User-Centered Design Activities of NEC Infrontia

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Abstract

Aiming at developing products with high accessibility by applying UCD (User-Centered Design), NEC Infrontia is deploying UD (Universal Design) standardization as a corporate-level promotion activity. This paper introduces details of this activity including formulation of UD Policy, enforcement of UD evaluations, formulation of UD guidelines and implementation of UD considerations in our product development.

Keywords

universal design, accessibility, UD evaluation, UD guidelines, UD considerations
multifunctional IP phone, Self-POS

1. Introduction

NEC Infrontia is deploying development and production business in the field of corporate network communications using multifunctional IP phones, distribution information systems such as POS systems and terminals of specific business types.

The main environments in which our products are used are in offices and stores and the opportunities available for various kinds of persons including the elderly to use our products are increasing. In addition, just as the POS terminals are operated by customers in the stores, an increasing number of products are required to be operable by general users as well as by the appointed operators.

In this changing environment, the application in the development process of User-Centered Design (UCD) is highlighted as an important issue for developing and continuing to offer products in order to provide high accessibility for all.

At NEC Infrontia, we are deploying standardization activities to support product development by adopting Universal Design (UD) considerations and we are applying UCD as corporate-level activities.

Below we introduce details of these activities together with actual examples of UD considerations regarding deployment of specific product categories.

2. UD Policy of NEC Infrontia

At the beginning of our UD activities, we established a UD Policy to match the characteristics of our goods as shown in **Fig. 1** .

> In order to obtain opinions such as “It’s so easy to use” from more users,
> we aim to provide UD information terminals
> that can be used securely by anyone from novices to experts.

Fig. 1 NEC Infrontia UD policy.

Under our UD Policy we deployed in-house activities supporting standardization of UD so that it would be apparent in the actual products.

3. UD Evaluation

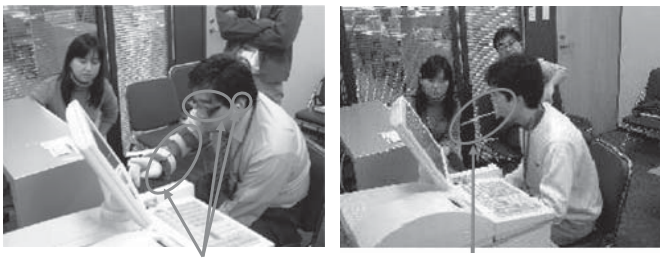
In order to define the current status before the start of the UD standardization, we conducted UD simulation evaluations and UD user evaluations to assess our product awareness from the viewpoints of a wide variety of users.

3.1 UD Simulation Evaluations

To check usability from the viewpoints of various users, our development staff performed UD simulation evaluations of our products by allowing persons that included both elderly and handicapped ones to experience product characteristics by using UD simulated experience tools.

The UD simulation evaluations utilized twelve kinds of UD simulated experience tools including an artificial limb stick, eye mask, mild cataract goggles, gloves, earplugs and a weight on the upper half of the body.

A total of ten development staff evaluated six of our products while verifying “whether it was really easy to use, even under certain restrictive conditions.” The results evaluated a



Instant Senior Experience Tool　　Artificial Limb Stick

Fig. 2　Images of UD simulation evaluations.

total of 160 opinions.

Fig. 2 shows images of actual simulation evaluations.

3.2 UD User Evaluations

One of the merits of the UD simulation evaluations is that the designer is able to review the usability of a product designed by him or herself. However, since these are after all, evaluations based only on simulations, the results may sometimes be different from the evaluations of actual users.

Therefore, to obtain opinions that are more realistically based, we also conducted UD user evaluations in which various users participated in actually using our products. These included ones by those under constraints such as lack of experience, age or other adverse conditions.

We asked a total of forty users to use and evaluate five of our products under variable conditions. There were a total of 390 opinions notified in the evaluation results.

4. UD Guidelines

In order to ensure consideration of the results of UD evaluations, NEC Infrontia formulated unique UD guidelines.

4.1 Formulation of UD Guidelines

In order to indicate how to design our products it was essential for NEC Infrontia to formulate unique UD guidelines by applying the Accessibility Guidelines of the NEC Group.

For this purpose, we formulated our UD Guidelines based on the NEC's Accessibility Guidelines while at the same time incorporating the characteristic points supporting development of our products with reference to the feed back results of the UD evaluations.

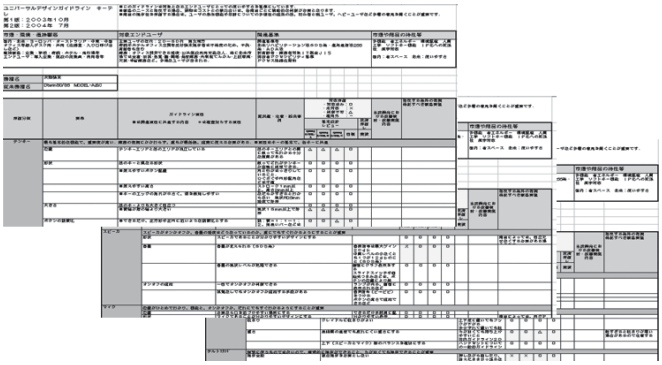


Fig. 3　UD guidelines.

Our UD Guidelines also reflect the standards of major public organizations. In addition, another feature of the UD Guidelines is that they describe specific solutions by quantifying the recommended values, for example (character height should be 4 mm or more, the color contrast should be 80% or more, etc).

Fig. 3 shows a chart of the UD Guidelines.

4.2 Systematic Operation of UD Guidelines

The operation of the UD guidelines begins with evaluation at the level of existing products according to the UD guidelines. Based on the results obtained by this evaluation, the target values of new products are set so that they exceed the obtained evaluation results. The development staff proceeds to development aiming at implementing the set target values. Products are evaluated again using the UD guidelines at the evaluation step of the development phase. If the results of such an evaluation are better than the target values the product is judged to be acceptable.

When a product upgrade is subsequently developed, values higher than those of the previous product are targeted and the new evaluation results are required to be better than these new target values.

The use of UD guidelines in a system as described above make it possible to improve the UD level each time that a new product is developed.

5. Examples of Applications of UD to Products

Based on the results achieved with our UD standardization program using the UD guidelines, we implemented the UD considerations in our product development as introduced spe-

cifically below.

5.1 UD Considerations for the Multifunctional IP Phone

In the development of the multifunctional IP phone shown in **Photo 1** , we implemented specific UD considerations based on the UD guidelines as described below.

(1) Numeric key feedback voice

It has long been standardized that numeric key "5" of a telephone set should have a convex surface. This allows even a completely blind person to dial a desired phone number by identifying the positions of other numeric keys with respect to the key "5."

However, it has not been possible to confirm every number dialed and the above method has often been accompanied by issues such as wrong number dialing.

Photo 1 DT series of multifunctional IP phones.

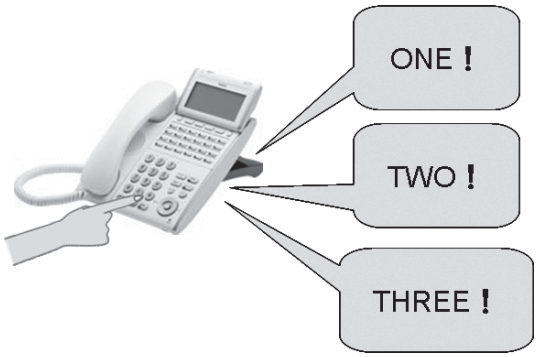


Fig. 4 Feedback voices of numeric keys.

To solve this problem, we implemented a function that generates a feedback voice by each numeric key at the moment of pressing as shown in the image of **Fig. 4** . A completely blind person can confirm the button he or she has pressed by the feedback voice of each key pressed so that the occurrence of wrong numbers can be significantly reduced.

(2) Braille stickers

Previously, in order to make a telephone set compatible with both ordinary visual input and Braille input, the standard function buttons should be removed and replaced with optional Braille input buttons. However, as this method requires disposal of the standard buttons it has been wasteful from the viewpoints both of economy and the environment. The multifunctional IP phone has adopted an environmentally friendly solution to this issue by making it possible to provide Braille compatibility by simply attaching Braille stickers to the tops of the function buttons as shown in **Photo 2** .

(3) White/black reversal and character enlargement of the LCD

Some people with weak sight or presbyopia find that white letters on a black background are easier to read than the ordinary black letters on a white background. The multifunctional IP phone is provided with an LCD (Liquid Crystal Display) white/black reversal function as shown in **Fig. 5** so that these persons can select the LCD display of white characters on a black background.

Since persons with weak sight or presbyopia also have difficulty in reading small characters, a function for enlarging the displayed characters as shown in Fig. 5 is also provided.

(4) Icon display of operation status

In an office environment, multiple phone circuits and multifunctional IP phones are usually shared by several persons. This situation makes it necessary to clarify the circuit

Photo 2 Braille stickers.

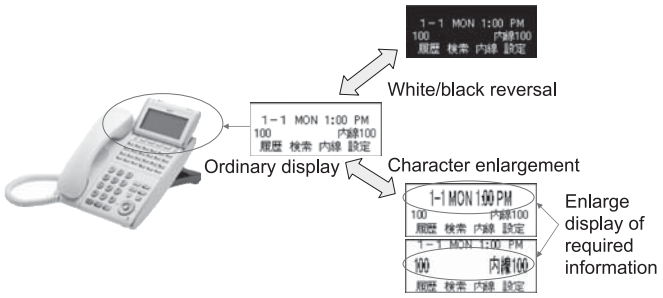


Fig. 5 White/black reversal and character enlargement of the LCD.

Operation status	Display by LED Colors	Display by LCD Icons
Own phone communicating	Green lighting	
Own phone holding	Green flashing	
Other phone communicating	Red lighting	
Other phone holding	Red flashing	

Fig. 6 Examples of operation status display using colors and icons.

usage such as user (own or other phone) and operation status (communicating, holding, etc.). Otherwise, there is the possibility of confusing operations such as hold or transfer. Previously, the operation status of each circuit has been allocated to buttons with LEDs which were indicated by a difference in the colors such as red and green lighting of the LEDs as shown in **Fig. 6** . This method however caused a problem in distinction of the current operation status for persons with color blindness.

Aiming at solving this problem, we added a means of displaying the operation status to the DT Series of Multifunctional IP Phones, by using simple icons on the LCD panel instead of color differences. This model can indicate the operation status even for persons with color blindness.

(5) Multi-language display of LCD

The language to be displayed can be selected from multiple options according to the language of the user.

(6) Backlit numeric keys

To improve the visibility, a backlight function is provided that causes the figures on the numeric keys to emit orange light. This is particularly effective when used in a low-light environment.

5.2 UD Considerations for Self–POS Terminal

Aiming at allowing even first-time users to easily operate the terminal, we have developed a self-POS system for use exclusively for electronic money settlement, as shown in **Fig. 7** .

We subjected the terminal to experimental demonstrations in actual store conditions in order for it to be compatible with various store environments and to respond to the user need for "the settlement of small sums to be speedy."

UD considerations are taken regarding the following points.

(1) Flexibility of use

The multi e-money reader/writer makes the terminal compatible with various kinds of e-money.

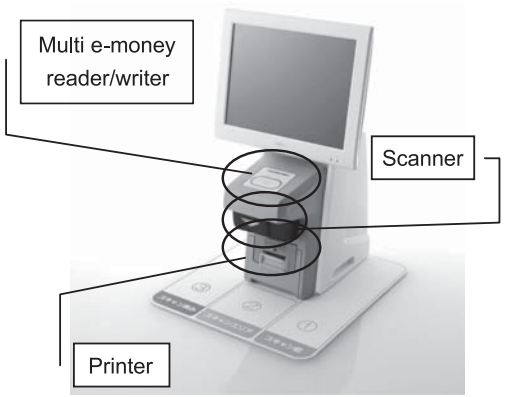
(2) Considerations regarding various operation environments

By integrating a scanner, a printer and a multi e-money reader/writer and by concentrating all functions in a space equivalent to that of an A4-size paper sheet as shown in **Fig. 8** , the POS terminal is compatible with the installation environments of a large variety of stores.

(3) Ease of operation

The LCD touch screen panel has high operability and legibility. The fixed scanner for use in reading merchandise irradiates laser from an obliquely up direction, so that merchandise can be read in a horizontal position without the need of being lifted high for readout.

We verified the operability with paper prototyping as shown



External design of TWINPOS 5500Si

Fig. 7 Self-POS terminal for electronic money settlement.

in **Photo 3** .

(4) Ease of intuitive comprehension

Voice guidance and easy-to-understand display instructions as shown in **Fig. 9** facilitate operation even for first-time users of the terminal.

Fig. 8 Concentration of all functions with a footprint equivalent to an A4-size paper sheet.

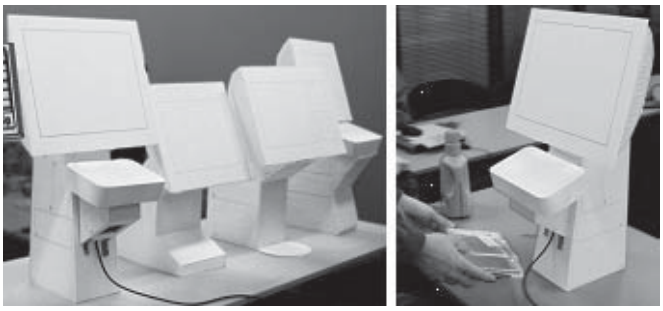


Photo 3 Verification of operability with paper prototyping.

Fig. 9 Voice guidance and easy-to-understand display instructions.

6. Conclusion

In the above, we introduced the UD standardization activities advanced in formulation of UD Policy, enforcement of UD evaluations, formulation of UD guidelines and implementation of UD considerations in the multifunctional IP phone and self-POS terminal.

In the future, we will continue to develop our user-centered design and UD standardization activities so that as many customers as possible will be made aware that "the products of NEC Infrontia are user-friendly."

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