Gizmo & WiiView:
Tangible User Interfaces Enabling Architectural Presentations

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ABSTRACT

Widespread use by 3D designers of simple digital modeling applications such as Google's SketchUp may displace the use of physical models in design. However, the difficulties often faced by non-experts in the ad hoc navigation of digital models during design reviews have not been eliminated. Keyboards and mice are clumsy navigational devices and difficult to share in a collaborative setting.

This work explores the combination of new, inexpensive interface hardware technologies with a popular 3D modeler in order to create a viable surrogate for physical models. Two architectural model navigation and presentation interfaces were developed, one based on an Inertial Measurement Unit (IMU) circuit board ("Gizmo"), and one that used a Wii Remote Controller ("WiiView"). Both were interfaced with the popular architectural modeling program SketchUp. Anecdotal responses and preliminary user testing results are presented.

1 INTRODUCTION

Physical models typically accompany architectural design presentations. Participants are able to manipulate the model and acquire particular views, as they choose. The adoption of 3D digital modeling often suggests that physical models will be eliminated and that 3D views will be reduced to pre-selected viewpoints or animations.

Unfortunately, many issues remain in the navigation of 3D digital models, particularly architectural models, for which interior views may well be as important as exterior views. The habitual use of the mouse, key board, and windows for interaction obscures their clumsiness when interacting with 3D models. Most applications used for 3D modeling have user interfaces that are involved with hiding or momentarily avoiding inconvenient geometry. The common user interfaces make the exact placement or definition of a viewpoint for rendering an exacting, frustrating process for experienced users, and a near hopeless one for inexperienced users. This work is an attempt to apply new technologies to this very old problem.

1 PRIOR WORK

1.1 "NOBODY WALKS IN VIRTUAL REALITY—"

"They all fly," as Chuck Blanchard reportedly said in a conference presentation (Hays, 1983). There is extensive literature covering virtual reality navigational methods (Bowman, Koller, and Hodges 1997; Mackinlay, Card and Robertson 1990), but little of it has been applied to widely used 3D modeling systems; instead, wheel mice and keyboards are the dominant tools. The most common mode of operation involves heavy use of zoom, pan, and orbit, combined with concealing and revealing parts of the model through the control of "layers," hide/reveal commands, and transparency. Architectural presentations that involve "walk-throughs" and "fly-throughs" are generally scripted and often precomputed. The difficulty of ad hoc navigation is that it shuts out largely inexperienced users, and the single locus of control makes it difficult to share or perform navigations during a discussion.

1.2 TANGIBLE NAVIGATION TECHNOLOGIES

Our devices are very similar to (though much less expensive than) the "Bat" (Ware and Jessome 1988). Architectural design has occasionally been a subject of tangible interface research: the Cubic Mouse (Fröhlich et al. 2000) and the "two-4-six" (Kulik, Fröhlich, and Blach 2006) are related most directly to our work.

Figure 1 & 2
Gizmo (left) and
WiiView (right)

2 DISCUSSION OF WORK

The incorporation of standard wireless interfaces such as Bluetooth and the widespread availability of MEMs accelerometers and rotation sensors have produced a new class of untethered interface devices, and invite exploration of programs such as SketchUp that expose appropriate APIs. We experimented with two of them: a robotics inertial measurement unit (IMU) nicknamed "Gizmo" (fig. 1), and a Nintendo Wii Remote Controller called WiiView (fig. 2.) For each device, we developed a set of gestures to control the SketchUp "camera" viewpoint (figs 3, 4).

Figure 3 & 4
Gizmo and WiiView:
Gestures
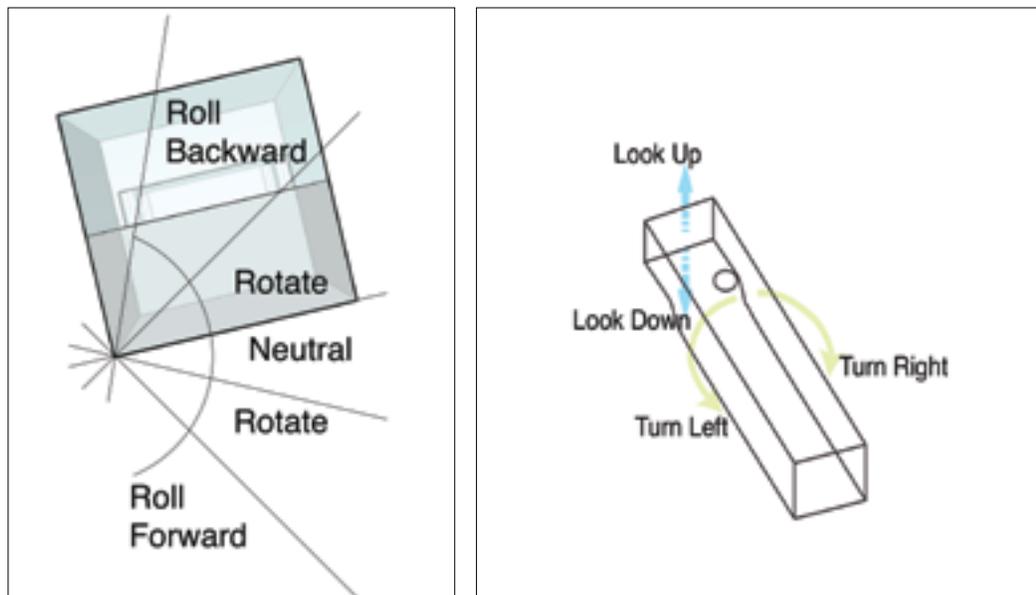
2.1 PRELIMINARY USER TESTING

One of our developers used Gizmo as a tool for developing a geometric model of the interior of our laboratory space. He found that for judging the quality and correctness of his interior model, and for placing viewpoints for lighting simulation, it was far preferable to a mouse and the usual SketchUp tools; it let him go inside the space in ways in which those tools did not easily support.

Time and the preliminary nature of the software did not allow for extensive formal user testing of the devices, but we did have three architecture students and one professor run a modest test. We downloaded from Google's 3D warehouse a model of a small three-story office with a full complement of furniture and interior finishes, and had our participants count

the chairs on three floors, one with a mouse, one with Gizmo, and one with the Wii Remote and our WiiView software. The results were interesting but mixed; there was a tendency for testers to fly out through the walls.

The following table summarizes the numerical results of the count:

Table 1 Chair counting test results

DEVICE	Mouse	Gizmo	Wiimote
Percentage of chairs found	81%	64%	47%

2.2 SOME NOTES & OBSERVATIONS

1) User tests closer to the intended application of each device's domain, design, and design review would probably produce data that is more interesting.

2) Some of the testers commented positively on the lack of a "roll" motion (turning on the axis of the line of sight). Our own experience with architectural model navigation suggests that, for most navigational purposes, roll is more of a hindrance than a help.

3) Users immediately associated the turning of Gizmo with the turning of the model displayed on the screen; users who used Gizmo tried to turn the Wii Remote.

4) The WiiView software appears to make it possible to control "fly" very well.

5) The Wii Remote's buttons were a great advantage; their multiplicity also turned out to be a source of confusion.

6) Subjects did not use SketchUp's own mouse-based "walk" and "turn" tools, though we did not forbid them to do so.

CONCLUSIONS AND DIRECTIONS

Both Gizmo and WiiView are interesting and attractive; we hope to deploy them in a studio review in the future. In our opinion the greatest successes of this experiment were the simple integration of easily available, moderately priced devices into a widely used design tool, and the clear relation between operator motion and the motion in the model. At times, this relation appeared to invoke directly the perceptions and responses involved in walking and looking. Yet, limiting the device to that type of cognition alone made the interface more difficult; Gizmo's complete lack of buttons limited gestural vocabulary significantly.

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