Institut Image – Le2i

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ABSTRACT

Institut Image is a department of Arts et Métiers ParisTech developing virtual reality (VR) for teaching, research, and innovation. The research team is composed of 30 people (teacher-researchers, engineers, PhD students) and is part of Le2i laboratory (CNRS lab). Institut Image hosts a master research program (15 students) and innovates through its technological platform PeTRiiV. Research activities are developed in strong relationship with industry. Several collaborative research programs are performed, including the VARI3 and Si2M projects presented briefly in this paper.

1 RESEARCH FOCUS AND STRATEGY

The goal of the research team is to develop an understanding of multisensory virtual immersion techniques to interact with a digital mock-up. This goal is developed through two research axes: 1) Interactive virtual mock-up, 2) Multisensory coupling. The research questions the team works on are situated at the intersections of these axes:

• How to represent a digital mock-up and its interactions with the environment?

• How to manage multimodal technologies in an immersive virtual environment?

• How to develop interactive while taking human perception into account?

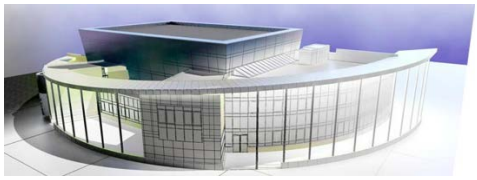

Figure 1: External view of Institut Image.

2 PETRIIV TECHNOLOGICAL PLATFORM

To support its research programs and also allow academic and industrial partners to access its facilities, Institut Image has created the PeTRiiV platform (Technological Platform for Research and Innovation in Virtual Immersion), gathering amazing hardware and software resources and a dedicated team of 8 engineers and technicians covering different domains from interactive computer graphics to virtual immersion and driving simulation.

2.1 Facilities

The PeTRiiV platform currently includes:

- A CAVE system with four faces for human scale immersion,
- A transportable CAVE system with two to four facesfor human scale immersion with full scale Spidar haptic system,
- Two static driving simulators,
- One dynamic driving simulator, and
- Many lightweight devices for VR including VR helmets and haptic devices for force feedback simulation.

Figure 2: CAVE system (left) and dynamic driving simulator (right).

2.2 iiVR Software

The PeTRiiV team also provides a complete software solution named iiVR based on popular open source components and internal developments to facilitate the creation of advanced interactive 3D applications for different purposes, including virtual immersion.

3 VARI3 PROJECT

The Virtual & Augmented Reality Interactive and Intuitive Interface (VARI3) project is an ambitious collaborative endeavor, funded by French Government, with industry partners Renault, ON-X, Lumiscaphe, Theoris, and CEA List. Over the past two years, the partners have designed and implemented a system which incorporates a tracked handheld tablet allowing users to manipulate and travel around a virtual automobile prototype while already immersed in a traditional CAVE system, as shown in Figure 3.

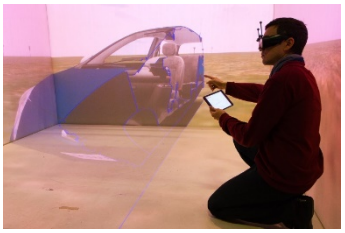

Figure 3: VARI3 allows a user to manipulate a virtual model using a tracked handheld tablet.

In the ongoing final phase, human-subjects testing is being conducted on several envisioned automotive design use cases and unique scientific questions. Augmented reality has been extensively researched, but there is surprisingly little literature on augmenting VR and the associated cognitive implications. A tablet

interface has the potential to add information and facilitate manipulations in a virtual scene, but perceptual problems may arise due to the integration of stereoscopic 3D CAVE graphics and monoscopic, often 2D, information on the tablet. These integration problems may lead to particular difficulties for virtual selection and locomotion tasks.

Direct selection is probably the most straightforward means of virtual selection on a tablet. However, in addition to the usual tablet considerations including touch feedback (or lack thereof) and ergonomics (e.g., fatigue), ineffective integration of spatial information between the tablet and the CAVE may cause problems.

Most scale-one car models are larger than the physical available space in a typical CAVE. This necessitates some means of displacement and, because a user's hands are already occupied with the tablet, it seems natural that the tablet itself should include this functionality. However, problems integrating information between displays could hinder a user's efforts to use the tablet to move to a desired location in CAVE-space.

4 SI²M Project

The SI²M (Simulation Interface Homme Machine & Interaction) project seeks to develop methods and tools for prototyping and development of ADAS (Advanced Driver Assistance Systems) for the automotive industry. This project is funded by the French government and done in partnership with Renault, Oktal SAS, Armines, Axtrid, and TechViz. The goal of this project is to provide VR tools enabling the evaluation of ADAS in driving situations. Because the car is still virtual in this design step, virtual immersion is accomplished with a cockpit surrounded by a virtual mock-up of a car in a CAVE system. One important issue addressed in this project is linked to motion sickness. For that, the driving simulation includes multi-sensory feedback (visual, auditory, motion platform, force feedback as well as visual ADAS-related equipment).

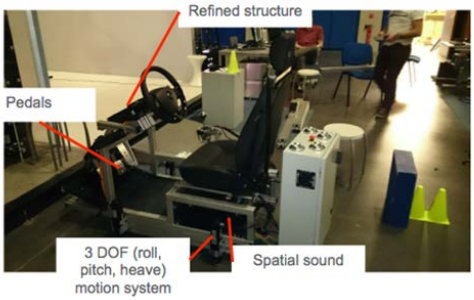

Figure 4: 3 DOF driving simulator.

Motion sickness may appear when the field of view is recovered and the vestibular system is not excited. To study these effects during the driving in a CAVE, we conducted several experiments under 8 conditions for both static and dynamic situations at a same driving scenario (mono visual type, stereo visual type, 60 degrees of horizontal field of view in CAVE, full horizontal field of view in the CAVE).

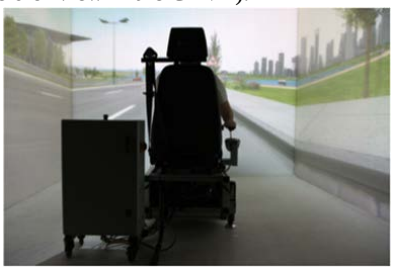

Figure 5: 3 DOF driving simulator during the experiments.

The evaluations have been realized by using both objective and subjective measurement techniques. For the objective measurements; longitudinal acceleration, lateral acceleration, and angular velocities (pitch, roll, and yaw) have been taken into account in order to have an objective metric of visuo–vestibular sensory conflict. Also, human motion perception thresholds have been investigated in terms of accelerations and the angular velocities. For the subjective measurements; "sense of presence (SOP)" and "modified simulator sickness questionnaire (MSSQ)" have been assigned to the participants.

5 Key Events

- Joined Laboratory LiV (Renault–Arts et Métiers) created in 2011
- Spin-off company Paztec created in 2013
- 900 k€ research contracts per year
- 3 large research programs per year
- 3 new PhD theses per year

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