

Experiencing Infrastructures Sharing for International Research Activities

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Abstract

The Visionair Project aims at the creation of a distributed infrastructure of technological facilities in Europe as a visible, attractive entry point towards research and experimentation in high level visualisation, virtual reality and augmented reality fields, for hosting international researchers and giving them the opportunity of trying and practicing their ideas and their research topics. The infrastructure provides access to an extensive pool of visualisation services, including visualisation environments, leading visualisation software packages, post-processing resources and collaboration environments. ITIA-CNR, as partner of the Visionair Project, is providing access to its infrastructure, namely VirtualFactory, it has already hosted transnational accesses in its facilities and this paper presents them as an example of experiences that can be done by accessing the common infrastructure for research of Visionair.

Categories and Subject Descriptions: I.3.7 [Computer Graphics]: Three-Dimensional Graphics and Realism-Virtual Reality; J.5 [Arts and Humanities]: Architecture; K.3.1 [Computers and Education]: Computer Uses in Education-Computer-Assisted Instruction.

1. Introduction

The Visionair Project aims at the creation of a infrastructure of technological facilities in Europe as a visible, attractive entry point towards research and experimentation in high level visualisation, virtual reality and augmented reality, for hosting researchers from all the countries by giving them the possibility to practice and try their ideas and their research topics. The infrastructure provides access to an extensive pool of visualisation services, including visualisation environments, leading visualisation software packages, post-processing resources and collaboration environments. Both physical access and virtual remote services are provided by the infrastructures. The accesses made by researchers to these facilities are called Trans-National Access (TNA) and the intended target of the TNA activities would be represented by researchers, professors, doctorate candidates that, for example: want to run their simulations on high-end visualisation platforms, want to do real time assessment of the simulation results during on-line simulations, develop novel post-processing methods or develop parallelised versions that require a large computing effort, need high definition/high resolution output devices, access virtual reality facilities for scientific research, share experience with virtual reality setups.

The activity of TNAs, in terms of access and use of shared infrastructures, is in a context different from an international research project. In fact, the access to a specific facility is an on-demand access, in the sense that researches write a sort of short white paper summarizing the aim of their work and asking for a site with the proper

infrastructure suitable for them. The infrastructure is represented by facilities (in terms of hardware devices and software tools) and by personnel that can give expertise for supporting the work. ITIA-CNR, as partner of the Visionair Project, is carrying on transnational accesses, two already done and other four are being scheduled for the coming period. The two concluded experiences have been done with the University of Sibiu, in Romania, and with the University of Delft, in Nederland. In this paper we present the experimental research activities that have been carried on at ITIA-CNR within the Visionair Project as an example of experiences that can be done by accessing the common infrastructures for research.

2. The E-Resources map

A key element that allows the selection, the localization and of course the utilization of an infrastructure is the online map of the facilities belonging to the partners of the Project (Figure 1). The map is supported by an ontology data representation where the facilities as hardware devices, software tools and applications of every type are described. A potential visitor can browse, also by applying different filters, the map. Every element of the map comes with a description about what it is, its technical features and characteristics and of course at which institution it is located. Within the E-Resources map the ITIA-CNR facility has been identified as VirtualFactory, since the experience of the Institute in international projects related to the virtual manufacturing environments topics ([SDM*11][SPT10][VGMS11]) and it consists of 3D

authoring and modelling tools, proprietary programming libraries for realtime graphics, interaction devices and visualization means and some of them are involved in TNAs activities described below.



Figure 1: A snapshot of the online map of the resources of the infrastructure. The different categories can be browsed deeper down to the specific facilities of an institution.

3. Experiments with virtual worlds immersion

The first trans-national access has been made by a doctoral candidate of the University of Technology of Delft, Nederland, by using the facilities offered by ITIA-CNR, in the field of study for enhancing creativity inspiration in the architectural and design processes, it represented a brick of the whole work. Creativity is the fountainhead of human civilization and all progress and innovation depend on the ability to change existing thinking patterns, to enhance the ability, to break with the present by building something new. Accentuating the role of creativity in design even more than other disciplines pushes one to underpin understanding creativity as key role player in the architecture discipline. The question that remains here is: how creativity of the designer can be enhanced? Since the creative idea is no more that new combination of what you already experienced also referring to the idea of conception blending by Mark Turner in unconscious mind [FT98], we can feed the brain with new data that it has never experienced before. These new data are represented by unconventional descriptions of the world, of the environment, of the space. With such unconventional descriptions no known physical rules are available, the user is projected in a new type of universe that does not behave as the real one, for example: no gravity, continuous changes, infinite depth. This new representation stimulates the brain to perceive the new environment and starts bending it with the previous knowledge of space and eventually more creative idea will appear. But the question still remains: is there any empirical evidence on this hypothesis? To this end, a measurement campaign has been started with the trans-national access with the aim of tracking and measuring the brain responses that occur during the exploration of an unconventional environment,

through the use of virtual reality techniques. The candidate has developed a virtual environment representing a unconventional space. The virtual world (Figure 2) is built by a large set of shapes composed in a way so that the basic orientation concepts of “ground”, “sky”, “left side”, “right side” are lost, thus giving the user the opportunity to feel free to go in an undetermined direction mainly by following the personal intuition and feeling.

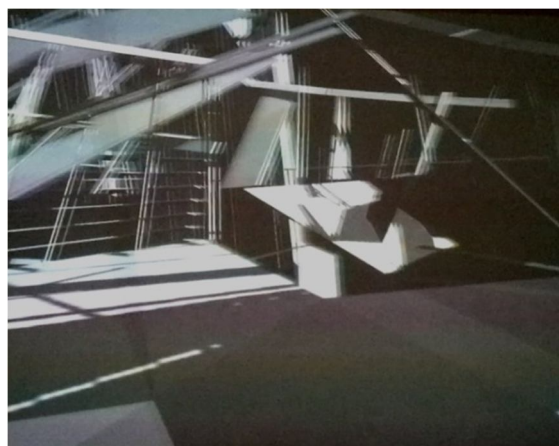


Figure 2: A snapshot of a point of view on the unconventional virtual environment.

The hosting Visionair partner (ITIA) made available part of its facilities consisting, in this case, in: stereo projector Optoma EX762 [OPT], XPand active stereoglasses [XPAN], 3D mouse 3DConnexion Space Navigator [CON] and in the software GIOVE Viewer, an in-house developed OpenGL-based application for loading 3D scenes and that allows various operations as navigating in the scene, positioning/rotating objects, taking screenshots, adding lights, customizing observers points of view, real time shadowing [VGMS11]. The candidate came with the headset Emotiv-EPOC [EEN] for recording brain waves (Figure 3) and with the 3D scene, designed and already prepared, that should be the base of the unconventional virtual environment.



Figure 3: The headset is fitted on the head of the participant for recording the brain waves during the test.

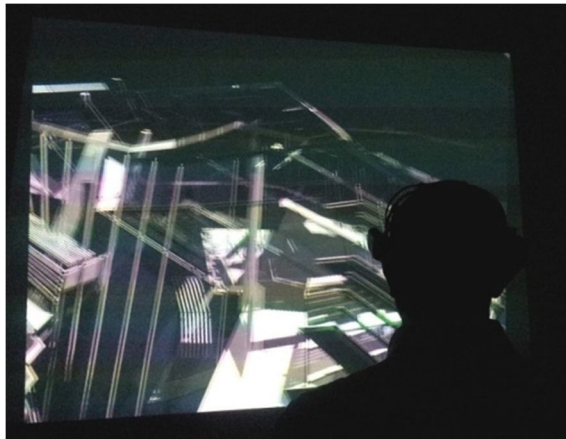


Figure 4: Once ready, the participant starts experiencing the unconventional spaces in the virtual environment.

A set of 21 users, 12 males and 9 females, has been composed. The user had to freely navigate in the virtual world while wearing a headset for recording the brain waves, the virtual environment was projected on a powerwall screen with active stereoscopy and the user also worn the stereoglasses while the navigation capabilities have been provided by the interaction means with a 3D mouse that the user hold in the hand (Figure 4 and 5).

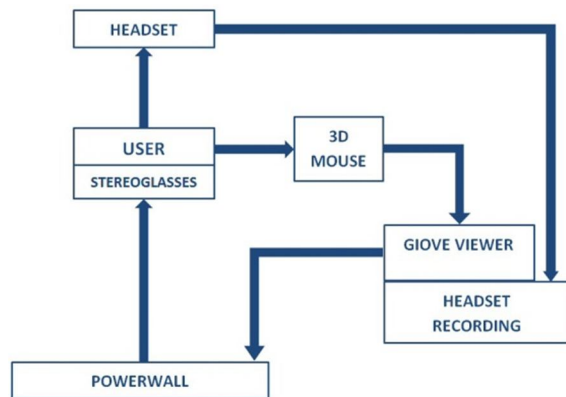


Figure 5: The logical architecture set of the experiment.

After the setup, the participants have been asked to navigate in the environment using the 3D mouse device. They have to play with it until they feel that they are master in using the device. They had as much time as they wanted. The participants have been asked to consider themselves walking and navigating in a real environment as they saw in the simulation with the same characteristics. Whenever the participant got ready, he (she) gave a “go” to the operator that started recording the brain functions for the next 4 minutes, while the participant was exploring and navigating the environment by going along the feelings. After the live exploration of the virtual environment, participants have been asked to write down a short report about the experience. The aim of the reports was the collection of their opinion and feelings in terms of: the experiment itself, the major feelings during the experience, the mental strategies or preferences used to navigate in the virtual environment, and any other eventual comment. Analysis of the experiment and of interviews went under

further processing in the doctoral path of the candidate with the aim of comparing the brain activities with previous standard creativity experiments to find out similar patterns on brain functions.

4. Experiments with augmented reality for learning CAD modeling

The second trans-national access has been granted to a doctoral candidate from the University of Sibiu – Faculty of Engineering, Sibiu, Romania, by using the facilities offered by ITIA-CNR, with argument the filling with the support of augmented reality (AR) the lack of spatial visualization in first year engineering students in technical design and descriptive geometry disciplines. This kind of lack occurs in engaging with such disciplines since the students have difficulties in “visualizing” the various steps of procedures and processes where 2D and 3D shapes take place. The tests with AR aim in this case at digitally showing the operations to be done over technical drawings (Figure 6 and 7). In the tests, step by step instructions for modeling 3D shapes in the CATIA CAD software on technical drawing were shown to the participants and also AR support in learning CNC machining process were provided. Technical drawings at medium difficulty were selected for the experiments.

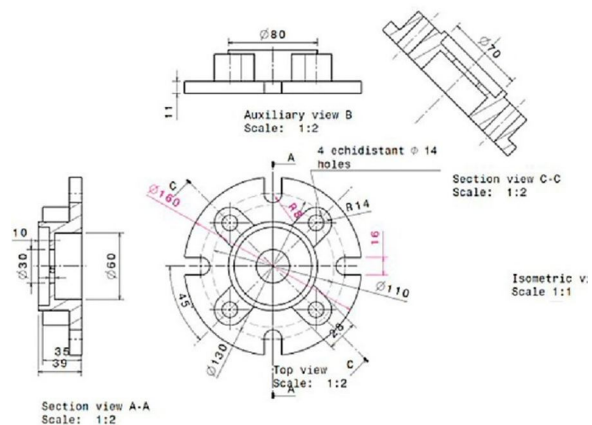


Figure 6: A 2D standard technical drawing is used for superimposing AR instructions.

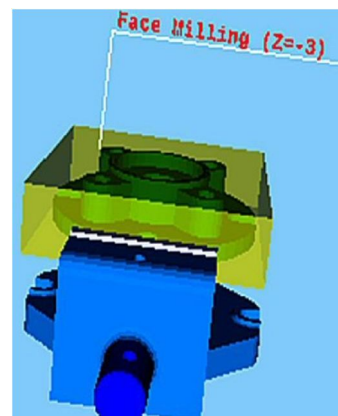


Figure 7: Various 3D models have been prepared to represent the work in progress with also the text indications.

The hosting Visionair partner (ITIA) made available part of its facilities consisting, in this case, in: SAP Visual Enterprise 3D file formats conversion and modeling tool [SAP], Head Mounted Display (HMD) SONY 3D helmet [SPV], 3D Mouse 3D Connexion Space Navigator [CON]. On the other hand, the candidate came with Catia CAD software, Vuzix STAR 1200XL see-through AR glasses [VUZ], Metaio Engineer AR software [MENG]. During the visit an AR application has been implemented and the tests were done. The 3D models representing the instructions to be shown were modeled as well the 3D objects of the various modeling and machining steps with CATIA and then exported and refined for augmented reality with the provided SAP Visual Enterprise application. The function logic of the step by step AR instructions and interaction has been programmed with Metaio application that provides visual workflow programming means. The main programmed functionalities (that are triggered by the user interaction) have been: selection of specific training program, selection of next (or previous) step in the current running workflow, scenario stop and restart, displaying of instructions. The user selects the specific training scenario and visualizes the instructions that appear contextually near the 3D representation of the current state of the shape to be processed, then the user performs the selected work and, in case of severe issues, he (she) can reset the whole training lesson (Figure 8). After developing the core of the application, the logic of workflow and the AR visualization techniques were then tuned so that the resulting training application could be tested with 3 different equipments for visualization (Vuzix, SONY HMD and standard LCD monitor). During the tuning phase there were some issues with Vuzix glasses related to a not sufficient performance, for the targeted purposes, in mixing live video feed with digital augmentation by giving overall results visually confused, thus the background has been changed from video live feed to a black not transparent one where the 3D models were superimposed. The tests have been done by the personnel of ITIA-CNR, by including people without a strict technical background in order to check the contents of the AR training procedures. The participants have tested the training applications with the 3 display devices. The training applications were: do a sequence of modeling on a base 3D model and do a machining operation by following the instructions (Figure 9 and 10).



Figure 9: The instructions show first milling operation that should be performed (face milling). These instructions will guide the user through all necessary machining operations until the rough stock becomes the finished part.

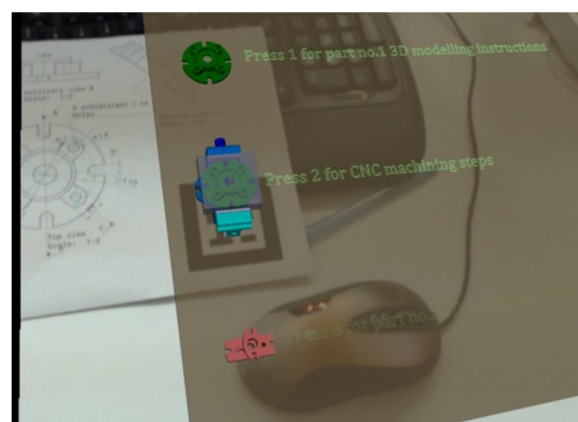


Figure 10: The main menu in AR, referred to a specific technical drawing.

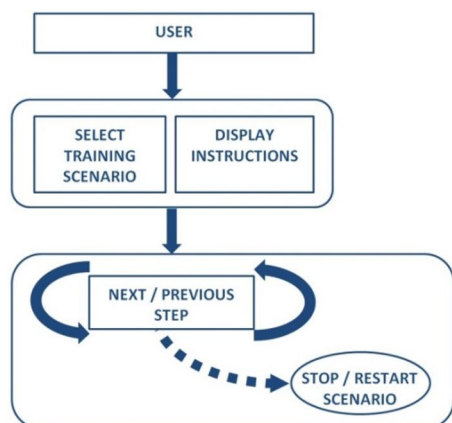


Figure 8: The workflow of the application.

The next step of the overall work of the candidate, where the work presented here is a part of it, is to apply some improvements to the visualization of the user interface in AR and to test its use on ex-students who are working in industrial companies around Sibiu, with the final goal of discovering if AR will bring real benefits in the industrial environment, which are these and how industrial workers perceive the use of AR in the industrial field.

5. Considerations about the experiences and future work

In this paper two visits at ITIA-CNR (Visionair Project infrastructure partner) made by PhD candidates have been presented. Such visits have been made possible by the E-Resources map of facilities hosted on the web site of the project. People that belong to the scientific and technological research and that are conducting research and that are planning to do specific experimentations or trials but that have not specific facilities at their own institutes can browse the map looking for sites allowing the required facilities, in terms of hardware, software tools and also supporting professional people. This is an example and an experience about how, in fact, the network of facilities provided by Visionair can really be an important aid for the international localized research activities. The specific characteristic is also the dynamic of the visit, that is similar to an on-demand support: a researcher already has an idea and a planning, also maybe a partial implementation of some system or of some methodology, but

he (she) lacks some tools. The researcher finds such tools in the Visionair infrastructure, keeps in contact with a specific facilities site by describing the planned work and the needs. Finally, the researcher physically goes for a period at the selected structure where he (she) can use the already available tools provided by the hosting institution and temporarily “installs” further ones (eventually carried by the candidate) and integrates them in the facility. ITIA-CNR is planning new visits, that are about to be done in the next autumn, where new young researchers will be hosted for carrying on their work in the field of visualization-enhanced design of transfer lines and of mechanical design and processing.

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