A Method for Visualizing and Navigating Tiled Alarm Information on Computer-based Display in SMART

S. M. Suh, G. S. Jang, H.Y. Park, G. O. Park, I. S. Koo
Korea Atomic Energy Research Institute, smsuh&@kaeri.re.kr
Y. R. Sim, J. H. KO, J. H. Jeong, D. H. Seong
Sam Chang Enterprise Co., Ltd., syr1312@samchang.com

1. Introduction

In a complex process control plant like NPP(nuclear power plant), the alarm system is one of the primary means which provides operating personnel with process abnormalities and failures. It is the principle source of information for the detection of the plant upset situation.

The alarm information is presented to the plant personnel in a various way of display formats. While an annunciator-based tile display is a main format for alarm information in the conventional control room, a computer-based message list display and integration display is an additional or dominant format in a hybrid and advanced control room. The following three types of alarm display formats are usually found in the control room of the process control plant:

- annunciator-based tile display
- computer-based message list display
- computer-based integration display

The main control room of SMART(System-integrated Modular Advanced ReacTor) is designed based on the advanced digital technologies. The alarm system is also developed using the computer technology, but its limited displaying area drives designers to make the conventional annunciator-based tile display into an independent overlapped one. And it is considered to take effect on the operator's performance in a negative manner.

In this study we present a new method to be used when the annunciator-based tile display for alarm information is implemented on the computer-based tile display. It was motivated from the work that Eser Kandogan and Ben Shneiderman had done[3].

The next section gives some requirements which are the bases for the ETD(Elastic Tile Display) method we proposed in this paper. In the next section, the ETD method is briefly described. And finally, the further works to experimentally validate its impact on human performance are described.

2. Requirements

When we incorporate those alarm information of the annunciator-based tile display into the computer-based tile display, we have to consider key advantages of computer-based one on human performance such as rapid detection and pattern recognition. To make those advantages maximizing, the following requirement should be established.

> *The display method should be assured that the only one display page accommodate all alarm information in the way of a tile display.*

It is very important task which operators navigate alarm information on VDU-based user interface to find out what's really going on the plant. Management and navigation of the displays can impose significant workload on the operator not related to the primary task of monitoring and supervising the plant [1]. To consider this issue carefully, the following requirement should be established.

> *The navigating task of the display method should be done with little attention as operators can concentrate the primary task of being aware of system status.*

When we implement or design a computer-based display system of tiled alarm information, it should be satisfied with the guidelines or standards on the density of alarm information. It is considered as a major factor on the human performance of recognizing alarm status. When we design a tile matrix in a single display page, the following requirement [4] should be satisfied.

> *The display method of the alarm tile should contain a maximum of 50 alarms in a single display page.*

3. Elastic Tile Display

In the previous section, we established three key requirements that the computer-based tile display should meet. Based on these requirements, the computer-based alarm display method, ETD, was designed, which can be used to visualize and navigate effectively many tiled alarms information (see figure 1). It was motivated from

the work that Eser Kandogan and Ben Shneiderman had done[3]. They proposed a rapid window management method called Elastic Windows (see figure 2). The method is based on the following three principles:

- *hierarchical window organization*
- *space-filling tiled layout*
- *multi-window operations*

The animating characteristics of ETD are similar to Elastic Windows. But the purpose of application is quite different to each other. The way of navigating tiled alarm information is illustrated in figure 1.

4. Further Work

In this study, we established the key requirements to implement or design the tiled alarm information on the VDU-based user interface. Based on these requirements, we proposed a display method called ETD. We expect the method is better than the independent overlapped tile display. To validate this, an experimental design will be established. The following two hypotheses will be tested in the experiment.

Elastic Tile Display yields faster performance than independent overlapped tile display for an alarm acknowledgement task.

Elastic Tile Display yields faster performance than independent overlapped tile display for situation awareness task.

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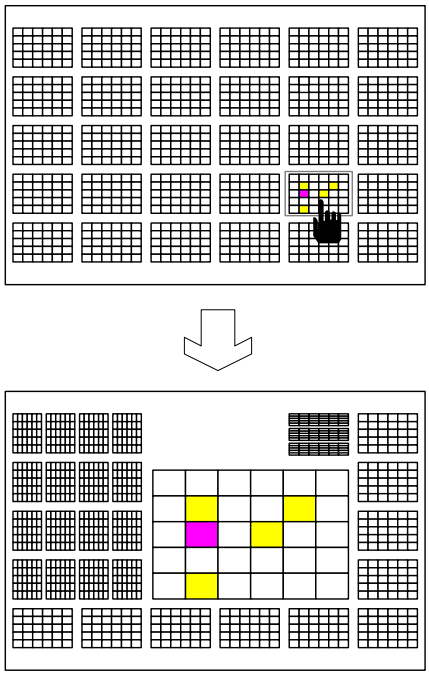
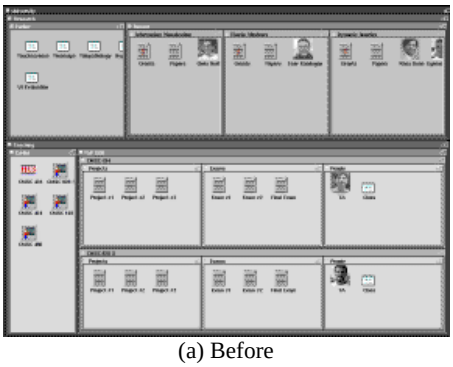


Figure 1. Elastic Tile Alarm: an effective technique of visualizing and navigating many tiled alarm information



(a) Before

(b) After

Figure 2. An example of multi windows operation in Elastic Windows (figure 2 in [3])