Lab Presentation of Laboratory of Integrated Systems - LSI

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1 INSTITUTION

The Laboratory of Integrated Systems, established in 1975 at the University of São Paulo, Brazil, has its research and development activities centered on computer integrated systems. As a pioneer in several research topics, LSI has strong partnership with industry and intense cooperation with foreign institutions.

Since its foundation, LSI has had as its main goals the development of new technologies and the engagement of its technical personnel in Ph.D. and M.Sc. programs. The engagement of undergraduate students in research activities is also strongly supported.

Among the current 250 LSI members, there are 22 professors from the University of São Paulo, 43 research fellows and staff members, 115 graduate students, 64 undergraduate students and several permanent foreign collaborators.

The technology transfer to the industry is also an important objective of our activities. One of our research projects in 2003 and 2004 was the development of Graphics Workstations and VR Clusters to a Brazilian computer manufacturing company called ITAUTEC.

As part of computing history in Brazil, LSI was a pioneer on the development of a great variety of subsystems - like a 32 bits super microcomputer, a parallel mini supercomputer with NUMA architecture and application specific microprocessors. Furthermore, it was responsible for the development of several laboratory's equipments such as digital oscilloscope, logic analyzer and equipments for characterization and processes for Microelectronics.

The first CAVE built in Latin America is installed in our Virtual Reality Facility. It is called "CAVERNA Digital" and it is a 5-sided cave with dimensions of 3m by 3m by 3m. This CAVE is powered by commodity clusters and has been running on clusters since 2001. This solution of running immersive environments with commodity clusters was explored in tutorials at ACM SIGGRAPH (2002 and 2004) and a Workshop at IEEE VR 2003.

VR researches developed at "CAVERNA Digital" include, for instance: VR Cluster management tools, hardware architectural studies, synchronization libraries, modeling, rendering and artistic exhibitions. For more details please go to http://www.lsi.usp.br/interativos/nrv/.

Figure 1 shows a panoramic view of the room that contains the CAVE and the other solutions for Virtual Reality.

Figure 1. Panoramic view of the Laboratory

Figure 2 shows a simulation of Rio de Janeiro in the Cave. Here the user can move freely and access any area of the world.

Figure 2. Cave

Figure 3 shows an user interacting with a simulation in a spherical screen. Here all the projection correction were adjusted to enable a correct visualization.

Figure 3. Spherical projection

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Demos: Hang-glider and Wireless Stereo Video Transition

2 HANG-GLIDING

Figure 4. Hang-gliding model

Hang-gliding is a very enjoyable sport, provided in many tourist places. But many people are still afraid to fly in such system or unable to travel to Rio de Janeiro. Using virtual reality we developed a virtual tour over Rio de Janeiro. In this system the user can see the city and its beautiful sights from a different perspective providing a safe and fun environment where people can experience a truly immersive hang-gliding flight. This virtual tour is composed by a real hang-gliding structure of about 9 square meters (Figure 4) where the user can rest on a hang strap. The control is a modified joystick connected to the glider's frame.

For user visualization we are using I-glasses SVG 3D HMD which supports stereoscopic vision and audio stereo, see Figure 5. For head tracking we are using an Intertrax2 tracker, see Figure 6. The wind sensation is created by a fan positioned in front of the user, see Figure 7. This is a controlled fan that reacts when the user interacts with the glider.

Figure 5. HMD

Figure 6. head-tracker

Figure 7. Electrical Fan

The model of Rio de Janeiro is in X3D. The sound simulation has background music, and some points in the environment have special sounds, like in Maracanã, and Sambódromo.

The tool used to visualize is Jinx. Jinx is a tool developed internally. It is a 3D browser and supports X3D files. Jinx was projected to support commodity cluster, then each computer is responsible for some specific tasks. It supports stereoscopic graphics and 3D sound, besides other possible expansions.

The Figure 8 shows a user interacting with the solution and the images that are been seeing by him.

Figure 8. Hang-gliding use

Detail: http://www.lsi.usp.br/interativos/nrv/hangGlidingRJ.html

2.1 Requirements

3m x 3m space to install
1 x 110V outlet

3 WIRELESS STEREO VIDEO

Stereoscopic video has been widely studied over the past years. But only recently stereoscopic digital video acquisition has become less complex to implement. With the advent of wireless network devices with bandwidth capabilities of supporting video data, it is now possible to implement real time stereoscopic video acquisition and transmission over local wireless network.

In this project we implemented a device to do wireless local network stereoscopic mobile video acquisition, transmission and display. It includes software and hardware as well as a prototype. Currently we are able to capture a stereo par with resolution of 640x480 per frame and transmit it over wireless networking with up to 22 frames per second. The system is assembled in a backpack weighing about 3Kg and there is also a helmet where the cameras are mounted. The prototype can be carried around, acquiring and transmitting stereo video. The data is compressed using JPEG algorithm, transmitted over WIFI using IEEE 802.11 wireless protocols and then received in a client node, where the stereo video can be visualized. Future developments include MPEG compression protocol, increased frame-rate and higher resolution for the system.

Figure 9. Helmet with Cameras

Figure 10. Equipments

Figure 11. System ready to use: Backpack and helmet

Figure 12. System in use

The capturing system utilizes a standard laptop with wifi connection, batteries and cables, and two firewire cameras assembled in a helmet, as can be seen in figures 9 and 13.

All software were developed in the laboratory. The cameras were assembled in the helmet by a company called Absolut Technologies.

Details: http://www.lsi.usp.br/interativos/nrv/helmetT

3.1 Requirements

2 x 110V outlet

1 square meter to install a desktop PC with WIFI to serve as a client