SMART SPACE FOR OFFICE DAILY LIFE: A SITUATED LIFE PATTERN APPROACH

JU-HUNG LAN
Department of Interior Design
National Taichung Institute of Technology, Taiwan
jhlan@ntit.edu.tw

Abstract. Researches in smart space design have been focused on using ubiquitous computing technologies to provide the visions of future lives in physical spaces. However, most researches have less concern for the logical usability in creating smart spaces for the occupants. The study is interested in designing a smart space which is occupant-centric and situated-life-oriented based on ubiquitous computing technologies. A spatial system prototype with smart door, smart wall, and smart table is developed from a situated life pattern approach to support typical office life events. The design problems of integrating ubiquitous computing devices with physical spatial components are explored and discussed.

Keywords. Smart space, ubiquitous computing, situated life pattern

1. Introduction

Researches in smart space design provide the visions of future lives by applying ubiquitous computing technologies (Weiser, 1991; Johanson et al., 2002, Aldrich, 2003; Chen and Jeng, 2005; Cook and Das, 2005). However, most research projects have inclined to emphasize the capabilities of computing technologies, with less concern for the logical usability in creating smart spaces for the occupants. Many smart space projects are not user-friendly to interact with since they are developed from technological point of views, rather than from user-centric point of views. The issues regarding with smart space design are complicated since they have to deal with the integrating problems of design and computing (Jeng, 2004).

2. The Goal

The study is interested in designing a smart space which is occupant-centric and situated-life-oriented. The study doesn’t intend to make our usual life complicated and unnatural by creating a smart space which is difficult to image and interact with it. However, the study does believe that spatial components, including floor, wall, ceiling, door, window, furniture, etc., are becoming communication interfaces between occupants and daily-life information for future living environment (Jeng, 2005; Chiu and Chiang, 2006). Thus, how to apply ubiquitous computing technologies to design natural interfaces for the occupants to interact with daily-life information becomes an important issue in the study field. To challenge the research issue mentioned above, the study proposes a situated life pattern approach to develop a smart space based on occupant-centric point of view to uncover the important design issues for further investigations.
3. A Situated Life Pattern Approach

To design a smart space to support daily lives, the study believes the key factor is to map occupants’ situated-life patterns to the computing infrastructure and the physical space. To illustrate the design ideas, this pilot study presents a smart space project for a typical office daily life in the paper. An office of a college teacher is re-designed as an example to illustrate how to integrate ubiquitous computing technologies with physical space to serve the needs of occupants. The regular office life patterns of Prof. Lan can be described as the following scenario:

Everyday in the morning, Prof. Lan walks into his office. When he stands in front of his office, he is identified and allowed to get into his office by the smart door at the entrance. His status of “inside office” triggers a spatial event to display the daily schedule on the smart wall. He notices his students will come to his office for group meeting later. After he works for a while in front of his computer, the computer shows a video image to inform him that his students are just in front of his office. He sends a command from his computer to the smart door and let them get into his office. During the group meeting, the students present their projects by plugging a tablet computer into the smart wall. The smart wall shows the related information regarding with specific design project. Lan uses an electronic pen to open a design drawing and add some annotations on the smart wall during the discussion. These annotations are stored and linked with the design drawing for further reference. In the afternoon, during the tea time break, one of Lan’ s colleague stops at his office. He is unscheduled but still welcome to enter Lan’ s office by the smart door. He wants to chat and discuss with Lan about a new design project he is doing and asks for some comments. Lan uses a smart table to connect to the website of the new design project in his colleague’ s computer. They use the smart table to display and discuss related design information of this project. They use electronic pens to draw sketches and add annotations on the smart table. These sketches and annotations can also be stored with the related design information of the project.

By observing the scenario, we can find there are typical office events occurring regularly. These patterns of events are underlined in the scenario and could be roughly classified as personal identification, daily schedule noticing, group meeting, project presentation, information processing, and social interaction. In order to narrow down the research scope, the paper only explores three typical office life patterns, including user identification, group meeting and social interaction. These three office life patterns are the main design objectives to serve for the occupant in developing the smart space project.

4. Project Implementation

To achieve the research intention, the study starts to develop the spatial system prototype of the renewed office design project. Three smart spatial components are developed in the project, including a smart door, a smart wall, and a smart table. In developing these smart components, a set of web cameras are used for image recognition and office-life-event detection. Besides, some ubiquitous computing devices, such as remote sensors, interactive whiteboard, touch-sensitive tabletop, and video projector are augmented with the spatial components in implementing the project. A view of the developed spatial system prototype is shown as Figure 1.
4.1. SMART DOOR

The smart door is designed as a medium between the hallway and the interior space in the project. A video projector is mounted over the ceiling to display information on the door. A web camera for image recognition is installed at the top of the door. A passerby can use his fingerer as an input device to interact with information on the smart door. The smart door provides services such as visitor identification, information displaying, and message board to support the needs of office daily life. Figure 2 shows the interface of the smart door.

4.2. SMART WALL

The project develops a smart wall to serve the need of project presentation for group meeting in the office. A smart board with remote input device is augmented with a physical wall in the project. The teacher and students can use the smart wall to display project information, add annotations, draw sketches, and save the discussed information in the server. They can directly interact with the information displayed on the smart wall with a pen-like input device. A picture of the developed smart wall for group discussion is shown in Figure 3.
4.3. SMART TABLE

The smart table is designed based on the concept of information furniture. A touch-sensitive tablet display is augmented with a physical table. The smart table provides the services for social interaction in the office. The occupant can use it during tea time break, chatting with friends, and making small group discussions. They can use the smart table to access digital information through wireless network. The users can use a pen-like input device to draw and add information on the table. The added information can be stored in the server for further reference. Figure 4 shows a picture about a small group discussion on the smart table.

5. Discussions

The design and implementation of smart door, smart wall, and smart table in the project have brought some important issues for discussion and further investigation.

5.1. PERFORMANCE EVALUATION

In this project, for instance, the smart door provides the service of visitor identification. It can identify who is visiting the office and trigger specific event. However, since the limitations of computational devices, the smart technologies can only work at a limited distance in this
project. Besides, since the video projector and web camera are mounted on the ceiling, the location has it’s constraints to display clear information and make better image recognition on a vertical surface. Therefore, in addition to aesthetics consideration, how to design and integrate computational devices with physical spatial components to support better performance has to be studied further.

5.2. NATURAL INTERFACE

One research intention in this study is to build natural spatial interfaces for the occupants to interact with daily life information. The implementations of smart door, smart wall and smart table appeared to be natural interfaces for communication in terms of their physical forms. However, the surface materials designed for display information in the project most are made by glass or acrylic material with transparency. Although the transparency style provides a high-tech image for communication, however, this kind of icy material shows less user-friendly atmosphere. In a physical space design project, the appearances of surface materials provide the key atmosphere to support the functions in the space. How to integrate various surface materials to design a more user-friendly smart environment is worth for further study.

5.3. ILL-DEFINED LIFE PATTERN

The scenario mentioned above presents a good way to analyze the typical office life patterns. The smart door, smart wall, and smart table provide reasonable services to support typical office daily life. However, the life patterns of occupants, just like design, have the ill-defined features. One “usual” office life event is there is always something un-expected happened, such as an un-scheduled meeting, a student drop by, an interrupted matter, etc., during the office daily life. The smart mechanism developed in the project has its constraints to deal with this kind of “usual” life events. Thus, for further studies, the research will conduct a rigorous evaluation to the system prototype to verify the performance of the occupant-centric and situated-life-pattern approach. The evaluation results will be used to develop a smarter mechanism to deal with the ill-defined life patterns to support “usual” office daily life.

6. Conclusion

This paper proposes a situated life pattern approach to design a smart space to support typical office daily life based on ubiquitous computing technologies. The situated life pattern approach provides a potential way to design a smart space to fit in with occupants’ needs. Based on the situated life pattern approach, the study develops a smart space project with smart door, smart wall, and small table to verify the design solutions to support office daily life. The design problems encountered and important issues regarding with system performance, natural spatial interfaces, and the ill-defined features of life patterns are discussed.

In the study, we can envision there is likely a great change in space design with the development of ubiquitous computing technologies. People will get used to interact with physical spatial components for information processing to support the needs of everyday life. The design strategies and design concepts to integrate ubiquitous computing technologies are needed to study and explore further.

Acknowledgements

The study is supported by National Science Council in Taiwan, NSC96-2221-E-025-012. The author is grateful to this support.
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