Virtual Reality Based Disaster Management

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Abstract- ***User interface (UI) is an important factor for user experience (UX) because UI has significant impact on feeling of use. Wall mounted buttons which are used as physical UI for elevators, room rights and soon. However, changing installation locations of wall mounted buttons is not easy. In addition, changing button labels and types is not easy, too. If we can change installation locations, labels and types of wall mounted buttons easily, their UX is improved. In this paper, a virtual wall-mounted button is proposed. The proposed system projects virtual wall mounted buttons on a wall by a projector. The proposed system gets user's height and change buttons' vertical position. In addition, users can change a button label and type. As a result of the user-test, the proposed system improves the problems of wall mounted buttons and has a possibility that it improves product and system UX. On the other hand, user-test shows necessity to improve buttons' visibility.***

Index Terms- AR, UI, UX

I. INTRODUCTION

User experience (UX) is an important factor when we create products, systems and services. UX refers to a person's emotions and attitudes about using a particular product, system or service. Companies need improve UX for making differentiation demanded by diversified electronic apparatuses or web services. Factors of UX are information architecture, accessibility, interaction design, visual design, usability, user interface (UI) and so on. In addition, UX is relative to ergonomics and psychology. Therefore, the specialized knowledge related to the above is necessary for to improve UX. Namely, UI which is the mechanism for communication between human and computers is the important among the knowledge, since UI design has a significant impact on feeling of use. Paying attention to the so-called "affordance" is important for designers/engineers to design good UI. Affordance refers to the possibility of an action on an object or environment is used [1]. For example, if there is a Push-plate on the door, the perceived affordance is that a person push it to open outward. If there is a handle on the door, it should be clear that he/she can pull it to open it inward. Object's affordance depends on users' physical capabilities, purposes and experiences. Affordance also is used in digital UI design for smartphone or Personal Computer (PC). Button is frequently used among many components in the digital UI. When a person finds button in front of him/her, the perceived affordance is that he/she can push it. Such appearance is applied to UI of "click" on a computer screen, on which users virtually push an area even if there is no depth to push in. Buttons mounted walls are used as physical UI for elevators, room rights and so on. Generally, the wall mounted buttons need mounting construction work to change installation locations, labels and types. Therefore, if we want to change the buttons' position for reason of physical or rearranging the furniture, changing installation location is not easy. If we want to change button labels and types for reason of comprehensibility, interior design or usability, changing labels or types are not easy. Although UIs driven by voice and/or gesture may be a solution for the problem, no affordance from the UIs causes user's difficulty to manipulate them intuitively. Therefore, we need to learn how to operate or be shown operation methods. If we can change installation locations, labels and types of wall mounted buttons easily, UX improves. Therefore, in this paper, we consider the augmented reality (AR) technology for making the virtual wall mounted button. We use a projector for AR, because wall mounted buttons need to be visible without equipment for individuals for use by many people. The proposed system projects a virtual wall mounted button on a wall by a projector. This virtual wall mounted button allows users to operate by touching. The proposed system gets user's height when user stands in front of the button and change the vertical position of the projected button. In addition, users can change the button label and type on the setting screen.

II. PROPOSED SYSTEM

The proposed system gets user's height when user stands in front of the button and change the vertical position of the projected button. In addition, users can change the button label and type on the setting screen. The setting button is usually displayed, and the proposed system goes to the setting screen by touching the setting button. The proposed system is implemented on a PC, which connects Sony Xperia Touch [2] both for the projection and the sensing touches, and Microsoft Kinect [3] for getting information on user's height, through USB devices.

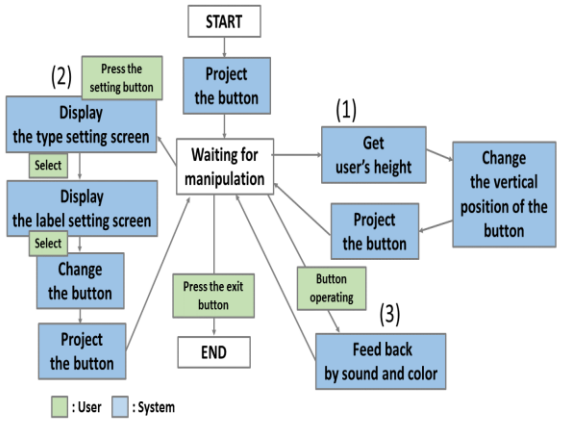

Figure 1: the transition diagram of the proposed system

Figure 1 shows the transition diagram of the proposed system. In the key behaviours shown as 1-3 in the figure, the proposed system works as follows.

1. Changing the vertical position of the button The proposed system has three vertical positions of the button, 100, 110, 120cm. Kinect gets a height of user's head in front of the wall mounted button. If this value is lower than 150cm, the vertical position is 100cm. If this value is higher than or equal to 170cm, the vertical position is 120cm. If this value is higher than 150cm and lower than 170cm, the vertical position is 110cm.

2. Setting a type and label User can change the button type and label on the setting screen. The proposed system goes to the type setting screen when user touches the setting button which is usually displayed. In this screen, user selects a button type and the proposed system goes to the label setting screen associated with each of a button type. In this screen, user selects a button label and the proposed system displays a button which have a selected the type and label.

3. Feedback to the button operation
The system represents sound and color-change as feedback of the operation of the button.
The proposed system has the following features;

- Users are given a suitable projected button according to their height.
- Users are given changeable label and type of the projected button according to their preference.

III. EVALUATION

The proposed system implemented for evaluation is equipped with two buttons, which can be chosen among five types of three labels. The adopted types and labels are usually seen as a light switch or opening/closing door switch in an elevator car. Figure 2 shows the whole picture of the proposed systems, Figures 3-6 show the virtual buttons and the setting button projected on the wall behind the system. From Figures 4-6 it is easily seen that the buttons are projected at different of height (vertical position). Figures 7-12 show the setting screen. At the setting screen shown in Figure 7, the type of the virtual button can be selected, which is followed by the selection of the label among three shown in Figures 8-12, respectively.

Figure 2: The proposed system

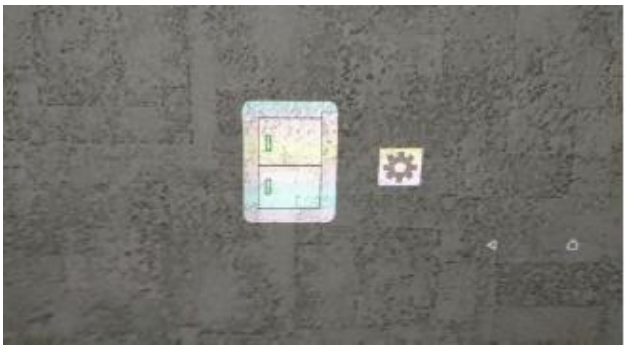

Figure 3: Virtual buttons and a setting button

Figure 4: Button's lowest position

Figure 5: Button's middle position

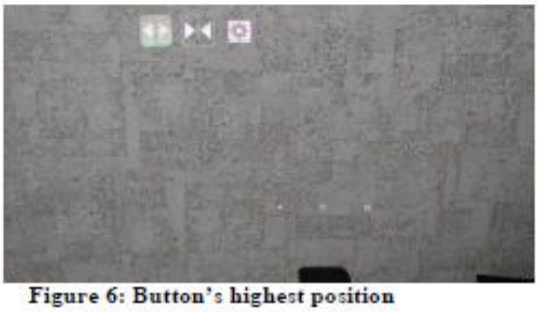

Figure 6: Button's highest position

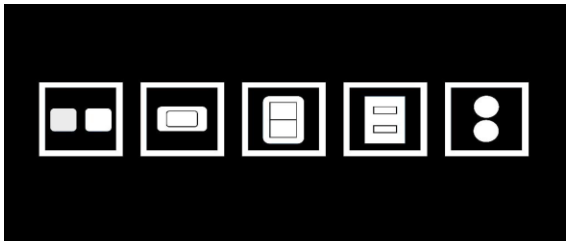

Figure 7: Type setting screen

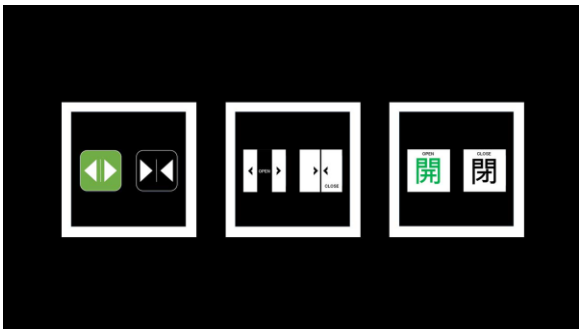

Figure 8: Label setting screen 1

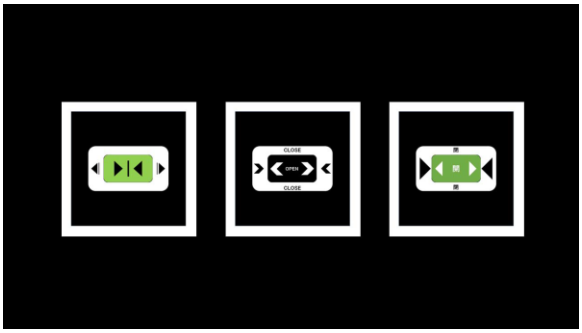

Figure 9: Label setting screen 2

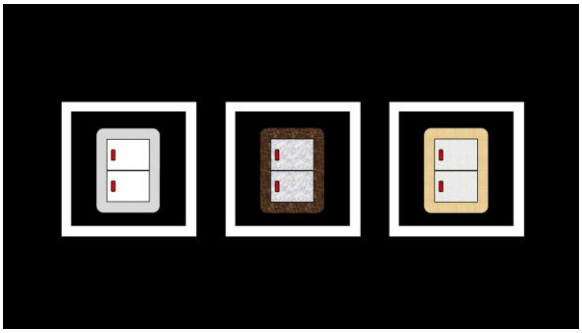

Figure 10: Label setting screen 3

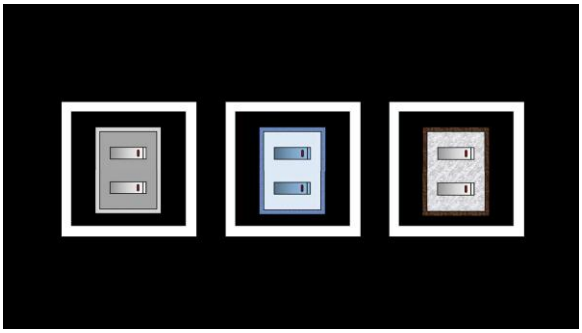

Figure 11: Label setting screen 4

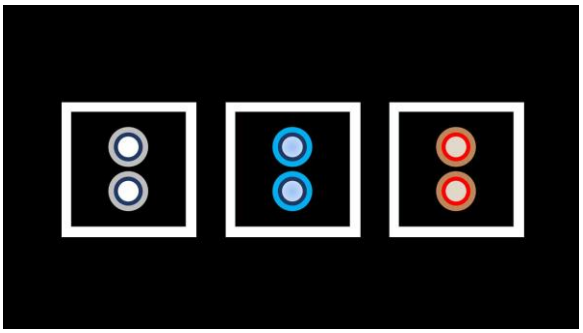

Figure 12: Label setting screen 5

The user-test was examined by 20 Japanese members of society. The examinees rated the system with five levels a-b (a: best - e: worst) according to the several aspects, shown in Tables 1-3.

A. Evaluation about operability

Table 1. Evaluation about operability

	a	b	c	d	e
1.1 Did you perceive an affordance of the virtual button?	7	9	3	1	0
1.2 Compared to physical buttons mounted wall, are virtual buttons with the same level operability?	5	9	3	3	0
1.3 Do virtual buttons have not trouble with visibility?	5	7	3	4	1

From 1.1 and 1.2 in Table 1, it is shown that the examinees could perceive an affordance from the virtual buttons and operate them as the same level as the physical buttons in the real world. While at the same time, 1.3 in Table 1 shows lower evaluation on visibility of the buttons. Some examinees pointed out that low contrast of projection and small characters on the labels as the reason.

B. Evaluation about function

Table 2. Evaluation about function

	a	b	c	d	e
2.1 Do you think that position adjustment function is an effective solution?	7	7	4	2	0
2.2 Do you think that label change function is an effective solution?	12	8	0	0	0
2.3 Do you think that type change function is an effective solution?	13	7	0	0	0

From Table 2, it is shown that the position and the select function of type/label of the virtual buttons are effective, respectively.

C.Comprehensive evaluation

Table 3. Comprehensive evaluation

	a	b	c	d	e
3.1 Compared to UI of physical buttons, do UI satisfaction improve?	5	8	3	4	0
3.2 If the proposed system be introduced into a room light as UI, would you think UX improve?	9	5	4	2	0
3.3 If the proposed system be introduced into an elevator as UI, would you think UX improve?	5	7	5	3	0

From 3.1 in Table 3, it is shown that the virtual buttons by the proposed system contribute to increasing satisfaction about UI. Some examinees pointed out the benefit caused by the trouble experience about the position of the button in the real world and the increasing flexibility of room design by the proposed system. On the other hand, small number of the examinees lowly evaluated the proposed system. They claimed no pressure sense at pushing the virtual buttons and low visibility of the buttons. The solution of the issues should be considered at the improvement of the system. Also from 3.2 and 3.3 in Table 3, the potential of improvement of UX is shown when the proposed system is applied to UI of lights and elevators. In consideration of overall evaluation, the proposed system is recognized as a useful interface by the examinees.

IV. CONCLUSION

In this paper, a virtual wall-mounted button is proposed. The proposed system projects virtual wall mounted buttons on a wall by a projector. The proposed system gets user's height and change buttons' vertical position. In addition, users can change button label and type. As a result of the user-test, the proposed system improves the problems of wall mounted buttons and has a possibility that it improves products and systems UX. On the other hand, user-test shows necessity to improve buttons' visibility.

ACKNOWLEDGMENT

This paper is partially supported by Chuo University Personal Research Grant.

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