3D Multitouch : When Tactile Tables Meet Immersive Visualization Technologies

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1 Introduction

Multitouch tactile input, while having been in the research labs for quite some time, is just reaching the general public through well-known interfaces like mobile phones or multitouch tables. The technology, when used in the right context in the right way, is known to provide an intuitive manipulation of the synthetic – mostly 2D – content that is displayed on its surface.

Likewise, means to display stereoscopic images are known for decades now, but are just beginning to be understood and accepted by the general public thanks to very well received movies and all the announcements around the soon to be released 3D television. When rendered properly, stereoscopic displays indeed offer a huge sense of depth to previously flat images. Furthermore, combining stereo rendering with viewpoint tracking definitely provides an immersive visualization of 3D models.

The combination of the two technologies introduces specific constraints that have not yet been dealt with nor extensively studied. Following the reviewers comments, we therefore propose to give a talk on our current work that will be demonstrated in the emerging techonologies section, including the new issues and preliminary developments.

2 Technological Constraints

While the two technologies share many objectives, while both multitouch tables and immersive visualization are being extensively studied by the research community, they have to our knowledge never been combined into a single solution. Such a combination is indeed not that obvious, since strengths of a technology become constraints for the other one. They more precisely consist in:

- single viewpoint : multitouch tables are efficient for collaborative work, but this implies that two users will face each other, have opposite point of views on the content and their right and left sides will be switched. On the contrary, most stereo technologies are single viewpoint only.
- Viewing angle : multitouch tables are intended to be used horizontally, while most stereo technologies are ready for vertical visualization requiring a narrow viewing angle.
- Hand and 3D content collision : the most immersive stereo visualization is obtained when negative parallax is used, to make the 3D content appear in front and outside of the display. Fingers in contact with the screen ruin the depth perception, since they wrongly pass through the 3D objects.
- Parallax : activating the head tracking implies that the content will move according to the user's head, dynamically changing the actual 3D points that are projected beneath the fingers.

3 Proposal

Trying to take the multitouch tables from 2D interaction to an efficient and collaborative 3D immersive interface, we built a two-user multiview multitouch table that we has been accepted for demonstration in the ETech. Two-user multiview, which ensures each user has his own perspective correct viewpoint on the same 3D model, is obtained by combining active and passive stereo technologies and using six dof sensors that help to retrieve the position and orientation of each user's head.

The focal plane has been set right on the tactile surface. Negative parallax, which then leads to the most impressive stereo visualization with the 3D content coming out of the display, is used as long as no hand approaches the tactile surface. When a finger touches to the surface, the model may slowly be lowered to obtain a positive parallax, with the 3D content located right inside the table. Thanks to the diffuse infrared illumination our multitouch video analysis algorithms rely on, we are also able to detect features beyond the simple 2D contact points and therefore retrieve a hand presence even before its fingers touch the surface and break the depth perception.

While image plane interaction techniques would work quite well for a single user, they would hardly take into account the two users' opposite viewpoints and the stereo positive parallax. We therefore chose to experiment with shooting virtual rays orthogonal to the tactile surface from each finger in contact, which currently seems to strenghten the fingers presence within the virtual world and its relationship with 3D objects.

4 Talk

Based on the ETech reviewers comments, we propose to focus our talk on the new issues that the combination of tactile interaction and immersive visualization introduces. We will briefly describe the state of the art, both in terms of immersive visualization, multi-view systems, visualization of 3D information on tabletops, tactile and multitouch interaction. This will include the studies of Hancock et al. on the 3D perspective rendering on tabletops, as well as the work of Shning et al. on tactile stereoscopic vertical screens.

The technical constraints each of them introduces will be described, leading to the presentation of the specific issues one will face when merging together those two worlds. After focusing on the specific solution we devised, specifying both its strengths and weaknesses, we would describe the open questions as well as alternative ways to address our issues, present our first user feedbacks[1] and our short and long term goals.

5 Conclusion

Our ETech demonstration will offer attendees a first experience with the combination of multitouch tables and immersive visualization technologies, and is built to help them experiment with the first issues it introduces. We herein propose a more formal talk that would present all our issues, results and thoughts in a better way than the exchanges on our booth, and could therefore complement our actual demonstration. We are indeed very confident stereoscopic visualization will find its way within multitouch tables in the future, and we would like to have a chance to reduce this delay by sharing our first results through a Siggraph 2010 Talk. Given all the topics such an integrated solution is raising, this could be of interest and open up new possibilities for both the 3D, interaction and visualization communities.

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