MEDIASOFT - SOFTWARES E PRODUÇÕES MULTIMIDIA LTDA
Rua Lauro Linhares, 589 Trindade
88.036-002 – Florianópolis –SC
Fone: +55 48 2107-2718
contato@mediasoft.com.br

Virtual reality through the Cyberball

Cyberball, the vehicles movement simulator, possesses integrated systems which involve graphic computation, robotics, and high performance electromechanical systems and it applies concepts of Virtual Reality.

With application in most of the knowledge areas, if not in all of them, and with a great investment in the hardware, software and special devices production, the Virtual Reality (VR) has been experiencing an accelerated development in the last years and indicating quite promising perspectives for the several segments, also finding great applications in the training and simulation [1,2].

The interface with VR involves a highly interactive three-dimensional control of the computing processes. The user comes into the virtual applications space and thus visualizes, manipulates and explores the application data in real time, using the senses, particularly the three-dimensional natural movements of the body. The great advantage of this kind of interface type is that the user's intuitive knowledge regarding to the physical world can be transferred to manipulate the virtual world. To support this kind of interaction type, the user utilizes non-conventional devices, such as the visualization helmet and control, glove, etc. These devices transmit to the user the sensation that the application is working in the real three-dimensional atmosphere, allowing the exploration of the atmosphere and the natural manipulation of the objects with the use of the hands, for instance, to catch, to manipulate and to accomplish other actions [3,4,5].

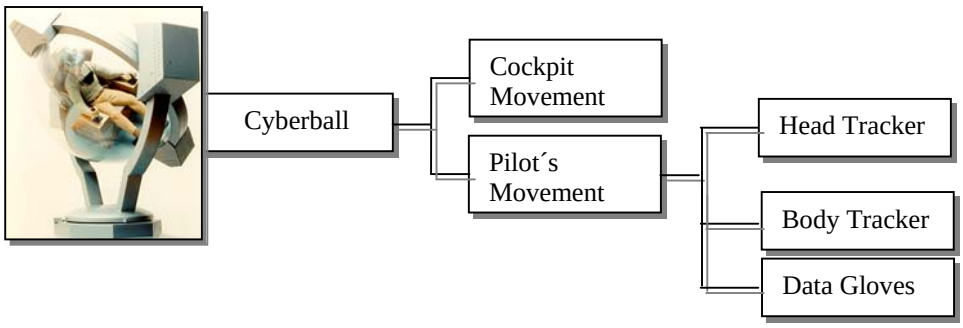
The adaptation of VR systems, in equipments as the Cyberball, brings as a technological contribution the domain on several areas, such as: hardwares and specific VR softwares manipulation, capability of interfacing through software among these equipments, the need of the use of high performance and high graphic capacity computers, domain of geometric modeling and three-dimensional graphic, simulation in real time, navigation, collision detection, evaluation systems and haptic interfaces [5,6]

Virtual Reality devices: Head Mounted Display and Data Gloves

Basically, the application of the Virtual Reality in Cyberball happens in two ways: The reproduction in 3 D of the cockpit movement, following up all of the freedom degrees imposed by the simulation, and

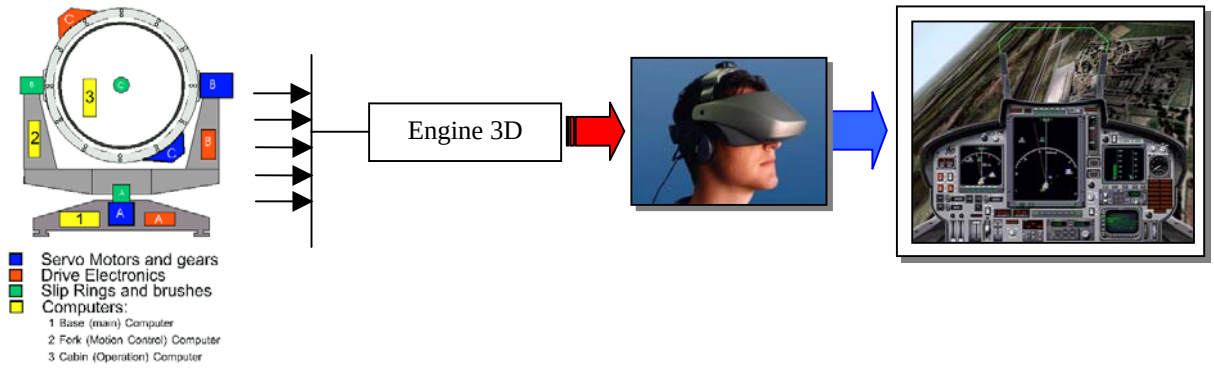
Author: Fabiano Luiz Santos Garcia, PhD. (INPG – France): Mediasoft Executive Manager

the reproduction of the pilot's movement, in other words, the movement of the head (6 degrees of freedom - Degrees of Freedom (DOF)) and of his/ her hands, arms and legs (6 DOF).



Cyberball outline and the movement systems

The 3 D graphic simulation of the cockpit movement is accomplished by an interface connected to a 3 D graphic engine, which receives the information about rotation and translation of the electromechanical cockpit, updating the simulation scenery in real time. These information are updated in the pilot's HMD who, at the same time in which feels physically the simulator action, visualizes the updating of the three-dimensional graphs.



Cyberball and the systems of the cockpit movement

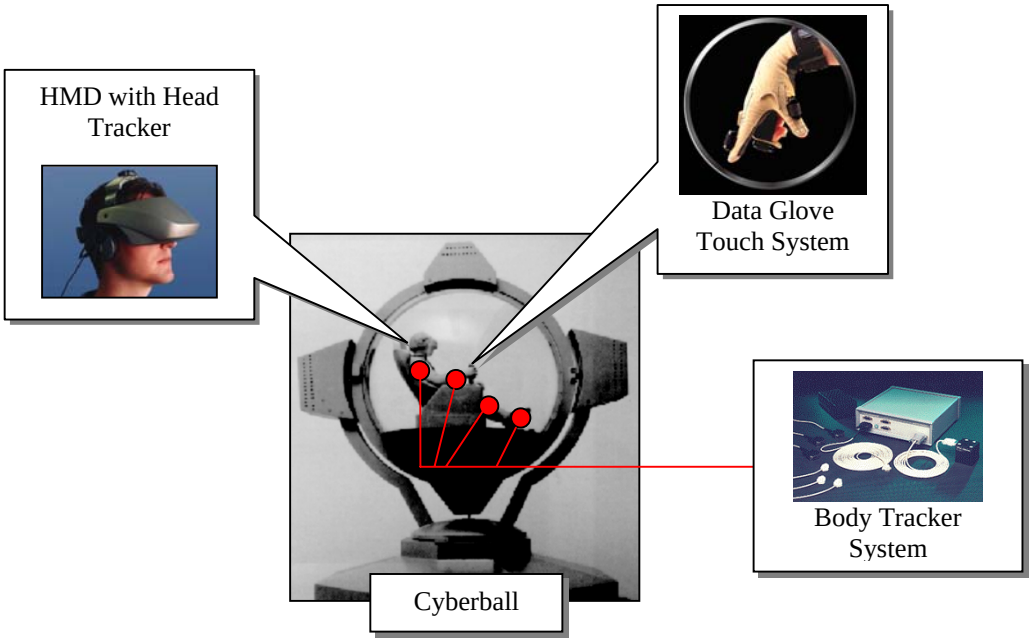
The 3 D graphic simulation of the pilot's movement in the Cyberball cockpit involves the development of more specific interfaces and the use of movements' capture devices (tracker) installed in the pilot's helmet and also distributed in his/ her body.
For the movement of the hands, gloves of data acquisition guarantee the capture of such movements.

For the head's movement, a head tracker is used coupled to the pilot's helmet. These devices capture rotation information and displacement of the pilot's helmet. To each movement of the head, the tracker informs to the computational system the modified variables and the 3 D graphic system updates them in real time, be a rotation or translation of the head.

For the movement of the pilot's arms and legs in the cockpit, several sensors coupled to the pilot's body capture the data and the computational system interprets these data moving the virtual model of the pilot, through algorithms of inverse kinematics allowing the 3 D system to reproduce these movements in a virtual 3 D pilot.

This way, the pilot in the Cyberball cockpit can see, through HMD, the movement of his/ her arms and legs, simulated by a virtual pilot in real time.

The touch sensation in the virtual panel in the cockpit is also simulated through data acquisition gloves, with sensors of touch, conferring to the system a complete realism during all the simulation.



Cyberball trackers system

The group of systems involved in the development and application of the Virtual Reality concepts in the Cyberball project, provides a high interaction degree among the real device - Cyberball - and the 3 D atmospheres of simulation.

These integrated systems composed by the Cyberball project, confer it a character of last generation in terms of technological innovation and promising future perspectives in regard to simulations of vehicles, be in the commercial or military aviation, automotive industry and entertainment areas.

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