International Workshop on Tele-Education in Mechatronics Based on Virtual Laboratories

Title:

D E R I V E

European IST Research and Development Project

Distributed
Real and Virtual
Learning Environment
for Mechatronics and Tele-service

Authors: Dr. rer.nat. Ulrich Karras
Festo Didactic GmbH&Co.
Rechbergstr. 3
D-73770 Denkendorf
phone: +49-711-3467334
fax: +49-711-3475754334
email: dka@festo.com
www.festo.com/didactic

Dipl.-Inform. Hauke Ernst
Research Center ARTEC
University of Bremen
Enrique-Schmidt-Str. 7
D-28359 Bremen
Phone: +49-421-2189090
Fax: +49-421-2184449

Homepage of DERIVE: www.derive.uni-bremen.de

Objectives

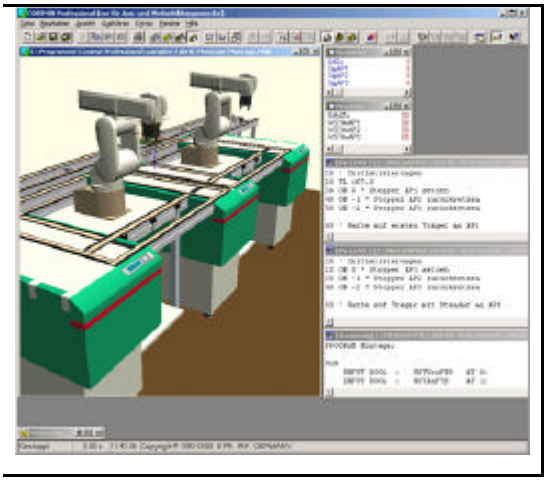
The requirements for this project arose from demands of vocational schools and their links to industry. Increasing pressure is placed on vocational schools to expose students to real working environments and to support the education and training of multi-skilled technicians. This led to a new type of job profile which contains a mix of electrical, mechanical and IT knowledge (mechatronics) . The project brings together these target demands with the development and evaluation of a new kind of multi perspective learning environment for vocational training in Mechatronics. It will be supported by a combination of real and virtual, local and remote media.

Technical Training

New trends in technical training are an inherent focus of the DERIVE project. In the last 20 years changes in technology have been brought into the classroom. Some examples are: the use of video material to exemplify concepts that cannot be shown on the black board; the use of concrete models and practical exercises and examples. The developments in computer technology did not only have an impact on the worlds of commerce, engineering and leisure to name a few, but also on education. Computers are now used in the classroom as multimedia tools to provide alternative sources of learning material, to provide interactive learning situations and to provide simulation of systems that cannot for reasons of cost, size or safety be used in reality. The use of the Internet is rapidly increasing and is being seen by some people as the greatest source of knowledge available to students.

There are two aspects of the use of computers in engineering, the first being that engineers use computers as part of their work. Originally, their use was limited to solving complex calculations requiring all engineers to have programming skills. The phenomenal increase in power of the last decade as seen their use expand to the point where they have now replaced the 2 dimensional drawing board with 3D representations complete with textured rendering that allows the visualisation of the finished product.

The use of simulation tools has a number of benefits to education. The learner is not exposed to the hazards of the real world. The learner is able to explore a range of possible solutions easily and quickly. The learner is able to use the tools that will be available in industry. The cost of simulation tools is significantly less than the real world components and allows more participation and interaction than a limited demonstration. An added benefit is that learners today, enjoy using computer based technology and this enthusiasm aids the learning process.



As a matter of fact, mechatronic systems already play a key role in modern automation technology. It is obvious that the dissemination of mechatronic systems simultaneously requires adequate service techniques. Mechtronic components can be easily integrated into telematic environments and corresponding work concepts for tele-service, i.e. remote diagnosis and maintenance of mechatronic systems. Mechatronics may be therefore considered as an enabling technology for tele-service.

DERIVE will provide a new learning environment which will support vocational schools to deliver courses in mechatronics. The support for the learning process will be reflected in a graduation from local concrete to local virtual to remote virtual to remote concrete, taking the student from basic knowledge to the full implementation in industry. The tele-cooperation functionality in the learning environment will allow companies to use the training facilities of vocational schools and/or other providers for updating their employees. With new equipment being more complex and requiring more complex maintenance, the training requirements for staff increases. The new environment will allow groups of staff at remote locations to take part at the same training using the same equipment (either simulated or real). This staff will be able to work in a collaborative way to solve

problems and explore learning situations. This new kind of interaction will allow the systematic support of skilled workers and engineers by educators in vocational schools. Also, the DERIVE learning environment will be the appropriate tool to realise project orientation in technical training, providing a platform for self-managed and collaborative learning.

Research

Our main research focus is the analysis and development of innovative mixed reality human computer interfaces. To develop adequate technological and pedagogical concepts for e-learning in future technical training, user need must be analysed in depth. The requirements of different user groups (students, teachers, employers) are described and consolidated. Acting in an environment, where real world objects and IT-technologies are applied simultaneously, requires new concepts of supporting cooperating local and distributed learning groups. The scientific challenge is to handle physical as well as virtual presence and awareness without confusing side effects for the users. In DERIVE we evaluate the user-friendliness of the developed software, analyse the established communication and tele-cooperation behaviour and qualify the learning benefit of the system prototype.

Product

DERIVE developes a mechatronics learning environment where on-site and remote components merge into a cooperative learning process. The envisaged system allows to work together with complex real and virtual mechatronics systems, consisting of parts which may be distributed all over the world. The learning environment includes a supportive web-database with multimedia learning sequences providing theoretical background information, exercises and help to handle training tasks. Mechatronic hardware equipment can be connected to the virtual environment with a special sensor-actor coupling. Real electro-pneumatic circuits can be directly imported into the virtual world via image recognition facilities. The DERIVE learning environment smoothly integrates equipment and supports full hardware-in-the-loop functionality, allowing to build up real mechatronic systems as subsystems of complex virtual systems.

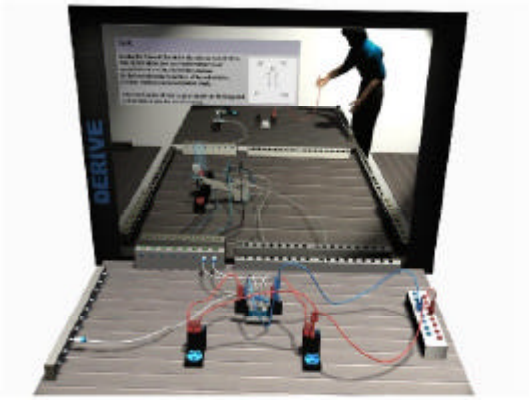


Abbildung 1: DERIVE Design Sketch

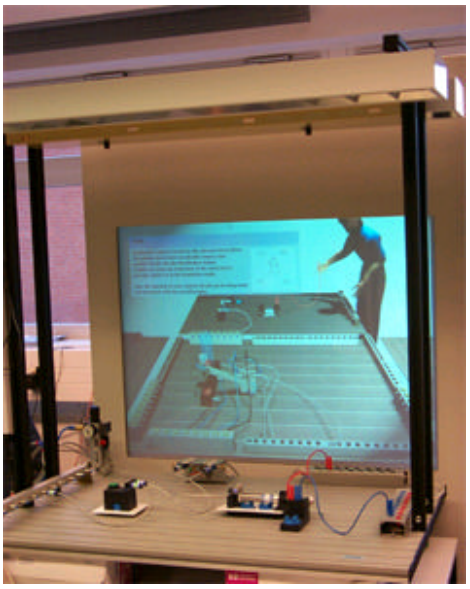


Abbildung 2: DERIVE Prototype