Computer Graphics Literature Review 2

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Paper 1: MRTouch: Adding Touch Input to Head-Mounted Mixed Reality
(Robert Xiao, Julia Schwarz, Nick Throm, Andrew D. Wilson and Hrvoje Benko) (link)
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Paper 2: MTMR: A conceptual interior design framework integrating Mixed Reality with the Multi-Touch tabletop interface
(Dong Wei Steven Zhiying Zhou∗ Du Xie) (link)
Date of Publication**:** 13 October 2010

Introduction:

Article 1 talks about MRTouch: a multitouch input solution for mixed reality. Head-mounted, mixed-reality devices can overlay realistic 3D content onto the physical environment, enabling a wealth of interactive possibilities. Current-generation commercial mixed reality devices, like Microsoft HoloLens or Meta 2, are primarily driven by in-air hand gesturing, gaze and voice. Many systems ship with accessory physical controllers, offering finer-grained input, though at the expense of occupying the hands with a special-purpose device that then impedes free-hand manipulations. It has been overlooked as an input modality in head- mounted mixed reality systems, despite the inherent ability for many systems to affix virtual interfaces to physical surfaces which are then gestured at instead of touched.

Article 2 talks about Multi-Touch Mixed Reality (MTMR) which integrates mixed reality with the multi-touch tabletop interface, to provide an intuitive and efficient interface for collaborative design and an augmented 3D view to users at the same time. Under this framework, multiple designers can carry out design work simultaneously on the top view displayed on the tabletop, while live video of the ongoing design work is captured and augmented by overlaying virtual 3D furniture models to their 2D virtual counterparts, and shown on a vertical screen in front of the tabletop. Meanwhile, the remote client’s cam- era view of the physical room is augmented with the interior design layout in real time, that is, as the designers place, move, and modify the virtual furniture models on the tabletop, the client sees the corresponding life-size 3D virtual furniture models residing, moving, and changing in the physical room through the camera view on his/her screen. By adopting MTMR, which we argue may also apply to other kinds of collaborative work, the designers can expect a good working experience in terms of naturalness and intuitive- ness, while the client can be involved in the design process and view the design result without moving around heavy furniture. By presenting MTMR, we hope to provide reliable and precise free- hand interactions to mixed reality systems, with multi-touch inputs on tabletop interfaces.

Study: Article 1 present work concerns mixed-reality input techniques and on- world touch tracking. A vast range of input techniques have been proposed for use in mixed-reality systems, such as gaze input, hand gestures, voice input, physical controllers using physical buttons, motion sensing, or external tracking, tangible interfaces, or multimodal combinations of these approaches.The most common intersection of touch input with mixed reality is for providing haptic feedback, which adds a sensation of physicality to virtual objects. To this end, a number of haptic interaction techniques have been proposed for mixed reality, including special-purpose haptic controllers articulated probes, gloves, handheld devices or even body suits, in-air haptics, or robotically-presented textures. Many of these approaches require instrumenting the user or calibrating to the background environment, and in general methods based only on optical sensing have difficulty determining whether a finger has contacted the surface or not (disambiguating hover from touch).

The MRTouch prototype is implemented on a Microsoft HoloLens development kit device, sold commercially for developer use since 2016. The HoloLens features a time-of-flight depth camera similar to the Microsoft Kinect for Xbox One, which can operate in both short-throw and long-throw modes, used for hand tracking and environment sensing, respectively. MRTouch uses only the raw short-throw depth data and infrared imagery from the depth camera through a private API. The algorithm should therefore be portable to any device which provides a similar API, *e.g.* Google Project Tango devices. To quantify the spatial tracking accuracy and performance of MRTouch, we performed a user study with 17 participants – 5 females, 2 left- handed, with Fitzpatrick skin types ranging from II to VI.

In Article 2, implementation of MR is similar to the 3D MR view at the designer side. The client resides at his/her remote room and receives designers' control messages. These control messages, including the existence, position, orientation and size of the virtual furniture in the design plan, are passed to the client's computer through network to construct and update the client's MR view in real time. A camera captures live video of the client's room. This video is augmented with life-size virtual furniture models constructed according to the control messages. The difference is that at the designer side, the camera is fixed, while at the client side, the client is supposed to view the furniture layout from different perspectives with a rotatable camera.

The feedback in terms of sending back the video streams of the client's MR view of the design to the designer side was not implemented in MTMR. This function is like what an instant messaging software such as Skype does, which is more about network communication and may be out of the scope of this project. But it is very helpful for the client’s ideas to be understood by the designers easily and for the designers to know what their design looks like on the spot, therefore the video feedback of the client’s MR view to the designer side is important and meaningful to MTMR in terms of the efficiency of the communications and the fidelity of the design intentions.

Conclusion: Article 1 presented MRTouch, a touch tracking solution which brings un-instrumented touch input, on a wide variety of common surfaces, to head-mounted mixed reality. In this way, mixed reality systems can benefit from a precise, tactile and familiar way to interact with virtual content, neatly complementing the existing input modalities. Through a user evaluation, they determined that our system can provide near-touchscreen levels of spatial accuracy, enabling a host of useful interactions. By demonstrating usable touch input using our commodity setup, we hope to demonstrate that touch input is a feasible and useful addition to the mixed-reality in- put toolbox, and hope that it can serve to inspire further work in this area.

Article 2 present MTMR, a conceptual interior design framework which integrates MR with the multi-touch tabletop interface, to provide an intuitive and efficient interface for collaborative design and an augmented 3D view to users at the same time. Though at this stage it does not support complicated tools for design work, we argue that it is a successful attempt to integrate MR with the multi-touch tabletop interface, which complement each other. The multi-touch tabletop provides reliable and precise freehand interactions to the MR environment and a horizontal surface to display useful planar views (such as the top view of a layout plan in this work), while the MR view augments the planar views and gives enhanced 3D spatial presentation. In this way, we believe MTMR establishes a brand new prototype for collaborative design frameworks.