EDITORIAL: VIRTUAL REALITY TECHNOLOGY IN ARCHITECTURE AND CONSTRUCTION

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1. INTRODUCTION

Communication is a personal, intentional, transactional, symbolic process for the purpose of exchanging ideas, feelings, etc. Communication is not an impersonal conveying process. These widely adopted definitions in communication science are clearly showing that communication is a skill area where one originally puts emphasis on the understanding of messages. This is suggesting that within a properly planned communication process one is always trying to maximise chances for the comprehensive understanding of the sent messages. Having this as a starting point the used media, writing or presentation technique and style are chosen.

The discussion above has presented the communication concept as a wide framework covering all kinds of interaction between individuals where we have a message to be sent and received. Information technology should naturally provide the necessary services for a successful communication. In technical terms we may first focus on data transfer, its possibilities and implications for true communication purposes. From a human viewpoint we are aiming at a dialogue. A genuine and effective communication can enable dialogue where individuals are together creating new innovations, entrepreneurship and commitment. This would naturally require that the communication infrastructure can fully maintain and support the dialogue. Advanced information technology can have a vital role here.

In the complex businesses and operations involved in architecture and construction it is not often easy at all to achieve the described target situation. In practice due to cumbersome or otherwise too much time-consuming communication people tend to minimise all required communication with other participants in the process. Research results are highlighting that this is causing severe disturbances that are widely affecting the activities of other partners and the final product (Lahdenperä, 1995).

The described overall situation is a big challenge for the research and development community. An obvious solution is to provide easy-to-use communication solutions for all different stakeholders in architecture and construction. The desirable target system is one where all those involved would have a good understanding of the building object on their own terms, at any time, and without trouble. Virtual Reality technology seems to be eminently suited to this purpose. Virtual Reality (VR) can be defined to be a computer generated environment that can utilise visual, auditory and haptic (touch and force) channels for communication between a user and a computer (Kalawsky, 1993). Through this VR is giving the user an experience of being surrounded or immersed in a virtual, computer simulated environment. Applications of VR have clearly been an area of increasing research and development activities in architecture and construction.

2. UNDERSTANDING POSSIBILITIES OF VIRTUAL REALITY TECHNOLOGIES FOR ARCHITECTURE AND CONSTRUCTION

Three abstraction levels are proposed for classifying and directing research and development in the field of virtual reality technologies for architecture and construction. These are

1. *Enabling technologies*. VR systems can vary from desktop systems to facilities consisting from one to six big projection screens. These are multifaceted combinations of hardware and software with plenty of specific research and development challenges. In particular, lacking standards have created a situation where the selection of any platform to be used as a development base seems to be a very risky choice for industrial applications.
2. *Applications*. Practitioners have found many applications for virtual reality visualisations across various activities from early design reviews to marketing (Whyte, 2002). Fundamentally it seems that this is about having new solutions to prove and understand directly the performance of the built facility or environment, a facility still to to be built, or the actual building process from various viewpoints.

3. *Processes*. The final implications of VR in architecture and construction are in new emerging processes. The traditional processes can change or they prove to be unnecessary and completely new processes can appear. The technology adaptation that happens during this is neither generally not very well understood nor it has been studied enough.

The following chapters provide additional discussions on the proposed levels.

3. ENABLING TECHNOLOGIES

Presently we are facing very exciting times where new solutions from the gaming industry seem to becoming a real affordable choice for the base technology of various VR applications. A multitude of innovative hardware and software solutions are seriously challenging current mainstream systems, which on the other hand have well-established solutions for many areas. At the same time the nature of these new solutions may look rather immature having less professional support, lacking standardization and only a recently established business unit as a historical background.

Despite this partial immaturity the solutions from the gaming industry can well meet the needs of industrial applications. Still the main challenge seems to be the identification and assessment of the technologies that would be appropriate for the application in question. VTT has during year 2002 completed the VTT Lumeportti visualisation facility that has been designed both for application development as well as for experimentation with PC based VR technologies (Fig. 1).

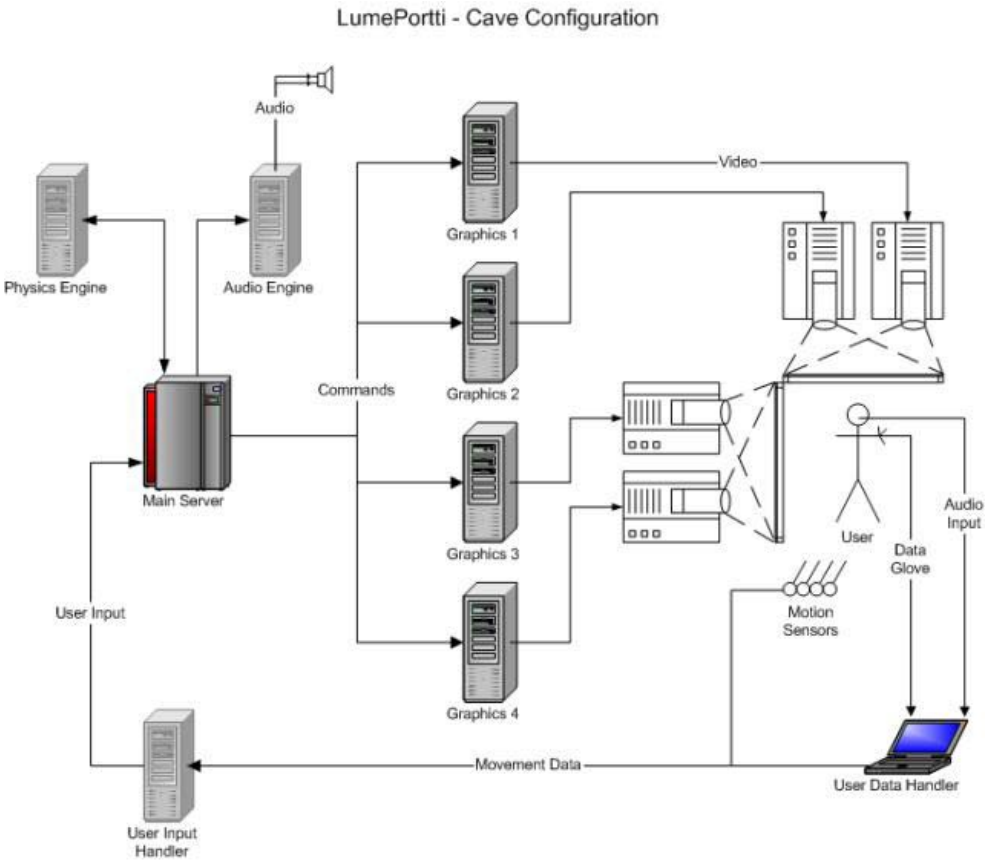

Fig 1: Hardware architecture of a scalable PC-technology based VR-studio developed in VTT.

4. VIEWPOINTS FOR APPLICATIONS OF VR IN ARCHITECTURE AND CONSTRUCTION

In simple terms, the development of the built-environment and of construction processes are "teamwork" where communication has an essential role. The facilities of the built-environment comprise a wide variety of different affecting factors. Examples of these are aesthetic, life-cycle aspects, environmental impacts, safety, security,

indoor conditions and comfort. Naturally cost and time issues are strongly present in most situations. The new, more comprehensive awareness of built facilities and their role relating to our life is creating a need for new communication environments and decision making basis. All listed factors have an increasing importance but they are still only loosely coupled with existing buildings or those to be constructed.

Another different viewpoint are actual construction operations and communication concerning their implications. Constructability, safety, logistics, productivity and the needs of construction management in general are examples of main viewpoints for different communication needs concerning construction operations. The pragmatic communication in construction is often based on traditional media where the breakdown of the object and its presentation can only provide some basic data concerning our main interests. For example, constructability needs to be evaluated using drawings or models that do not have any direct links to this interest.

Apparently VR technologies are opening possibilities for direct experiments from the different viewpoints discussed above. A current research project at the University of Salford termed nD is aiming in this direction where the expansion of modelling with new dimensions (from 3 to n) would provide a basis for additional performance realisations, simulations and visualisations (Lee et al, 2003).

5. NEW EMERGING PROCESSES AND BUSINESS OPPORTUNITIES

New possibilities for building product and process realisations can naturally improve current processes. More important aspects are new emerging processes, business concepts and related opportunities. At the moment an increasing research interest is particularly addressing interactive workspaces, which are seen as a way towards high quality dialogue where via real time experiments and visualisations a group of individuals can create common understanding and create further solutions. VR technology can have an important role by providing very communicative solutions that form a fundamental pathway towards quick respons, trust building between participants, fostering creativity, understanding total value. The major challenge is to provide a solution where an ad-hoc business development can take place in a successful manner, that would have not been possible without the provided solution.

6. THE PAPERS IN THIS SPECIAL ISSUE

The research and development efforts in the area of virtual reality technology in architecture and construction are widely addressing the challenges from specific technologies and applications to experiments and trials in live projects. The papers of this special issue are nicely reflecting this situation providing recent insights and results that can be seen to be related to all the three abstraction levels presented above.

- Kamat, V.R. and Martinez, J.C., Automated Generation Of Dynamic, Operations Level Virtual Construction Scenarios
- Lipman, R.R. and Reed, K.A., Visualization Of Structural Steel Product Models
- Savioja, L., Mantere, M., Olli, I., Äyräväinen, S., Gröhn, M. and Iso-Aho, J., Utilizing Virtual Environments In Construction Projects
- Whyte, J., Industrial Applications Of Virtual Reality In Architecture And Construction

7. REFERENCE

Kalawsky, R.S. (1993) The Science of Virtual Reality and Virtual Environments. Addison-Wesley.

Lahdenperä, P. (1995) Reorganizing the building process, VTT Publications 258, Technical Research Centre of Finland, Espoo, Finland.

Lee, A., Marshall-Ponting, J.A., Aouad, G., Wu, S., Koh, I., Fu, C., Cooper, R., Betts, M., Kagioglou, M. and Fischer, M. (2003) Developing a Vision of nD-Enabled Construction, Construct IT in association with the University of Salford, UK.

Whyte, J. (2002) Virtual reality and the built environment, Architectural Press, Kent, United Kingdom.