, which helps to reduce loneliness and reduce feelings of isolation. By adjusting more than three modes (such as game mode, dinner mode, and meeting mode) to adapt to different human activities, the system can become more variable and flexible, and the space will become friendlier and more suitable to live in.

References


