The Creativity Space: An Immersive VR Framework for 3D Creation

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Abstract

There is no doubt about the great revolution induced by the Computer-Aided Design systems in the workflow of fields like industrial design or architecture. These systems are of great aid to the creative process, allowing to set aside many inconveniences of traditional-design and providing many advantages, from high precision to illumination simulations and consistency planning.

Very certainly, this revolution has incited a new way of thinking, a new working methodology where users have access to a great amount of powerful, new tools, which need adapting to.

Nowadays, these environments are usually based on monitors and bidimensional WIMP interfaces with orthogonal and perspective views. But advances made on 3D devices and Virtual Reality and Augmented Reality technologies have opened new lines of investigation on immersive, 3D environments which are more intuitive and similar to reality.
The present document briefly explains a work in progress to introduce the concepts of presence and walkability in CAD systems, in order to add versatility to the creative process by avoiding user constraint to an unnatural environment.

Keywords: virtual reality, immersive, walkability; creative space

1 Introduction

Since its beginnings in the 60's, Virtual Reality has been an active research field, both in academic and corporate scopes.

Virtual Reality applications are varied, including scientific data visualization [2], education, training[1], entertainment[5], medicine[13], telepresence[9], etc.

Most of these applications are mainly focused on walkthrough and contemplation of virtual environments, sometimes using basic commands that provide a low level of interaction with the virtual world. This could be consequence of two large difficulties found in the development of these kind of systems.

Movement metaphors are usually unnatural, clumsy and unconfortable for the user. They require some training to adequately use the system and impose serious limits to the freedom of movement.

Interaction levels are usually limited. They are thought just for navigating through the virtual world and executing some basic actions.

The first problem is solved with walkable VR[7] or AR[4, 10] systems. However, they suffer the previously mentioned lack of interactivity.

There are many previous works on the application of VR to CAD. One example is Virtual Assembly, where the creative process consists on the composition of new elements from preexisting ones[11]. Another important application is Virtual Prototyping[12]. There are also some cases where the creation of geometric elements is possible[3], but they use semi-immersive systems.

The Empty Museum[7] adds the possibility to physically walk through the environment and move around the elements while they are being created, to examine them from different angles in an absolutely natural way, as we would if these objects really existed in space. This way, through parallax, the volume and position in the environment of what we are creating is easierly appreciated.

The work in progress here described takes the Empty Museum as starting point. The target is to add the interaction levels needed for enabling a creative process inside this immersive virtual environment.

2 The Empty Museum

The Empty Museum is based on the use of autonomous, wireless equipments, consisting of a backpack carried by the user and connected to an HMD with stereo audio and a tracking system. This portable equipment is connected through a

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wireless network to a central computer that co-ordinates the operation of all the portable equipments. (Figure1). This enables a multiuser system with synchronized contents and visualization of other users as personalized and articulated avatars. Because of the networked architecture of the Emtpy Museum, it is possible to coordinate users in distant geographical locations for telepresence applications[8]. The Empty Museum allows the integration of complex models, 3D spatialized audio, animations, multimedia contents (video and audio streaming), programmable shaders, physical simulations, particle systems and a generic interaction definition system based on interaction rules that use logical trees and sensors (position/proximity, visibility, time...). The system is also open to the implementation of new application-specific sensors and actions by the designer/programmer.

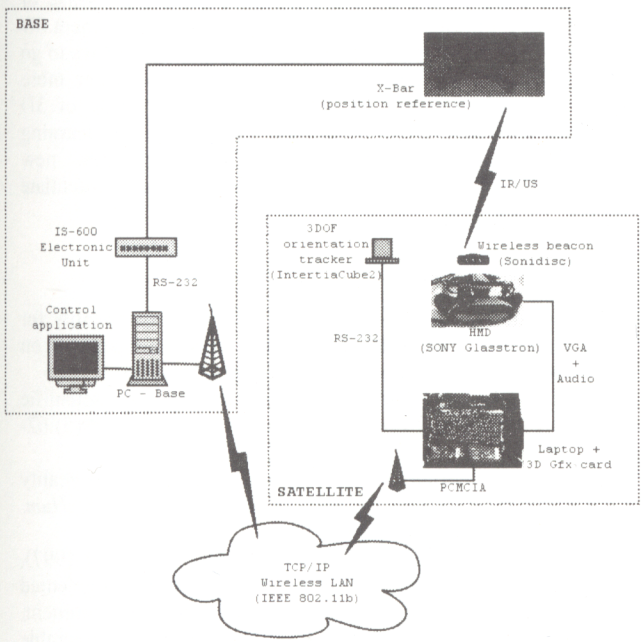

Figure 1. Diagram of the system blocks.

Until now, the Empty Museum has focused mainly on two aspects: First, to maximize the sense of presence by supressing the disturbing elements that distract the attention of the user or tie him to the real world. Second, the visual quality and the ability to create fully programmable, dynamic, virtual environments.

So we could say that work has been mainly focused on the flow of information from the machine to the user, rather than in the opposite direction. The input given by the user was limited to his movements and behaviours in the virtual environment: his position regarding certain points in space, the direction or elements looked at, which was detected by sensors.
What we are actually working on occurs in the opposite direction, involving the flow of information from user to machine, in order to increase the level of interaction and so enable actions that were previously not possible, as is the creation and manipulation of new elements inside the virtual world following the user's commands.

3 The Creativity Space

Theoretical foundation

The new system extending the Empty Museum has been named the Creativity Space. It adds a greater interaction with the world, allowing the creation and modification of new elements. This system is aimed to encourage the user's creativity.

It is often thought that creativity is a gift only for a few lucky ones. In fact, our mental process is optimized to work with basic patterns, which we apply to every situation. Experience (defined as the repeticion and memorizing of one same process) reinforces the cognitive process.

Experience inhibits creative thinking. In order to invent, we need to move away from our current mental patterns in order to generate new contents, otherwise unlikely to be associated. The Creativity Space encourages this ability, providing the user with a creative environment in a new virtual space, where the absence of gravity enables him to work with floating objects, forms can be sculptured without any physical effort and additive colors shine more than subtractive ones.

The Creativity Space is an inmmersive perception enviroment. (Figure2)This way, the user creates realistic/abstract architectural enviroments from inside the virtual space (not in front of a display), with all the advantages of seeing the results of his work in real time and real space, enabling him to decide in situ the best position for the objects. It also allows the creator

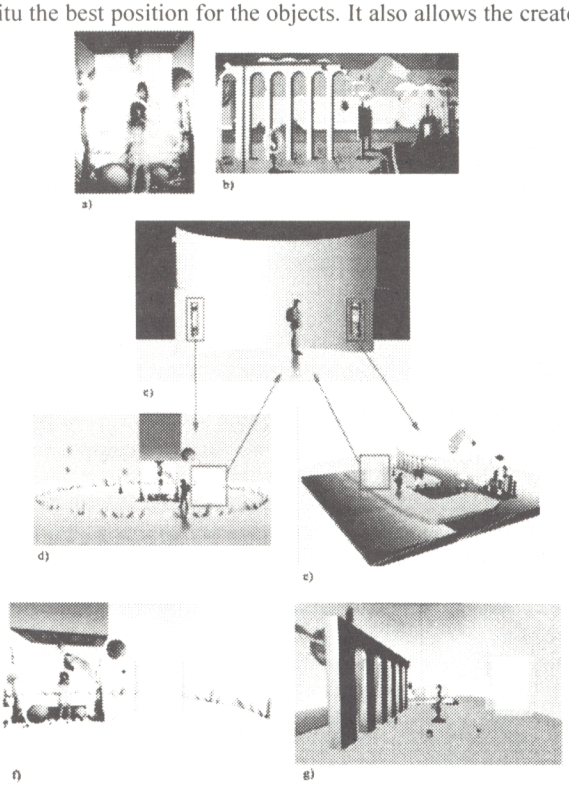

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Figure 2. Inmmersive perception enviroment.

possibility to work with large sized objects, impossible to manage in the real world, and to visualize them from unimaginable angles or distances, without any real movement, in an atypical way during the 3D creative process.

The Creativity Space is a walkable enviroment. The user can walk across the model during the constructive process, making the design process easier. Moving across the model allows the user to directly check the progress of the composition, in real

time, make better decisions and easily perceive the created objects in relation to the enviroment and in relation to him or herself. Abstract forms acquire a sense of space, increasing their feeling of presence. The user can contemplate the created model from inside, with the same perception as if inside the real, physical model.

The Creativity Space may be used as an artistic enviroment. This virtual space results in art-space in a natural way. The user-creator forces his or her imagination by making a formal searching based on intuition and enviroment perception. This is an old resource that the surrealism movement invented at the beginning of the twentieth century, with the first cadavres esquis (exquisite corpse). In this Creativity Space we work to increase the interaction of various users in the same three-dimensional creative process, in the same space and time, in order to create the collaborating, virtual and inmmersive opera aperta.

Design guidelines

The Creativity Space introduces new interaction abilities to the Empty Museum, turning it into a 3D creation system that follows to the last the WYSIWYG philosophy.

For this, starting from a series of pre-established tools, the user can create previously unexisting elements and manipulate them. The available tools include, among others, creation of primitives, grouping, selection, deletion, transformations (translations, rotations, scalings...), edition of primitives (vertex, control points...), material definition and application, etc.

The elements created from primitives can be grouped to work with in sets, following the Composite pattern[6]. This facilitates the development of transformation tools in a transparent way.
For the selection and use of the tools, it is very usual to find the extension of metaphores used in 2D GUIs (windows, menus, icons...) to their three-dimensional versions. However, these 3D versions are less productive than their original 2D equivalents, and they drastically reduce the sense of presence we try to achieve with the VR system.

For this reason, we have tried to avoid the use of artificial elements as much as possible, thinking of new interfaces which are more adequate for an immersive space. Getting away from WIMP interfaces, the research is headed towards 3D direct manipulation. The commands are given through gesture languages and through the voice. When necessary, we try to use elements with real positions inside the 3D space, instead of icons in a HUD for such tasks as tool selection.

We added some hardware elements to the Empty Museum, as is a 3D mouse, hand tracking systems and data gloves that detect the bending and movement of user's fingers. This way, the user's intentions can be easily interpreted through gestures like the grasping or dropping of an object, or throwing it to a side or giving it a slap, for actions like select, copy, move, delete, etc.

The use of the two hands for interaction allows the user to select an element and apply transformations to it in a way that would otherwise be quite complex to perform. For example, while rotating or scaling an object with one hand, the other hand can select and immediately vary the pivot point.

For such commands involving a spatial position or direction, the hand tracking is actively used together with the interpretation of gestures, while speech recognition is used for more abstract or conceptual commands.

The interpretation of gestures can help to improve the system far beyond allowing the manipulation of objects. For instance, it can also be used to enable the possibility of jumping or flying to places otherwise unaccesible.

4 Conclusions

This work opens a research line to improve the creative potential of CAD and DCC systems, based on the sense of presence of a multiuser, wireless VR system, to experiment 3D creations from inside in a way not possible before. It tries to go out of traditional 2D user interfaces, to think of a quicker, more direct and efficient way of working on the creation of 3D elements and environments, so we can reduce the learning curve and optimize productivity. Moreover, this new environment is heavily aimed to estimulate and potentiate designers' creativity.

References

1. Don Allison and Larry F. Hodges. (2000), Virtual reality for education?, Proceedings of the ACM symposium on Virtual reality software and technology, 160-165
2. Steve Bryson. (1996), Virtual reality in scientific visualization, *Communications of the ACM*, 39(5):62-71
3. Michael F. Deering. (1995), Holosketch: a virtual reality sketching/animation tool, *ACM Trans. Comput.-Hum. Interact.*, 2(3):220-238
4. S. Feiner, B. MacIntyre, T. Höllerer, and T. Webster. (1997), A touring machine: Prototyping 3d mobile augmented reality systems for exploring the urban environment, Proc. ISWC '97 (First IEEE Int. Symp. on Wearable Computers), 74-81
5. Scott S. Fisher. (1999), Real-time interactive graphics: taking location-based entertainment to the next level, *SIGGRAPH Comput. Graph.*, 33(1):18-20
6. E. Gamma, R. Helm, R. Johnson, and J. Vlissides. (1995), *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley
7. L. Hernández, J. Taibo, A. Seoane, and R. López. (2004), The experience of the empty museum. displaying cultural contents on an immersive, walkable vr room, Computer Graphics International, 2004. Proceedings, 436-443
8. Luis Hernández, Javier Taibo, and Antonio Seoane. (2002), Empty museum. an immersive, walkable vr framework for multiuser interaction and telepresence, ACM Multimedia 2002. WORKSHOP W1. Workshop on Immersive Telepresence, 52-55
9. Norman P. Jouppi. (2002), First steps towards mutually-immersive mobile telepresence, Proceedings of the 2002 ACM conference on Computer supported cooperative work, 354-363
10. D. Stricker, P. Dahne, F. Seibert, T. Christou, L. Almeida, R. Carlucci, and N. Ioannidis. (2001), Design and development issues for archeoguide: An augmented reality based cultural heritage on-site guide, Proceedings of International Conference on Augmented, Virtual Environments and 3D Imaging (ICAV3D 2001), 1-5
11. Hanqiu Sun, Bao Hujun, Tong Ngai Man, and Wu Lam Fai. (1999), Interactive task planning in virtual assembly,

Proceedings of the ACM symposium on Virtual reality software and technology, 174-175

12. G. Gary Wang. (2002), Definition and review of virtual prototyping, *Journal of Computing and Information Science in Engineering*, 2(3):232-236

13. Russ Zajtchuk and Richard M. Satava. (1997), Medical applications of virtual reality, *Commun. ACM*, 40(9):63-64