Human Centered Design (HCD) Applied to SCADA System for Railways

Human Centered Design (HCD), User interface, Usability, Monitoring and control system

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Abstract

In the past, the User Interface (UI) used in the monitoring and control system had many restraints due to overall performance level issues. Compared with the evolution of various system components, the rate of UI evolution had been slower. The recent advancement of computer performance, however, invited the advanced UI in a variety of fields and promoted the R&D activities on UI with better usability and design sensitivity. Based on the design philosophy of Human Centered Design (HCD), we promoted the development of many kinds of products with HCD. In the renovation work of existing monitoring and control systems, the project owner requests the improvement of usability and design sensibility, so we implemented such an interface design in the HCD-applied main monitoring and control screen environment.

1. Preface

Generally, the monitoring and control is very specific to a particular field and requires highly specialized technical knowledge.

This system is designed presuming that the user's operator has an expert knowledge in its industrial field. As a result, the User Interface (UI) tends to be very unique. In the past, since the priority was secured to real-time performance for the overall system, it was difficult to use a majority of computing time to make a very graphic UI in the monitoring and control screen. Consequently, there was little effort made to investigate further on how operability would improve the performance with a better UI.

A computers' high performance evolution has realized an advanced UI in various industrial fields. It has become common to see UI with rich expressions like on PC window systems, game consoles, as well as other platforms. In particular, with the rapid development of Web-based technologies, there is much progress in research on UI with high operability and design sensitivity by drawing on such Web technologies.

This paper introduces the UI design approach with high operability and design sensitivity built on the existing UI by introducing the design concept of Human Centered Design (HCD) during the innovation work of the SCADA system.

2. What is the HCD?

The HCD is a design concept to improve usability by designing and building a customer-driven system or a product based on a user's perspective.

The international standard for HCD is ISO9241-210. Our HCD-related activities conform to this standard.

According to our concept of being "user-friendly" to the consumer, it became our design policy to establish a product identity with a distinct aesthetic external view and operability. As an approach to apply HCD into our product, we designed an internal UI design guide. To implement the HCD processes, professional knowledge is critical. At our company, only highly qualified designers are in charge of the design work and they are certified as "Professional Human-Centered Designers authorized by the non-profit organization, the HCD Organization." To be specific, these designers always employ a "user friendly design" in product design, space design, and interface design while considering the human interface, visibility, and operability, based on ergonomics and cognitive science.

If a monitoring and control system only serves to meet functional requirements, it may become an unpleasant or challenging product to handle. We believe that in order to realize a user-friendly UI, the design must be a customer-driven UI design instead of the concept deriving from only matters of convenience in production.

3. Application to System Renovation

In order to build a UI by applying HCD during system renovation, the following points should be factored:

(1) Maintaining level of system familiarity and education and training requirements.

For a user who is very familiar with an existing system, a remarkable change in the UI may require the user to begin learning the system anew. By building on the basic design concept of the initial system, it will reduce the challenge and it may minimize the learning curve.

(2) Effective use of past assets

If programs and data on the existing system can be reused, we can expect cost performance savings. As such, the best use of such legacy programs and data should be made.

(3) Reflection of past lessons

Certain measures have been taken in a UI design to prevent an error that may have previously occurred. Employing such a design idea, by making UI design more easily to understand, we can avoid the danger of repeating the same failure.

As mentioned above, there are various UI design elements that should, and should not, be modified. As such, by applying HCD design consideration, we aimed to build UI design harmonizing these elements.

4. Application Approach

Fig. 1 shows a design work flow based on HCD design philosophy. First, we sorted out the essential functions and purposes of the existing monitoring and control screens. We organized the design arrangement based on the degree of frequency and priority.

Second, a prototype design considering the monitoring and control screen configuration and a screen design change history was created. At the same time, we investigated whether this prototype could be technically feasible. In regard to the method of operation, display, and color scheme, a visual design was adopted to fit the screen design in line with HCD design process.

Lastly, we repeated several reviews on the prototype design. By incremental design improvement, we got closer to the ideal screen design.

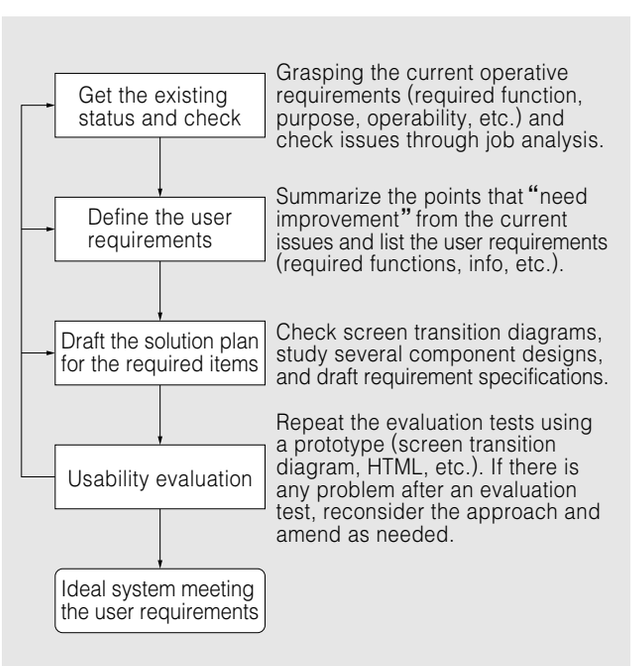

Fig. 1 Design Work Flow Based on HCD Design Philosophy

We repeat the procedure shown in this diagram and try to achieve a user-driven ideal system.

We applied HCD design approach particularly with respect to the following four points:

(1) Operability – Ease of use (intuitive).
(2) Visibility – Easy to see the information.
(3) Inducibility – Easy to spot vital information.
(4) Simplicity – Appropriate amount of information.

5. Examples of Applications

The case of monitoring and control system for railways is shown below. The screen has improved on the new design approach, ease of operation and design; all of which are built on the HCD basic philosophy, while keeping the best of the existing UI design elements.

(1) System operation control (Fig. 2)

The layout lines of screen architecture are in an order which gives the impression of a well-organized screen design. By using a highlighted color for emphasis in a monochromatic screen color scheme, it improves the inducibility or ease of spotting vital information (status indication).

(2) Traction power network diagram for control (Fig. 3)

Information that is organized and limited and that is displayed in a single screen makes the screen look clear and concise. The uniform component layout (place) design in each screen, and a button-size and shape design in each different application, helps support the uniform design so that the user will make fewer mistakes.

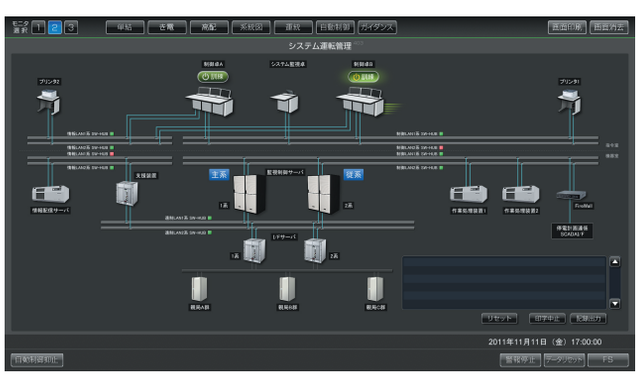

Fig. 2 System Operation Control

This shows the monitoring screen which shows the status of components for the monitoring and control system.

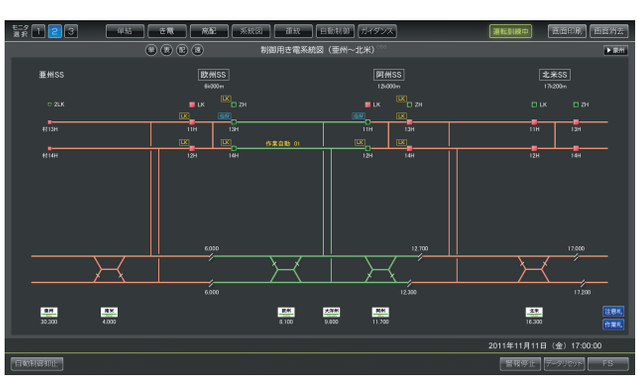

Fig. 3 Traction Power Network Diagram for Control

A screen to monitor DC traction power network is shown.

Fig. 4 Automatic Control Sequence
This shows a screen to check the execution status of procedure pattern of an automatic execution.

(3) Automatic control sequence (Fig. 4)

By grouping, the relationship between the display block and the operation block can be intuitively understandable for the user. By utilizing the former rules of the existing system, the font color remains unchanged and the contrast is factored in with the background color.

6. Postscript

After the Great East Japan Earthquake in 2011, the aware-ness level of risk management in society increased considerably. Against this backdrop, the role of monitoring and control system in support of social infrastructures became increasingly higher. Moving forward, we will make every effort to develop HCD-based UI design in order to build more user-friendly monitoring and control systems.

Product News

World-First 204kV Dead-Tank-Type Vacuum Circuit-Breakers (VCBs) for Hokkaido Shinkansen Bullet Train Project Shipped

After receiving an order from Japan Railway Construction, Transport and Technology for the production of 204kV Dead-Tank-Type Vacuum Circuit-Breakers (VCBs), we recently shipped them to substation for Hokkaido Shinkansen Bullet Train Project (between Shin-Aomori Station and Shin-Hakodate Station).

Regarding Meiden's dead-tank-type VCBs, the supply of 72kV VCBs was begun in 1979, 120kV class in 2006, and 168kV class in 2007. These VCBs are operating in good condition. With this time release of 204kV class VCB, we could complete the product series up to the system voltage of 187kV.

These VCBs can withstand 10,000 times of load current breaking and have a feature of easy maintenance. Our VCBs have many track records not only in railway sector but also in various power utility and general industry sector.