VEGA FINAL ACTIVITY REPORT

Publishable executive summary

Contract number: 16565
Project acronym: VEGA
Project name: Virtual Reality in Product Design and Robotics
Priority /Priority Component (e.g. Strategic Objective, etc.): IST&NMP
Project logo:

List of participants (organisation name, country):

Transilvania University of Brasov – Product Design and Robotics Department, Romania
Total cost (€): 900,000
Commission funding (€): 900,000

Main goal(s) of Specific Support Action

The general objective of VEGA project was to increase the capacity, quality and scope of research at Product Design and Robotics Department (PDR) of Transilvania University of Brasov by establishing strong and sustainable research cooperation schemes with centres of excellence in Europe and major industrial partners in the regional and European industry based on a competitive research infrastructure.
The goal set for the end of the project was to pass from the mechanical engineering predominant research and early research stages in Virtual Reality to the product life cycle approach via VR applications with full capabilities in terms of infrastructure, personnel and participation to the European Research Area (ERA).

Key issues

In order to achieve this strategic objective, three major operational goals are set:

- INCREASED SCOPE AND COMPETITIVE RESEARCH INFRASTRUCTURE: - This has been addressed through the creation of a backbone of *four research workgroups*. These teams undertaken the tasks of defining in detail the S&T objectives of each topic and the creation of the research capacity in terms of human resources, infrastructure and partnership.
- TRAINING and MOBILITY. Training of researchers through special intensive sessions and through integration within research groups from the department partners.
- INTEGRATION INTO THE ERA through development of a strategic partnership highly relevant for the ERA, able to generate of new competitive initiatives within the EC research framework programme.

Technical approach

The core scientific innovation of Project VEGA is to combine latest VR technology and concepts with product life cycle software (design, simulation, testing, manufacturing, maintenance and recycling) to enable the Fast and Flexible Manufacturing Enterprise.

The project had a backbone of *four research axes* that have been supported within PDR to cover the product life cycle and on which the whole strategy of the support actions was built. The four workgroups (WGs) are:

- WG1: *VR based design and simulation* group dealing with the aspects related to the valida-tion of the product functional characteristics, ecodesign and life cycle impact assessment
- WG2: *Virtual testing* group - focusing on matters related to integrating hardware and human in the loop techniques using real time VR & dynamic simulation capabilities for testing.
- WG3*: Manufacturing and recycling* workgroup that undertaken research in the field of Virtual assembly for planning of the assembly/disassembly sequences and validation of processes, process layouts and routes.
- WG4: *Maintenance w*orkgoup that developed Augmented Reality techniques such as to enable remote and e-maintenance applications.

These teams undertook the tasks of defining in detail the S&T objectives of each topic, the creation of the necessary research capacity in terms of human resources (hiring new young PhDs and training of the researchers), infrastructure and international partnership in order to achieve the established objectives.

Achievements/impact

The main achievements of the project include a high level research infrastructure in the field of VR in Product Design and Robotics and highly trained personnel especially newly hired young researchers working in an international cooperation context as well as a higher visibility of PDR Department in ERA. The package of measures supported within VEGA laid out strong scientific foundations able to support the integration of PDR Department into the European Research Area. In particular, the networking, the enhanced infrastructure and increased capacity to promote projects at European level provided an excellent self-sustainability on long term of the main project outcomes: joint research, exchanges, training of researchers and infrastructure. This is particularly guaranteed by the large number of RTD contracts currently under development within the VEGA research group

Work performed

As result of the 3 years of activity and the massive amount of funding that has been spent for research infrastructure, the Product Design and Robotics Department from the University Transilvania of Brasov took a new start at a higher scientific level, becoming a strong centre of excellence in the field of Virtual Reality in Product Design and Robotics in Europe already after the first project year. Thus, not only the research infrastructure has been updated up to the highest level in Europe, but advanced scientific applications have been developed, with significant results appreciated by the VR research community in Europe at various scientific events. Within VEGA project, several scientific events have been already organized and completed, rising the level of excellence and visibility of the VEGA research group in Europe and overseas at an unprecedented level.

The infrastructure developed by the project allows now targeting highly relevant scientific objectives in the field of development of generic multimodal interfaces for product engineering applications. The solutions envisaged could include 3 output modalities (3D visual, haptics and 3D audio) and 3 input modalities (tracking, gesture

and speech), such as to be able to replace totally the conventional desktop interfaces based on 2D display and mouse.
For the large 3D visualisation system CAVE as well as the large haptic devices (SPIDAR) have been developed by the VEGA team
Within project VEGA, large scale visualization systems have been envisaged like holobench and CAVE. An innovative multipurpose architecture was developed within VEGA project, able to provide both possibilities for the 3D visualization: CAVE and holobench functionality - "holo-CAVE" (fig.1).

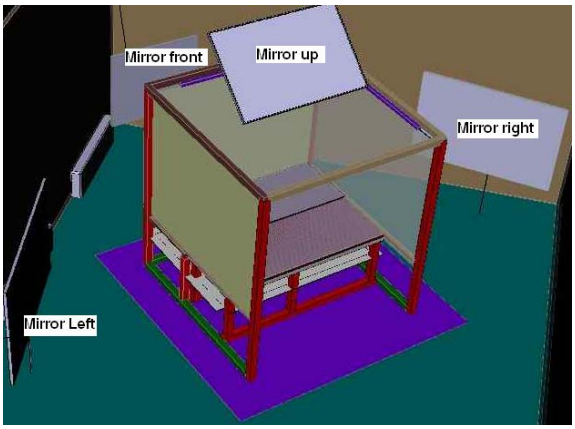

Fig. 1. *Holo-CAVE: an innovative concept developed by the VEGA team*

This solution allows making experiments related to the study of technical tasks that are performed by a human operator in the posture "seated" or alternatively, could be configured as a CAVE system, in which the user is performing tasks that require a "standing" posture.
A second visualization system that was acquired within VEGA mainly for augmented reality applications is the TRIVISIO HMD with see through option
In order to achieve a multi-modal interface, the second output modality that was chosen is haptic. Out if the commercial haptic device Phantom with 3 degrees of freedom (dof), force-feedback and 6 dof positional sensing that was purchased within the project VEGA, the research team of the laboratory developed a state of the art wired based system, that includes 8 wires and could be used as a 7 degree of freedom device that manipulates and grasps a 3D virtual object/ Tracking is achieved through a Flock of Bird magnetic tracking system with the range radius of 1.5 meters. For the gestures needed to emulate various commands in the virtual environment, data gloves are used, while for the speech

Fig.2. *The Flexible manufacturing cell installed in the VEGA lab*

ordinary audio system is used together with the Microsoft voice recognition classes.
For the third VEGA research workgroup (WG3) “Virtual manufacturing and recycling”, the infrastructure of the laboratory was enriched with a Flexible manufacturing unit including two articulated robots ABB IRR, two EMCO CNC machines (lathe and milling) and a VISION system. The real flexible cell installed is presented in fig. 2.
The system allows the achievement of full complex manufacturing cycles from machining to assembly without human intervention. It is provided with a vision system and is in process to be linked with the virtual environment described above in order to allow simulation of complex machining and assembly processes in virtual environment prior to the real execution.

A number of 9 PhD students and 2 postdocs have been hired specifically within the project VEGA and been engaged in International cooperation schemes for exchange of researchers, PhD in duble supervision as part of VEGA poroject as well. The first advanced applications already demonstrated by the team at the end of the project using the infrastructure developed have been in the field of CAD, CAE, CAM and Virtual testing.

The project included also the organisation of three major international events: Workshop on VR at University Transilvania of Brasov in 2006, Advanced Summer Institute in Greece in 2007 and a Brokerage event in Romania in 2008. These events created a high visibility of the VEGA research group in Europe and overseas. While at the start of the project the VR Research group was virtually unknown in the VR scientific community, at the end of the project, practically the group is known and recognized as a strong centre in all major VR centres of excellence in Europe.

The VEGA project has been largely disseminated within numerous journal articles and paper conferences being published by the group members during the project period. This has contributed at the realisation o good reputation of the group and integration within the international scientific community by being present at the important scientific events worldwide.

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