AN INTERFACE BASED ON HYPER REALITY FOR VIRTUAL MOCKUPS

Liliane S. Machado[1], Ronei M. Moraes[2]

Abstract *— Hyper Reality can be defined as the technological capability of join intelligence, virtual reality and physical reality. The main concept consists on provide to users a world better of the real world and added by information only available in a computer generated environment. In this context, the interfaces must be intuitive and natural to allow interaction among people and with objects present in the world. This paper presents an interface based on hyper reality to support several services from a virtual mockup, as access to laboratories, collaborative work, supervision, remote control and distance learning. The interface must integrate users to virtual representation of the real world and provide intuitive interactions with virtual components and real devices for remote manipulation.*

Index Terms — hyper reality, tele-manipulation, virtual reality, distance learning.

INTRODUCTION

In the 80's a book described the future with people and computers integrated to compose a global database, full of knowledge and constantly updated [12]. That ideas can be expanded to the view of a world in which devices aren't necessary to interact with data, once peoples' thoughts can start wireless communication through chips implanted in their bodies. In this world, the knowledge is distributed in several grids and the virtual is mixed to the real to increase, help the real life.

Nowadays, new interaction modes with computers, wireless networks and virtual worlds have been developed to provide new ways of communication between men and computer systems. Advances in information and communication technologies intend to provide access to services and data anywhere for everyone. The main idea includes new ways of distribution and visualization of information. The way people use computer systems is changing quickly and the use of three-dimensional environments for collaboration and exchange of experiences is not a novelty [15,29]. New concepts as ubiquitous computing and tangible interfaces have been pointed as a new and natural way of interaction between man and computing systems. In the ubiquitous computing the researchers and scientists look for ways to embed systems in ordinary devices, commonly used by people, to provide natural interaction through the called tangible interfaces [11, 37]. Additionally, the traditional idea of many people sharing a computer and after one computer for person was changed by the idea of one person using many computers. In this case, there is a network and a person doesn't know where information is stored, how it is distributed over the network or how many computers he/she is accessing.

Virtual reality [5] and related technologies allow the creation of three-dimensional digital spaces in which users can search and exchange information, cooperate to perform activities, supervise, control and also interact in social activities. When available through the Internet, these virtual worlds can reproduce real places or can be the augmentation of real places with extra information [10].

This paper presents a discussion of recent technologies used in games, data visualization, education and communication to propose an interface based on hyper reality to support several services from a virtual mockup, as access to laboratories, collaborative work, supervision, control and distance learning. The main idea is add several functionalities and services into a representation of the real world.

RELATED TECHNOLOGIES

Internet access has changed the way people look for information [6]. The amount of data and the diversity of subjects make it the most popular encyclopedia. Additionally, the Internet has been used as an important tool in education since the advent of distance learning. The idea of being virtually near everything stimulated the creation of virtual communities in which people can discuss specific subjects, play, watch movies and learn. Since three-dimensional worlds can be shared through the Internet, several educational tools [28], museums [20] and games have been developed [15]. In those worlds, the user can explore and visualize micro or macro structures, as molecules [14], human anatomy [16] and galaxies [36], and can interact to modify his viewpoint. By the other side, virtual museums allows knowing art and stimulate the discovery of new cultures [20]. Games can present a virtual world where users can play, communicate, exchange information, learn specific subjects [19] and work in groups. In this case, games technologies can be seen as a large laboratory of new ideas and developments [4].

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Intelligence is also an area of significant researches. Beside other applications, it has been used to develop virtual characters for games [8], crowds for emergency simulations [33], situations according user actions [1] and to assess users in virtual environments [24]. It is also present in algorithms used to identify user movements and actions to automatically process outputs [3].

The future of the information and communication technologies seems to be the union of networks, intelligence, computer graphics and devices. A pioneer study in distance education developed a virtual classroom to join students of three countries [35] through the Internet. In this case, a particular aspect relies on the Internet connection, how it will grow and if the diffusion of collaborative tasks will be supported [6].

HYPER REALITY

Hyper Reality (HR) can be defined as the technological capability of join intelligence, virtual reality and physical reality [34]. When in a hyper reality world, the user will access a computer graphics and interactive world, in which his actions could be performed through intuitive devices and interfaces. The main concept consists on provide to users a world better of the real world and added by information only available in networked virtual environment. In this context, the interfaces must be intuitive and natural to allow interaction among people and with objects present in the world. In a HR world, notions of time and space can be subjective since users around the world can be and share the same virtual environment. In fact, nobody needs to know where each other is geographically located and the Internet Time, counted in beats, could replace the traditional time count [13].

The intelligence in HR can be present in virtual humans able to response and interact. Generally, these virtual humans are used to guide or tutor real humans. However, both virtual and real humans representations can have the same kind of avatar [27]. The intelligence can also be used to monitor user actions and assess him/her [25] [31].

Actually, the use of satellite images and three-dimensional models can provide a realistic visualization of real places augmented with digital information [30]. By the other side, networked virtual environments have been developed to immerse users in a social net to exchange information or games [15].

INTERFACE FOR VIRTUAL MOCKUPS

An interface based on hyper reality can be used to provide access to virtual mockups that represent real spaces. These virtual mockups can augment the real world [2] with information and supply the demand of tools and interactivity modes for remote control [18], learning and cooperative work [35]. Thus, from a set of real images (satellite) users could have a macro vision of the earth and select the place they want to access. Additionally, places could be selected according to a given subject, like colleges, museums, medical centers, etc. The navigation through the selected place could be enhanced by context-based data (text, image, sound and tactile objects). In fact, the evolution of that kind of hyper reality interface can provide distinct immersion levels. That will depend on the devices available to be used during the use of the interface and will affect the perceived virtual presence of the user (Figure 1). Developments related to devices for realistic interaction have been developed to provide intuitive navigation and touch, as the haptic devices [5]. Automatic recognition processes can also be used to capture user actions and modify the environment or the user view/location [3]. In order to offer realistic visualization several devices, already available, can be combined to provide stereoscopic visualization.

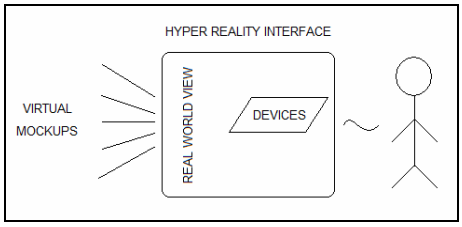

FIGURE. 1
HYPER REALITY-BASED INTERFACE FOR ACCESS TO VIRTUAL MOCKUPS.

The distribution and connection of real images and virtual mockups can be supported by researches related to grid computing and graphic processing unit (GPU) programming, among others. In order to do not compromise the graphics quality, the rendering of real images and virtual mockups are presented according to levels of detail and can be calculated according to scaling or user's avatar distance to each component of the world [30]. An interesting aspect related to the storage of these worlds is the processing and computational exploration of computers remotely distributed. In that case, the user that access a specific region of a world will receive data for one or more computers, but it will remain completely transparent for him/her (Figure 2).

DEVELOPMENT

Several researches and development in our group have been conducted in order to achieve the several requirements of a hyper reality interface and provide content to be accessed from virtual mockups. The first systems intended to offer realistic or intelligent tools for present and distance learning. The Calculadora Estatística [9] system uses an intelligent interface connected to a powerful statistical package to guide and teach users the correct steps necessary to the execution of statistical analysis. Intelligence was also the focus of Geoplano game developed to entertain and teach planar geometry for kids [26]. In both systems (Figure 3), user

actions are used as input for the generation of responses to guide users in the learning process.

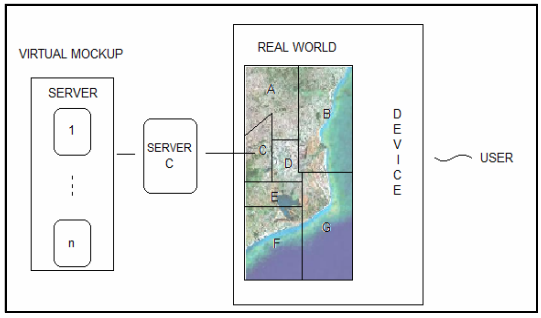

FIGURE. 2
DATA DISTRIBUTION OF A HYPER REALITY INTERFACE. BOTH REAL AND VIRTUAL WORLD ARE PARTITIONED AND DISTRIBUTED OVER THE INTERNET.

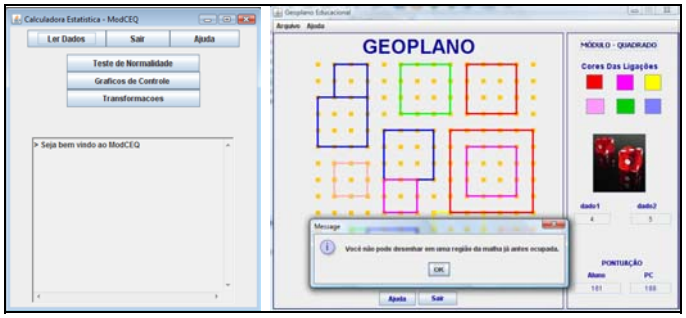

FIGURE. 3
THE EDUCATIONAL TOOLS: CALCULADORA ESTATÍSTICA (LEFT) AND GAME GEOPLANO (RIGHT).

In order to reach better results in training activities, simulators have been developed to provide realistic environment to medical training. Due to the difficulties found in qualify professionals to perform surgery related tasks, a virtual reality simulator for bone marrow harvest [32] can present a virtual environment in which materials, visualization and objects are similar to the observed in a real procedure (Figure 4). In this kind of system, haptic devices need to be used to give force feedback and simulate tissues properties [32]. Besides, algorithms in background can monitor user actions and assess his training [24].

Virtual mockups of real spaces are under development to support realistic and remote access to real places. Our approach is based on three-dimensional modeling of buildings of our university linked to virtual and remote laboratories, hypertext pages, services and distance learning tools [17]. The goal is provide access to all campus and improve a walkthrough with activities and services. Then, people will be able to remotely know the campus through its virtual mockup, access libraries, services and information. Additionally, we intend to support the distance learning courses provided by the university. Figure 5 presents classrooms of the Federal University of Paraíba (UFPB) that could be used to watch classes over the Internet.

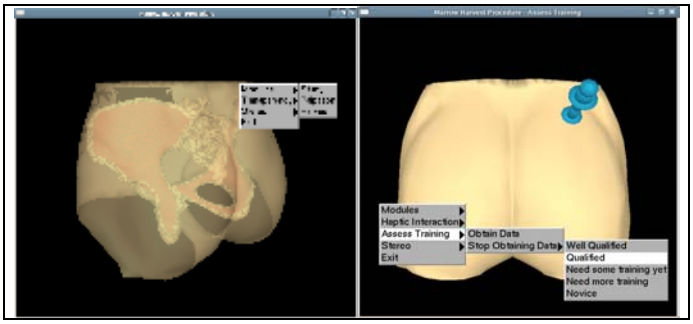

FIGURE. 4
SIMULATOR BASED ON VIRTUAL REALITY FOR TRAINING IN BONE MARROW HARVEST.

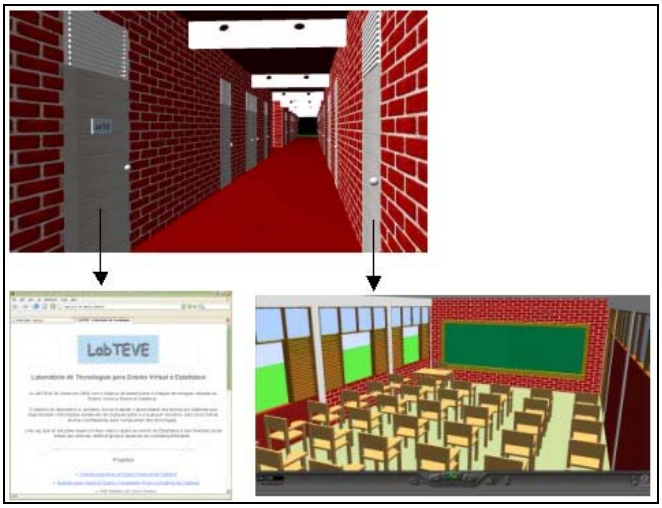

FIGURE. 5
VIRTUAL CAMPUS OF UFPB AND LINK OPTIONS. THE BLACKBOARD COULD PRESENT A VIDEO OF A LECTURE.

From the virtual campus or other virtual mockup users could access remote laboratories and remotely perform real experiments. For that, we are conducting experiments using haptic devices to perform experiments dependent on force feedback for distance learning of physic laws [18]. These experiments will allow the access of real laboratories over the Internet for tasks dependent of touch. Moreover, databases have been used to store status of real devices and allow their remote control [7]. Our goal is to supervise and control real environments at distance.

To evaluate the skills of users, several assessment methodologies have been proposed and include online assessment, multiple assessment, continuous assessment and assessment for web. The main idea of these researches is to

assess user performance during the execution of a virtual training [22,23,24,25].

The platform necessary to access the systems presented below was also a focus of our developments. In this case, we developed a projection-based platform called VirtWall to allow stereoscopic visualization [21]. This platform has been used for classes to help the learning of abstract concepts. Figure 6 shows the VirtWall being used to present abstract spaces related to image classifiers.

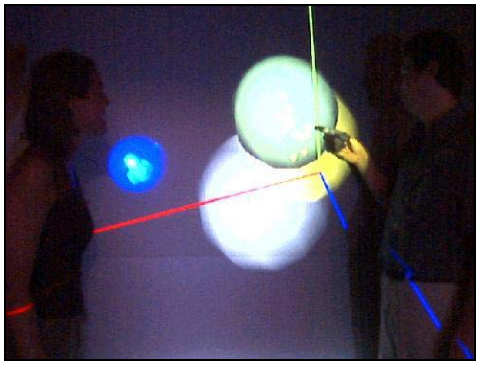

FIGURE. 6
THE VIRTWALL PLATFORM IN USE.

CONCLUSIONS

An interface based on hyper reality must be intuitive and natural to allow interaction among people and with objects present in the real world. The access to environments can be facilitated by the use of real images augmented with virtual mockups. The requirements necessary to make available such interface have been the focus of researches in our group. A concern about the systems developed is the cost and the hardware necessary to run them. In this case, all the systems presented have been developed using free tools and most of them are multi-platform.

Through an interface based on Hyper Reality, as a virtual campus, users will be able to access information, services, distance learning tools and remote laboratories. Besides, they will be assessed by their actions in the virtual environment. Immersion and interaction levels will depend on the platform and devices available. This approach will provide access for groups inserted in different contexts and social realities.

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