The CELSIUZ Interaction Room: the Vision of a Decision Theatre from an IT Perspective

Andreas Schulz[1], Michal Dostál[2], Jörg Lässig[1,3]

1 University of Applied Sciences Zittau/Görlitz, Theodor-Körner-Allee 16, 02763 Zittau, Germany
2 Technical University of Liberec, Studentská 1402/2, 461 17 Liberec, Czech Republic
3 Fraunhofer IOSB AST, Wilhelmsplatz 11, 02826 Görlitz, Germany

Abstract

We present our previous and current work for the CELSIUZ Interaction Room, which aims to provide a technology-enabled space for Co-Creation. We describe the established keyboard video mouse (KVM) setup, the associated challenges in terms of the chosen technology as well as possible usage scenarios, and outline our current plus prospective further solutions to improve the setup towards a vibrant and prolific work and collaboration environment, to enable simulation, presentation, training, and teaching use cases and supporting decision-making processes, among others.

1. The CELSIUZ Interaction Room

The CELSIUZ is a transfer laboratory of the University of Applied Sciences Zittau/Görlitz and a Co-Creation space located in Zittau, which intention is to serve the exchange and transfer of research with business and society. As part of the CELSIUZ, the so-called Interaction Room was planned, among other things, which intends to promote and support this exchange with its technical equipment. It is designed to help sketch, simulate, and validate ideas but also to present, teach, and train.

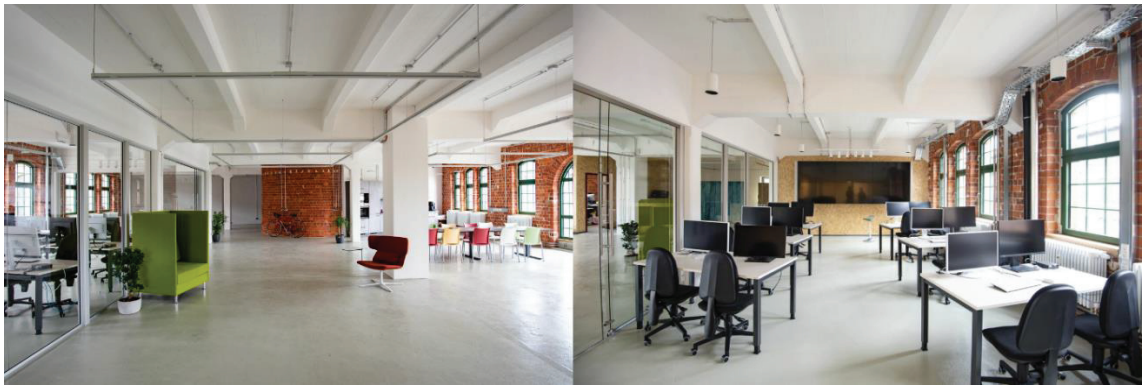

Figure 1: The CELSIUZ Co-Creation Lab with ist Co-Creation area (left) and the Interaction Room (right) (photographer: Martin Kunack).

The Interaction Room (see: Figure 1 right) consists of six desks with two monitors each and a display wall consisting of six monitors (3x2 arrangement). Linked to this in a separate server room are six computers, five of which provide two graphics outputs each, and a more powerful computer with six graphics outputs. The link between monitors and computers is the KVM technology, consisting of input and output modules, which are responsible for converting the KVM signals into network packets and converting them back. In between is a KVM router that enables the free switching of inputs to outputs. On the one hand, this enables the spatial decoupling of monitors and computers and, on the other hand, any graphics output of this setup can be switched to any

monitor, whereby signals can also be output to several monitors without any problems. In the opposite direction, control signals (i.e., keyboard and mouse signals) are passed on from the desks to the computers. This enables, for example, several workstations to control the same computer. Thus, this hardware equipment supports the desire to promote cooperation and exchange between the actors and to work together on solutions in a goal-oriented manner, thus offering Co-Creation a place to flourish.

2. Usage scenarios

The CELSIUZ was established as a central point for the topic of supply infrastructures for all Saxon universities of applied sciences as part of the Saxony5 joint project (Smart University Grid - Wissenströme intelligent vernetzen). In the follow-up project Saxony5 2.0 (Sustained University Grid), the focus is broadened to include more aspects of sustainability and the environment. A research focus of the University of Applied Sciences Zittau / Görlitz deals with energy technologies as part of its research profile *Energy and the Environment*. Energy supply and infrastructure operators, e.g. in the area of critical infrastructures (KRITIS), often have elaborate control centers consisting of large display walls and are equipped with just such KVM hardware. The simulation of such control centers was the main motivation for using the KVM technology. The objective was to be able to reproduce and simulate such control rooms. Furthermore, the Decision Theatre at Arizona State University, as described in (Edsall & Larson, 2006) and (Miller, 2019) served as a model for the vision of making suitable content available and being able to discuss and even edit it cooperatively.

In addition, the use in teaching or for presentations should benefit as much as possible from the great flexibility. The technology of the Interaction Room can be used in different configurations for this very presentation, but also for collaborative work on content. The display wall can be operated in different modes (e.g. six separate displays, a 4+2 setup, where four screens are combined into one big picture and next to it are two small screens or, as a whole, with one joined content over the entire display wall) or content can also be played out over the workstations. Different models of interaction can also be realized (e.g. front-of-class, mutual exchange, and joint editing of content by working together from multiple workstations). The Interaction Room should support as many cases as possible and facilitate the necessary interaction with as little disruption as possible.

3. Challenges of the KVM setup

Unfortunately, the reality in the face of the high degree of desired flexibility looks different. Classical hardware KVM's typically provide an on-screen display (OSD) and the possibility to configure shortcuts for interaction. Both options are not easily accessible and entail considerable limitations in their interaction with the associated KVM technology. The KVM solution used in the Interaction Room at the CELSIUZ is provided by hardware by HETEC GmbH, specifically the V-Switch-Compact. The KVM switch provides a configuration interface in the form of an OSD that is accessible by a specific keyboard shortcut entered on any workstation connected to this switch. From there, the user can perform switching operations of input and output connections. However, this workflow is complicated and cumbersome and implies a steep learning curve.

The number of definable shortcuts is usually quite limited (e.g., 12 or 24 shortcuts maximum) and thus only offers an option for predictable switching scenarios. The shortcuts

need to be preconfigured for predefined scenarios - and due to the limited number, are also limited to these. However, this presupposes that the number of scenarios can be defined in advance. This restriction is not practicable, especially not for our desire for high flexibility in the application scenarios.

The OSD, on the other hand, is not suitable for ad hoc switching of several screens in our specific case but only allows individual switching one after the other. This inevitably leads to unacceptable switching times. Moreover, the genereal switching times of the KVM in our concrete setup are not insignificant (up to about one to two seconds). This is only suitable to a limited extent for particularly dynamic content changes and increases the desire for more seamless content orchestration.

The obstacles to mastering the OSD and the shortcuts are high. However, with their concrete restrictions, they also limit the user in the flexibility to distribute and place content. In addition, the KVM technology does support interaction, in that specific computers can be controlled from several workstations. But even these possibilities are quite limited due to the technical conditions of the KVM (only one user at a given time and again not insignificant switching times between user changes).

4. Current and prospective solutions

The hardware-technical solution results in several limitations and challenges, which we have tried to counteract and solve with the conception and realization of software-technical solutions. These include two mobile apps that ease control and use, as well as a prototype that is intended to facilitate the distributed playout of content and the interactive editing of this content. These solutions are briefly outlined below.

To achieve greater flexibility in working with the KVM technology, we have used an existing API interface of the KVM switch and made it available via a service. Based on this interface, we have developed two mobile apps (a Progressive Web App (PWA) and an Android app) to control our premises. With the help of these apps, the user is made free from the classic control options and, due to the flexibility gained, has more degrees of freedom in the individual control of the specific technology.

Figure 2: The Interaction Room in action: (left, photographer: Stephan Flad) the display wall used for presentation and discussions and (right) while development of the control apps, showing the LeitstandsApp PWA on a touch table in the back of the Interaction Room, from which the whole setup can be controlled.

In doing so, the PWA enables easier switching of KVM technology without having to rely on OSD or shortcuts, provides greater flexibility in configuring scenarios and extends

the possibilities with specialized Virtual Desktop (VD) switching, and enables even more powerful switching by integrating and coupling these possibilities with classic KVM switching, in a so-called presentation mode. The user benefits from greater flexibility and more intuitive use. In addition, a second Android app offers the possibility to control the Interaction Room with the hardware buttons of a standard mobile phone, just like a PowerPoint presentation can be controlled with a standard remote presenter and thus frees the user from the complexity of the technology and allows him to focus on the presentation of his or her content.

The possibilities of KVM technology and virtual desktop switching are flexible but still insufficient for particular application scenarios. It requires additional concepts that enable control of the content on several computers, for example, if one wants to use all 18 monitors as an output surface for presentation purposes, e.g., in a showroom setup.

Furthermore, the current setup does support the shared control of a computer (and thus the connected screens) over several workstations. However, the control using the KVM capabilities is competing. This restricts truly cross-device interaction. There is a need to allow more complex forms of interaction where multiple users can interact simultaneously and with each other rather than just split mouse and keyboard control. Software KVMs as alternative approaches do not offer a serious solution for either problem in their current form, as they only address partial problems. Web-based distributed user interfaces (DUI), on the other hand, promise more flexible delivery of web-based content to any output device (Monroe & Dugan, 2015) and, in combination with techniques of web-based collaborative software, also more flexible possibilities for interaction.

As part of the work on the Interaction Room, we have developed a proof of concept web-based DUI that makes the playout of content using web technologies more flexible and enables collaborative interaction on this content. The possible decoupling of the workstations could be further enhanced by connecting external locations and thus enable location-independent collaboration or even remote control of the KVM technology. This offers possible solutions for the challenges described above, even without the need for cost-intensive IP-based hardware KVMs.

The two mobile apps, including the VD switching and the presentation mode as well as the DUI prototype, create new possibilities that were previously not adequately realizable with pure KVM technology. The tools created thus expand and complement the range of applications of the infrastructure created. In addition, we developed further ideas to improve and enhance the interaction capabilities within the CELSIUZ Interaction Room.

Quellen

Edsall, R., & Larson, K. L. (2006). Decision making in a virtual environment: Effectiveness of a semi-immersive “decision theater” in understanding and assessing human-environment interactions. *Proceedings of AutoCarto*, *6*, 25–28.

Miller, & others., J. ,. Salla, R. ,. Amresh, A. ,. Smith, H. ,. Kandala, S. ,. Hinrichs, M. ,. Gorantla, R. ,. Sokteva, E. ,. Wei, F. ,. Hirsch, K. (2019). *The Decision Theater: Collaborative Research Methodology* (DOE-SLC-6903-1). Arizona State University.

Monroe, M., & Dugan, C. (2015). Disperse: Enabling Web-Based Visualization in Multi-screen and Multi-user Environments. In J. Abascal, S. Barbosa, M. Fetter, T. Gross, P. Palanque, & M. Winckler (Hrsg.), *Human-Computer Interaction – INTERACT 2015* (S. 418–435). Springer International Publishing. https://doi.org/10.1007/978-3-319-22698-9_29