A proposal from Information Visualization and Human Computer Interaction point of view to the Design of Industrial Interfaces

Larrea, Martín L. Martig, Sergio R. Castro, Silvia M.
Departamento de Ciencias e Ingeniería de la Computación
VyGLab - Laboratorio de Investigación en Visualización y Computación Gráfica.
Universidad Nacional del Sur
Avenida Alem 1253
Argentina, CP 8000, Bahía Blanca, Buenos Aires
mll@cs.uns.edu.ar srm@cs.uns.edu.ar smc@cs.uns.edu.ar

ABSTRACT

In this paper we show how the design of the interfaces present in a control room can benefit from the combination of concepts and techniques from Information Visualization and Human Computer Interaction (HCI). The process monitoring GUIs must present all the necessary information to control and change the state of the plant in a safety and productive way. Every person inside a control room must handle a high information volume and the exploration and analysis of this huge data volume has become increasingly difficult. This difficulty can lead to risk not only the production but also human lives. Information Visualization and HCI can help to deal with the flood of information.

Keywords

Industrial Graphics Interfaces, Process monitoring, Information visualization, Focus+Context Visualization.

1 INTRODUCTION

The design of the interfaces present in a control room can be tackled from two points of view, showing the states of each process in an effective way and providing all the necessary interaction to control theses processes. Process monitoring tools base their representation in a mimic visualization. This technique creates visual images that exactly match the process they represent. However, these visual representations may often do not fit the actual size of the display, forcing the user to see only a portion of the process. Because of this limitation, the user can only handle a part of the process information while losing the remain of it. The problem of exploring large data sets has been studied over the last decades within two major areas as Information Visualization [Kei02] and Human Computer Interaction [Shn98]. In this paper we show how the design of the interfaces present in a control room can benefit from the combination of concepts and techniques from Information Visualization and Human Computer Interaction (HCI). We apply the results obtains from these areas to create an effective visualization tool that reduces the user cognitive workload.

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2 INDUSTRIAL PLANT VISUALIZATION

Each industrial plant can be seen as a single process that receive some input and produces an output. This view may not be sufficient to control the state of the plant and a more detailed representation might be needed. If we replace this single process with all the main ones, we achieve an equivalent view but with more information. This decomposition of processes can be repeated for each process and continue until we reach a level where no new process can be added.

An industrial plant is a set of processes interconnected. Theses links between them create a graph where each node represent a process and the edges are the connections between them. Hence it is correct to say that the problem of visualizing industrial plant processes and its states is equivalent to visualize a graph and all information relative to each node and edge.

Today's techniques divide the plant into sectors and allow the user to navigate them. These techniques don't allow the user to combine different levels of detail at the same time in the same view and have a lack of context on the user position. Theses are the problems that we seek to solve combining the work done in Information Visualization and HCI with the develop of industrial control interfaces. Our main objective is to obtain a technique that present all the necessary information to control and change the state of the plant in a safety and productive way.

3 A NEW PROPOSAL

We propose to combine different level of the multiresolution structure in the same view. The user will be able to increase or decrease the level of detail in a specific area, both semantic and graphically. To avoid the situation where the entire graph does not fit in the display's area, we define a constant value **max** that represent the maximum number of nodes allowed on a view. When the number of nodes exceeds the given value **max**, automatic implosions are produced on the periphery of the graph. The main purpose of this is to reduce the number of elements in the display with a minimum disorientation of the user.

A change in the level of detail is not only a graphic modification but also a semantic one. When the user increases the level of detail on the focus, we provide more information and possibly, but not necessarily, a different graphic representation. The same situation occurs when the user decrease the level of detail.

When the user focuses on an element of the graph, we use the fisheye view transformation [Sar94] to modify the current view. By doing this, the element selected gain focus and the rest of the graph becomes context.
Since fisheye view applies a geometric transformation, the entire graph is in the view at all time. And while the focus is at one level of detail, the context may present a different one, or even more than one.

The user will be able to specify, for each node, which are the ones he/she wish to see when the node change to an emergency state. This set of elements is called an **emergency graph**. A node with an unknown alarm and its emergency graph will never be hidden from the user automatically (figure 1a-1b). Finally, the user has the option to lock a node so that it never implotes.

4 CONCLUSIONS AND FUTURE WORK

It is possible to transfer the result from Information Visualization and HCI on large data set exploration to the industrial plan control room. By doing this we can apply techniques specially designed for this purpose and that have proved to be successful.

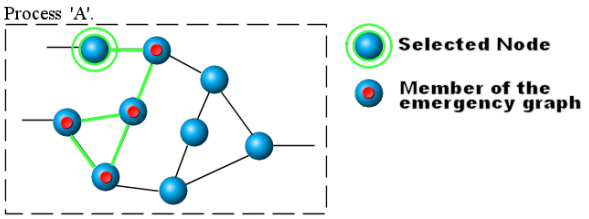

Figure 1a. The nodes with the red dot belong to the emergency graph of the selected node.

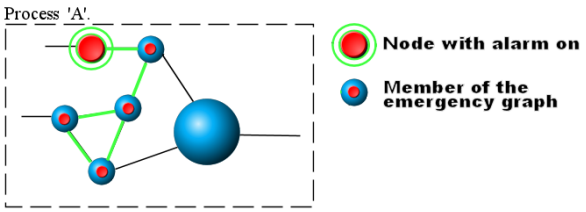

Figure 1b. Implosion of the nodes that are not in the emergency graph.

Our proposal for the visualization includes: Multiresolution graphs that represents the industrial plant and the emergency graph. Geometric zoom, Semantic zoom and the use of Fisheye View to achieve Focus + Context.

Unfortunately, there has been no testing of the usability of this visualization. Much more study of this area is sorely needed. In addition, there needs to be a study of how other transformations techniques can applied to design of the interfaces present in a control room. Current work has been limited to a few interactions between the user and the visualization. In order to recognize the true potential of this technique real interaction must be consider under our proposal.
Future work will involve the develop of a prototype with a simulation of an industrial plant and testing this prototype with real users.

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6 REFERENCES

[Kei02] Daniel A. Keim, "Information Visualization and Visual Data Mining". IEEE Transactions on Visualization and Computer Graphics, Vol. 7, No. 1, January-March 2002.

[Sar94] Sarkar, Manojit and Brown, H., Marc, "Graphical FishEye views". Comunication of the ACM. December 1994/Vol 37, No. 12.

[Shn98] Shneiderman, B., Designing the User Interface, Addison-Wesley Publishing Company, 1998.