STUDENTS CHALLENGES AND WAYS ON HOW TO MOTIVATE IN ENGINEERING EDUCATION

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Abstract *– This paper describes ways of cooperation between the Department of Control Systems and Instrumentation and industry, and with companies representing a main role in industrial automation from the point of view of their contribution to education and ways of motivating students. This cooperation has been developing through the last decade by various means implemented into teaching. One of them is a competition of students from the field of Control Systems and Applied Informatics who present their projects, which are leading in their diploma thesis. Further, this paper presents an overview of some of the students' projects, their techniques on how to complete a project, with results which can develop teaching curriculum and be used during teaching again, as well as the results developing skills and abilities, which students take with them after graduating from University, put them into practice and perhaps coming back in the future as specialists and role models for the next student generation.*

Index Terms – Internet, supervisory control, client server architecture, students' projects.

INTRODUCTION

As businesses evolve, they need computer architectures that match the patterns of business operation and internal structures. In other words, as human operations change and application systems develop, computer architecture must evolve accordingly. These tasks can also demonstrate how new trends involving client-server architectures in supervisory control substitute for the traditional approaches in teaching supervisory control, students' projects and their work.

FactorySuite Web Server™ 7.1 is a program used during the the teaching at the Department of Control Systems and Instrumentation, enabling client Internet users to access remote data and applications, which are on the same local network together with FactorySuite Web Server. It creates an administrative centre and data gate for processing and producing information determined for operators, process engineers and maintenance workers, who need identical HMI (Human Machine Interface) visual information locally and remotely through Internet. It also serves the managers, who need a summary of production information through the Internet.

InTouch™, as another part of the FactorySuite2000™ supervisory control software package used at the Department, is providing a full range of possibilities to control a technological process in the environment of the Internet for a user. Users can supervise, control, and monitor remotely operated technologies without limits by Internet/Intranet, and there is no need to change the particular application.

One of the tasks implemented at the Department was dealing with an application of InTouch, which represented remotely operated technology. The students worked on developing the application first (in a development environment of the supervisory system) creating and configuring objects and linking them to scripts with animations. The application had all of the properties as other industrial applications have, including security with operators' name and a password. Further, FactorySuite's Web Server created a link to Internet/Intranet and enabled browsing technological data through this net. A very important part of technological processes is the configuration of communication with WWW server. In this case it is represented by a NetDDE or SuiteLink communication protocol of Microsoft (see Fig.1).

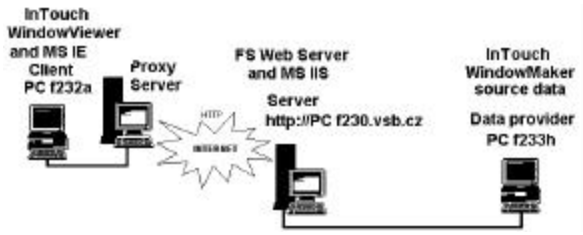

FIGURE 1
CONNECTING THE CLIENT TO DATA PROVIDER WITHIN THE EXISTING NETWORK

The main steps, which describe the process of data transfer between the client and server, are as follows:

- Query: Client requires data.
- Client/Server Communication: FactorySuite Web Server communicates with source application by SuiteLink or NetDDE. FactorySuite Web Server receives data.

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- Data compression, coding and conversion: Received data are compressed, and in case of higher level of security used, also coded and converted into HTML.
- Data transfer: Through Proxy server data go to a client, where they will be decoded and displayed.

The goal of these tasks was to extend students possibilities in system implementation of integrated software components for industrial automation. The Department has a computer lab devoted to students work on projects with SCADA/HMI applications. The lab enables programming client's applications based on PC configurations for connections to a portal via Internet/Intranet and a server. Modeled tasks provide data, as they would be coming from real technological systems (see Fig.2).

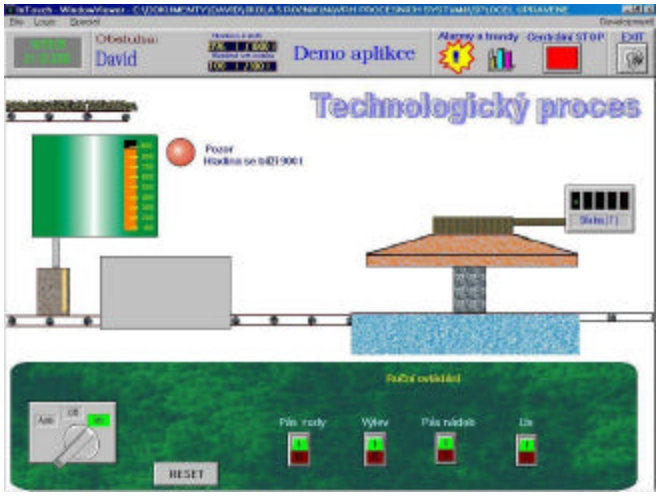

FIGURE 2
DATA PROVIDING TASK

NEW APPROACHES TO TEACHING CONTROL

One way how to motivate students in learning control is through the new approaches to distributed control based on PC platform, which use terminal services, SQL server and COM and OPC technologies, which are demonstrated in simple tasks.

These approaches provide:

- Easier orientation in applications,
- Different possibilities for visualization,
- Display of static and dynamic data for monitoring and control of the process's quality,
- Possibility of privileged access,
- Equipment diagnostics,
- Visualization and processing of trends and alarms,
- Ability to communicate with superior or/and supervised stations,
- Distributed functions and communication for information and control systems.

Modern control systems in industrial automation collect enormous amount of data, which are connected to more and more users in different levels of production or administration. Some of these users need comfort and effective means in order to monitor and control processes. Others do not require data continuously, but are interested in data summary, production results, quality and history of data. These users only need simple interface to look at the data, for example Internet browser. The Internet has changed its environment into interactively and graphically very powerful tool, which is now closer to visualization systems of the human - machine interaction category, because it is able to bring data presented by means of WWW to the end users. Data are transferred between Internet clients and servers, where client is the computer who asks for documents, while server is a computer who is able to send them, because it is equipped by specific software. In case the server sends files directly written in some of the standard supported formats, like HTML or XML, the client only needs a browser to view them, and is called then a "thin client". Internet server is able to send data in other format as well, but the client needs specific software, in order to be able to read, process and display the data. In such case the client is called a "fat client". Both have advantages and disadvantages. Fat clients provide the end users with comfortable access, because the data transferred via Internet are compressed and without formatting. It is also fast. But the client's PC station needs a software package and it makes this solution requiring maintenance, upgrading and expensive, as well. On the other hand, the thin client solution requires PC only with ordinary office software, the operational system and the Internet browser. Of course, the graphical presentation of data is much simpler and limited by speed of their transfer.

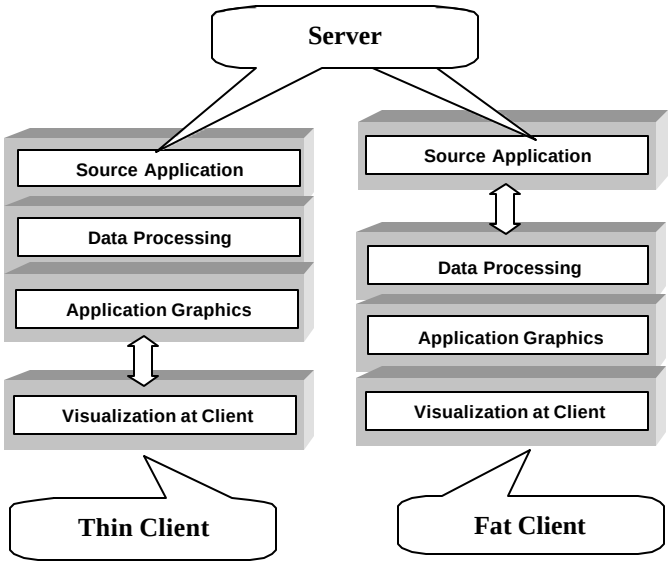

FIGURE 3

FUNCTIONS OF THE THIN AND THE FAT CLIENT

Also the applications based on Microsoft Windows DNA (Distributed interNet Applications Architecture) standard have configurations for server and a client.

Server's main functions are:

- Data acquisition,
- Data processing,
- Alarm control system,
- Data archive and trends,
- Static and dynamic process control,
- Reports.

Then, the client's function is mainly to provide users interface for server configuration and visualization, and supervisory control.

DNA architecture is a comprehensive framework for new business solutions that combine the benefits of the Internet, client-server and PC models of computing. Representing a unified and integrated approach for building distributed, multi-tier applications, the Windows DNA framework allows organization to focus on producing and implementing value-added business solutions rather than systems integration.

The Windows DNA architecture distinguishes three independent tiers: client, data processing and data itself. They bring mainly these advantages:

- The development and maintenance of applications are centralised (saved on a server, but enabled to all client stations). The time is considerably minimised for both of them,
- Information from data processing is being distributed to superior systems (MES, ERP) anywhere world-wide,
- The architecture enables flexible implementation on small as well as large systems, so that all three tiers can be run on one computer or in a multiple server configuration.

Since these functions are complex and reach far beyond the simulated tasks, they can be demonstrated the best during students visit to industrial practice. Students then get a better idea about the complexity of the technological process and the importance of adequate human - machine interaction representation in the environment of supervisory control systems. The following pictures show photographs from real operation in steelworks, the technological process of continuous casting with 6 steel strips, which the students visited while studying control, and a SCADA/HMI screen corresponding to it, created by system integrators - the former graduates of Technical University - from professional company (see Fig. 5 and Fig. 6). In this way, students are learning how to use software commonly implemented in practice and how to configure simulations for real technological processes.

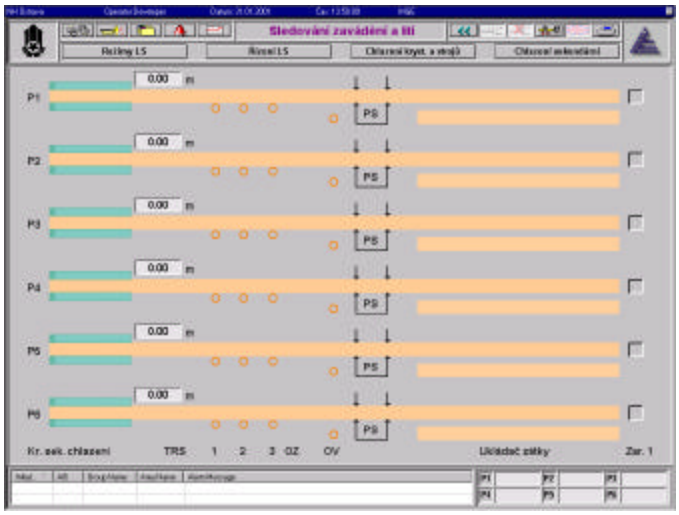

FIGURE 4
OPERATORS SCREEN (COURTESY OF INGELECTRIC)

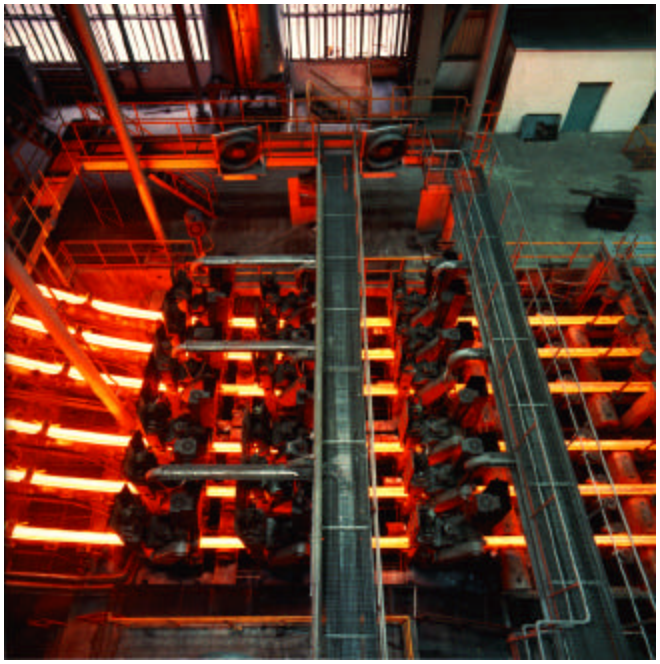

FIGURE 5
A PICTURE FROM TECHNOLOGICAL PROCESS OF CONTINUOUS CASTING

STUDENTS RESULT PRESENTATIONS

Projects are presented at the Department's web sites (see Fig. 6, 7 and also at *http://www.352.vsb.cz/)*. The application is described there and provides students with steps to be followed during installation, modeling and monitoring.

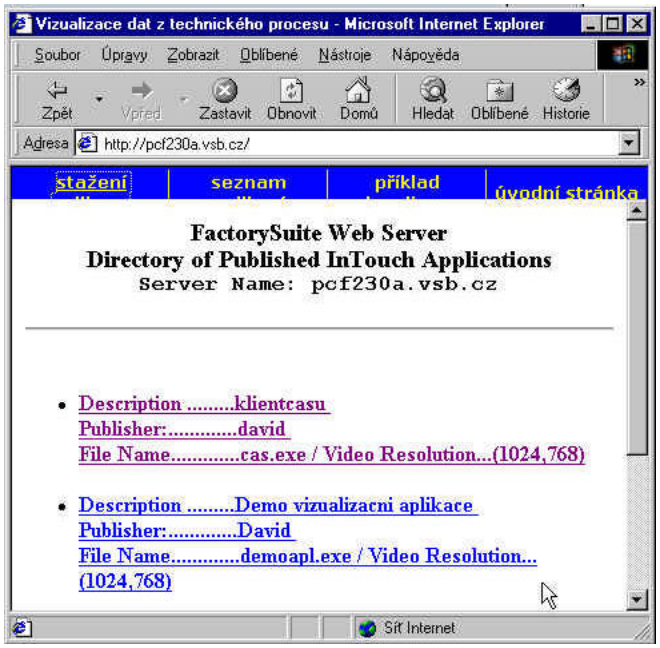

FIGURE 6
PROJECTS ENABLED FOR CLIENTS BY INTERNET ACCESS

It is easier to put these results in practice for teaching, if they are published in this way, students can access them during their exercises or from home as well.

FIGURE 7
PROJECTS PRESENTATION IN DEPARTMENT'S WEB SITES

The web sites created for the purpose of introducing and teaching SCADA/HMI systems show the general overview of the products, introduction into installation conditions, instructions for working with applications and have privileged access with a user name and a password.

These web sites also make a link to cooperation with other departments, or universities in other countries. There has been, for example, cooperation with Technical University of Kosice in Slovakia for many years. Applications available at the Internet can be downloaded and monitored, experience can be exchanged. There is always continuity in work, even after our students graduate and new students come.

CONCLUSION

Teaching subjects with the help of supervisory control systems has a great influence on the students. Besides improving their knowledge of classical approaches to control and automation and other skills acquired by taking subjects like Computer Practice, Simulation and Modeling, Automatic Control Theory or Measurement and Sensors Systems etc., which are taught by the Department, they use their abilities, imagination, creativity and learn more about ways of dealing with situations, needed after they graduate from school and join the real world.

The advantage of introducing the new software into education and responding to quickly changing and upgrading technological means is that students are able to learn and follow new trends in the area of supervisory control, and make bridges and connect other programming subjects with this topic, as well as with other subjects of the curriculum.

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