Modeling the Types of Interaction with Ambient Environment

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Abstract. This paper proposes a new modeling methodology about the interaction with the ambient environment such as tables, windows, physical objects and so on. We analyzed interaction factors in existing scenarios that involve the interaction, and then classified the result of analysis. We made modeling elements though the classification results and designed modeling method combining the elements. The modeling method can reduce the time to understand the existing interactions or the interactions that are designed by co-workers. Moreover, we believe that it can be useful when designers make a new scenario or modify the existing scenarios.

Keywords: Interaction Modeling, Pervasive Computing, Ambient Interaction, Interaction Categorization, Type of Interaction.

1 Introduction

Pervasive Computing opened the way that users get information or services from the ambient environment such as tables, windows, physical objects and so on. Therefore, many researchers have proposed a variety of scenarios based on Pervasive Computing and suggested scenarios that users interact with the ambient environment. [1-5]. Sixth Sense [1] is a typical study that makes user's ambient environment the interaction space using wearable system. Previous studies about modeling method of interaction have focused on expressing interaction flow [6-7]. The systematic approaches in modeling interaction type have been rarely studied. For the purpose of systemic ideation and analysis, we present a new modeling methodology about the interaction with the ambient environment by analyzing existing scenarios.

2 Interaction Analyze and Categorization

We analyzed the type of interfaces, the type of information, the presence of related digital devices and its relationship from the scenarios to figure out the category of the interaction with the ambient environment. As the result of the analysis, we classified the category as shown in the Fig.1. These categories are divided into two cases: the ambient environment used for 1) interfaces or 2) information. The former is categorized into two types. One is that the ambient environment always became an

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interface (we named this 'Static Ambient Interface'); another one is that the ambient environment temporarily became an interface depending on the related digital device (we named this 'Dynamic Ambient Interface'). The Dynamic Ambient Interface has five different types according to relationship between the device and the ambient environment. (1) Move: The interface of the device is moved to ambient environment. Therefore, the interface of the device becomes no longer available. (2) Expand: The interface of the device is expanded to ambient environment. (3) Divide: The interface of the device is functionally divided into ambient environment. (4) Duplicate: The interface of the device is duplicated in ambient environment. (5) Create: The interface on ambient environment is created by the digital device.

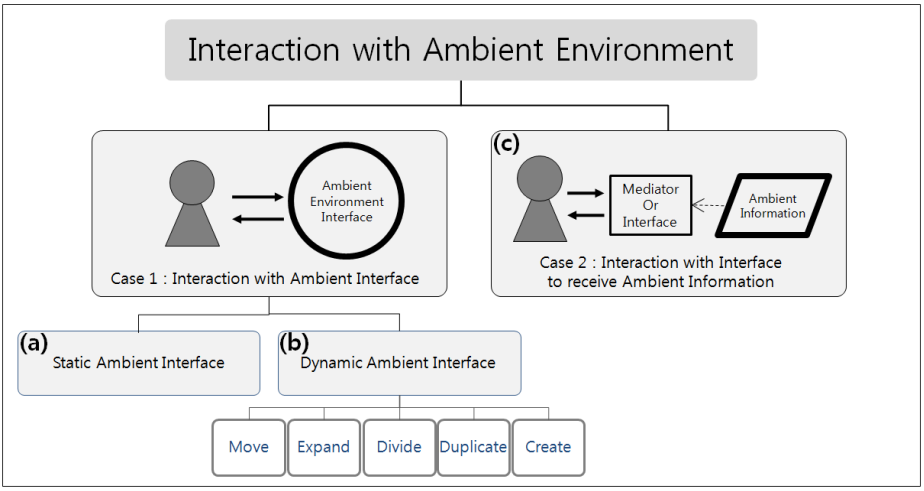

Fig. 1. Result of Classifications

(a) Environment/Real Objects always provide their own interfaces.
(b) Environment/Real Objects temporally provide their own interfaces depended on related digital devices.
(c) Information of Environment/Real Objects is inputted into interfaces.

3 Modeling Method Design

We made modeling elements (see Table.1) for designing interactions based on the result of the category in Fig.1. Then we designed a new method for modeling interactions by combining the modeling elements. The modeling elements categorized into four categories: 1) the interface/information factors, 2) the interface for user interaction, 3) the line that defines the relationship between factors, 4) the description about user actions in the relationship. 1) The *Factor* has three elements: Original Interface Device is the device that is made for the role of input/output interface (e.g., keyboard, mouse, display, and touch screen). Ambient Environment Interface is the original common thing, but become input/output interface by an embedded computer

or a support device for ambient computing (e.g., projector, camera). Ambient Information is the information element of ambient environment received by input interface. 2) The *Interface* is divided between Input Interface and Output Interface, and each can contain elements of *Factor*. 3) The *Flow* defines the relationship in case of Dynamic Ambient Interface. The five elements of *Flow* (Move, Expand, Divide, Duplicate, Create) except for Input Information define the relationship between elements of *Factor*. And the Input Information of *Flow* defines the relationship between *Factor* and *Interface*.

Table 1. The modeling elements for designing interaction with ambient environments

1) Factor	Original Interface Device	Ambient Environment Interface	Ambient Information
2) Interface	*Elements* Input Interface	*Elements* Output Interface	
3) Flow	Move	Expand	Divide
	Duplicate	Create (Additional Option)	Input Information
4) User Activity	*Description* Description on User Action for Flow Process		

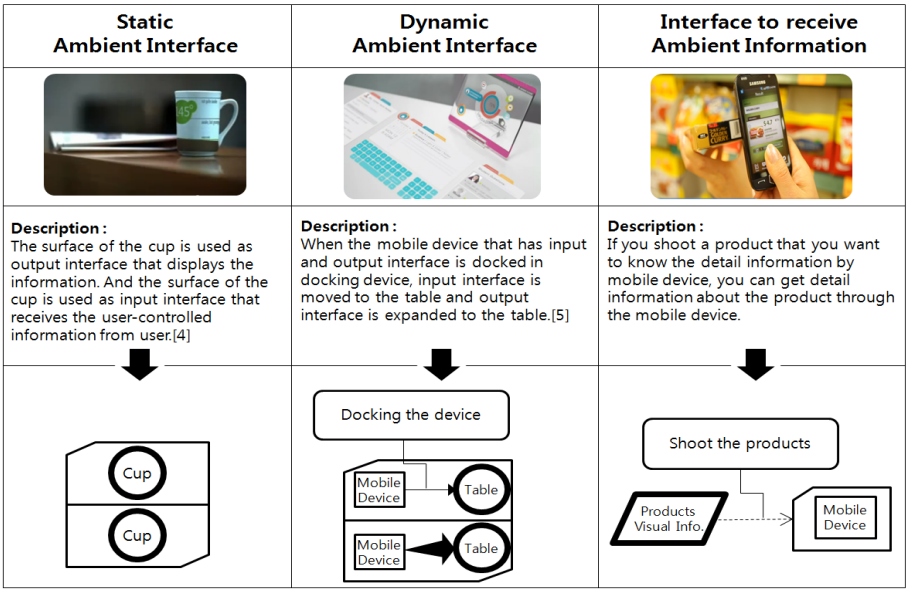

Fig. 2. Modeling examples

Elements in Table.1 can be expressed as one diagram in Fig.2 by combining elements. The *Interface* can have both input and output or have one of them. In case of having both, the Output Interface must be drawn under the Input Interface. Each of the *Interfaces* can contain elements of *Factor* except for the Ambient Information to indicate the interface composition. The contents of the *Factor* should be filled in the *Factor*. If the Interface has more than one *Factor*, *Factors* must be defined a relationship among elements of *Factor* by using elements of *Flow*. If Input Interface receives the Ambient Information, Input Interface must be linked to Ambient Information using Input Information of *Flow*. Therefore, Interaction designers can express only one diagram instead of a long and complicated description using the modeling method, as shown in Fig.2.

4 Conclusion and Future Work

The modeling method can reduce the time to understand the existing interactions or the interactions that are designed by co-workers. Moreover, we believe that it can be useful when novice designers make a new scenario or modify the existing scenarios.

Based on this study, we have a plan to apply the application of the method to other interaction theme, especially organic interaction.

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