Virtual Reality and Multimedia Research Group (GRVM)

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***Abstract*—This paper briefly describes the Virtual Reality and Multimedia Research Group – GRVM – its research lines, projects and some previously published work. The group, founded in 1998 at the Federal University of Pernambuco – UFPE – has already become a national reference when it comes to scientific and academic research in multimedia and virtual interface design. GRVM's international cooperation is taking shape under a number of research projects and high quality publications.**

Keywords: Virtual Reality; Augmented Reality; Interaction; Advanced Interfaces

I. HISTORY

The Virtual Reality and Multimedia Research Group – GRVM – was founded in 1998 with an agenda for training human resources in the development of advanced topics in Virtual and Augmented Reality, and Human-Computer Interaction areas. As part of Computer Science Center of the Federal University of Pernambuco in Recife – Brazil – GRVM offers a workplace with sophisticated laboratories equipped with cutting-edge technology.

Along these years, the group has published its research in conferences at both the national and international spheres as well as in reputable journals from the related areas. The group currently regularly publishes around eight papers a year. Several book chapters, courses and tutorials were also produced by the team members, composed by twenty-six researchers among whom are undergraduate, graduate, master and PhD students, and university professors.

As an academic unit, every team member is also actively engaged in a particular ongoing investigation with the necessary support needed with regards to workstations, software and supervision. Graduate course reports, dissertations and PhD Thesis are usually conducted in the context of externally funded projects while sharing some of the project´s activities. Around four graduate investigations are performed each year within the group; in addition to three MSc students and one PhD degree completion.

Using its own modern infrastructure, GRVM has two laboratories available for development and the undertaking of experiments as well as a library and a conference room. To offer a suitable research environment, the laboratories are equipped with modern hardware and interaction devices for use in Virtual Reality applications, such as HMDs, data gloves, trackers and several controllers.

CHESF, CNPq, FACEPE, FINEP and PETROBRAS

II. MISSION AND OBJECTIVES

The GRVM group continuously seeks to pioneer Virtual and Augmented Reality studies, providing an environment that embraces multidisciplinary collaborations from various scientific areas. Through an application-driven approach to Virtual and Augmented Reality, the developed projects are always generating relevant results in both academic and scientific areas, as well as in applied research for conceiving new technologies and products.

One of the main objectives of the group is to provide the scientific society and industrial partners with modern and advanced solutions for Virtual Reality problems. To achieve this goal, the group relies on a highly trained and engaged team.

Another prime goal the group strives to achieve – and at the same time one of the priorities of the University in which the GRVM is inserted – is to train and sharpen students' capabilities, forming highly qualified human resources and preparing better scientists for tomorrow's challenges.

III. RESEARCH LINES AND INTERESTS

The GRVM team acts in several research areas, such as graphics modeling and simulation, virtual and augmented reality, advanced interaction devices and techniques and embedded systems. It focuses on finding key problems in these areas and developing innovative solutions with a human-centered approach.

Since these lines require multidisciplinary knowledge, the group has a team composed by engineering and computer science students as well as designers, mathematicians and statisticians.

Since its creation, GRVM has been interested in high-end interaction technology. The group focuses on developing next generation software and hardware prototypes. To achieve that, GRVM feeds the team´s aspiration with astonishing challenges and is regularly searching for new bright minds.

Research projects are carried out cooperatively with industrial companies, such as Petrobras and CHESF (*Companhia Hidro Elétrica do São Francisco*), and research organizations in Brazil and overseas, such as the Federal University of Manaus and the Seventh Research Programme (EU FP7). This way, GRVM is funded by both government (through Brazilian funding agencies) and private companies.

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IV. Past and Ongoing Projects

Some past (A) and current (B) projects are presented in this section to illustrate the previously commented research lines carries out by the group.

A. *Some of the completed projects are:*

- ARCam – The Augmented Reality Camera (ARCam) infrastructure [1] is an embedded framework for the development of Augmented Reality applications on FPGAs using fiducial markers (similar to the ID-based ones used by ARToolkitPlus [2]). This framework simplifies developers' work by providing several hardware modules directly described in the register transfer level, which can perform every operation of a marker based augmented reality pipeline. This way, the developer doesn't need to concern itself with the infrastructure's development details required by an Augmented Reality application, such as camera capturing, marker detection and image displaying.
- CIDA – Short for Chaotic Interaction Devices Abstraction, CIDA is an input device management platform that abstracts the type of the device used [3]. The platform allows changing the interaction devices used by an application as well as the way of interaction happens, abstracting concepts such as connectivity, property mapping onto functionalities and driver utilization dependence. One of its important features is the support for haptic devices. Input devices are accessed through plugins, which are responsible for dealing with their particular features. This way, the platform recognizes them as members of the supported device families.
- RPR-SORS – The Real-Time Photorealistic Rendering of Synthetic Objects into Real Scenes project integrates in real-time synthetic objects into actual scenes in an imperceptible way. A framework that facilitates the development of applications with such requirements was built and implemented. It consists of an API for photorealistic rendering as well as a scene editor software [4].
- A2 – The Augmented Ambient project constructed a highly interactive mobility scenario based on Augmented Reality applications running on heterogeneous multimedia devices [5]. Mobility is made available through ambient networks, which are dynamic computer networks that compose automatically. A case study has been performed for a virtual museum, where users make use of the ambient networks concepts to join a service network that includes art pieces visualization, interview broadcasting, chat between museum network users, and remote live auctions. These services are implemented in a desktop, a Pocket PC and a Symbian OS platform.
- miva – The miva platform – short for mobile, interactive, virtual and autonomous – works by grouping selected hardware and software components. By doing so it achieves high-performance levels for multimedia applications often better than that of common computers, seamless device interchange, and rapid application development in addition to giving a whole new level of experience to the user [6].

B. *Ongoing Projects include:*

- R3D – The 3D Reconstruction project produces an application for 3D reconstruction, which is capable of generating automatically three-dimensional scenarios of power substations. The models automatically generated may then be used in several applications afterwards. These include the architectural planning of buildings and the reconstruction of archeological objects and oil drilling platforms. These 3D models are generated from two-dimensional images taken previously and can be incorporated in 3D applications that offers support to *.obj* files [7]. Figure 1 shows some results of a rusty hydrant reconstruction.

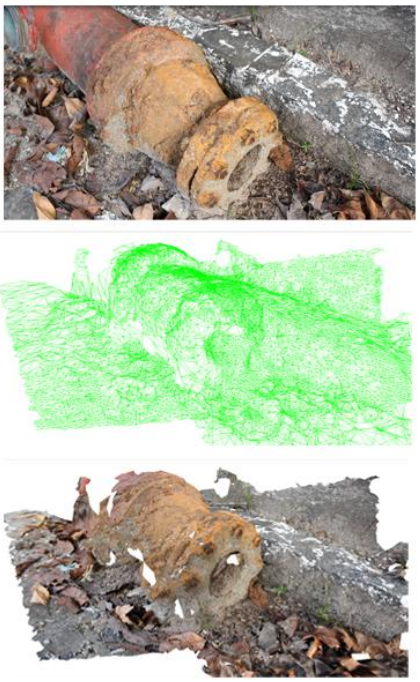

Figure 1. Selected frame of a video chosen as input, followed by its reconstruction: mesh and texture views

- vWeb – The vWeb project is concerned with assistive technologies and accessibility. The project focuses on using voice synthesis and screen reading to support impaired users' access to the Web. It aims to develop an open source multiplatform screen reader with improved usability.

- DAR²T – While Augmented Reality applications add virtual objects into real scenes to enrich these with additional information, Diminished Reality removes real objects in order to visualize a cleaner and less tangled environment. Diminished Reality applications gather the information needed to synthesize the area to be diminished either from previous frames, other cameras or even from the input image itself, using inpaint techniques [8].
- mivaMain – this project takes advantage of the miva platform and state-of-the-art research in AR to develop a mobile system for training and maintenance activities. The primary objective is to build a system for guiding a maintenance team in its task. It also enables collaboration, monitoring, and automatic report generation for an assignment. As a use case, this project considers the power generation industry [9].

V. ACHIEVEMENTS

With regards to the group´s contribution towards the Virtual Reality and Computer-Human Interaction communities, GRVM regularly participates in many national and international conferences as well as supports the development of these research fields in Brazil. The group also took part in the organization of a number of local conferences and national events.

Relevant scientific and academic publications were always one underlying goal for the team. Some of its works received awards from the scientific community.

In 2007, the paper "miva: constructing a wearable platform prototype" [6] was awarded the best paper of the Symposium on Virtual and Augmented Reality – SVR. The miva prototype is presented in Figure 2.

Figure 2. Wearable computer interface – the miva being used

The paper "An Open-Source Framework for Air Guitar Games" [10] won the best paper award in 2009 in the Brazilian Symposium on Games and Digital Entertainment – SBGames – the biggest national academic event on the gaming field. Figure 3 illustrates a user while playing a song using the implemented framework with no need for physical instruments.

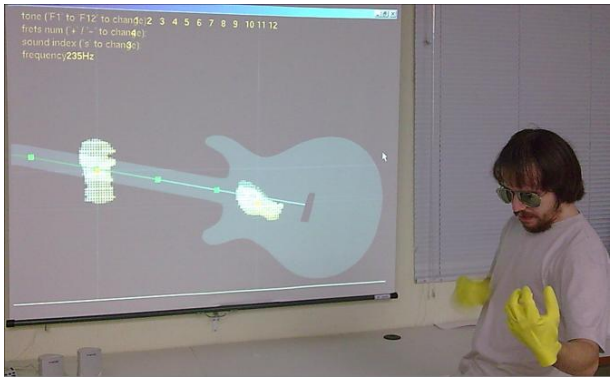

Figure 3. User's performance during a test of the Air Guitar Framework

In 2010, the CapCam device, a prototype for monitoring temperatures and performing thermal inspections as shown in Figure 4, obtained another award. The paper "Evaluating the CapCam: a device for thermal inspection of electrical equipment" [11] was considered the best paper at the event WRVA2010 – *Workshop de Realidade Virtual e Aumentada.*

Figure 4. First version of the CapCam device

Finally, in 2011, two papers authored by GRVM members were declared in the SVR2011 symposium as those with the highest research as part of the event´s program. The first work, entitled "Geometric Modifications Applied to Real Elements in Augmented Reality" [8], deals with Diminished Reality and has its technique overview presented in Figure 5. The second work entitled, "RPR-SORS: An Authoring Toolkit for Photorealistic AR" [12], is briefly illustrated in Figure 6.

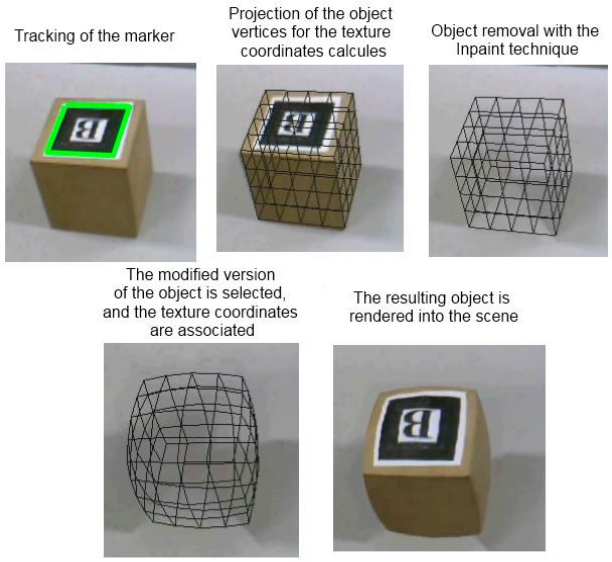

Figure 5. Overview of the steps of the technique

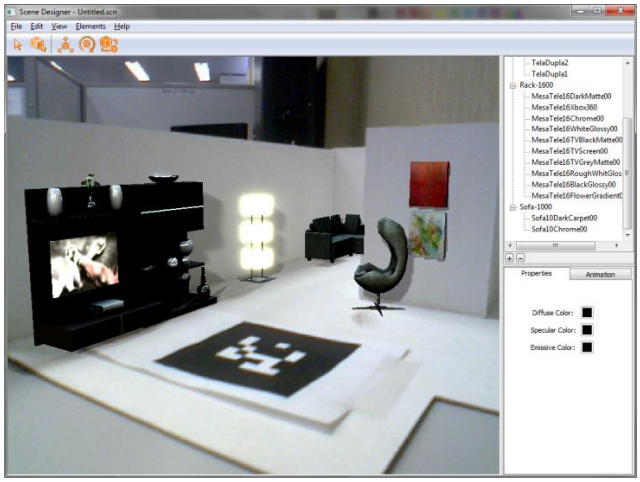

Figure 6. Example of a created scene made with the SceneDesigner application

VI. Future Directions

New research topics involve using Kinect for both the development and comparison with previous results from techniques developed by the group. An increasing use of small and portable hardware for development is also expected, especially with the iPhone´s Operating System (iOS). The correlation between Information Design and Augmented Reality is also subject to next studies.

Motivated candidates to join this team are always welcome. The desired profile should include exceptional reading and writing skills, curiosity, and creativity. Accordingly, partnerships and collaborations of all kinds are desirable, mainly for joint publication, projects cooperation and students exchange.

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