Interactive Light Field Painting

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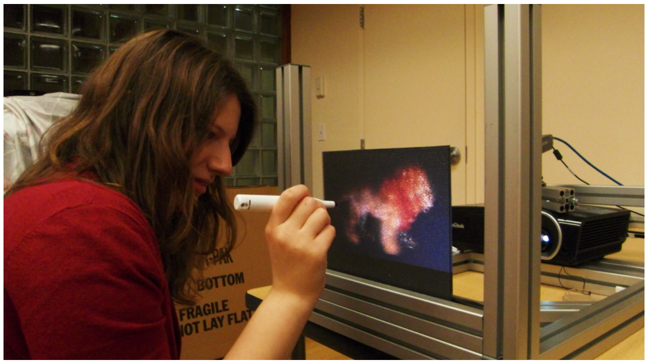

Figure 1: *An example of a user interacting with our first system.*

Introduction

Since the seminal SketchPad work of Sutherland [1964], direct interaction with a computer has been compelling: we can directly touch, move, and change what we see. Direct interaction is a major contribution to the success of smartphones and tablets; yet, the world is not flat. While existing technologies can display realistic multi-view stereoscopic 3D content reasonably well [Lueder 2012], interaction within the same 3D space often requires extensive additional hardware. We present a cheap and easy system that uses the same lenslet array for both multi-view autostereoscopic display and 3D light-pen position sensing.

The display provides multi-user glasses-free autostereoscopic viewing with motion parallax. A single near-infrared camera located behind the lenslet array is used to track a light pen held by the user. Full 3D position tracking is accomplished by analysing the pattern produced when light from the pen shines through the lenselet array. This light pen can be used to directly draw into a displayed light field, or as input for object manipulation or defining parametric lines.

Our system has a number of advantages. First, it inexpensively provides both multi-view autostereoscopic display and 3D sensing with a 1:1 mapping. To the best of our knowledge, this has not been offered in previous interactive content creation systems. Second, as the same lenslet array provides both 3D display and 3D sensing, our system design is extremely simple, inexpensive, and easy to build and calibrate. We show a variety of interesting interaction styles with a prototype implementation: freehand drawing, polygonal and parametric line drawing, model manipulation and model editing.

Demonstration Prototypes

While our first camera/projector prototype begins to demonstrate what is possible with such a system, it has some problems. These problems are largely mechanical and concern what equipment is used and how the equipment is set up, and do not significantly affect our algorithms for sensing and drawing. We are currently building a new prototype (V2, Figure 2) which will fix these problems, and this is what we wish to show at the Emerging Technologies exhibition. We outline a list of problems and how our new prototype fixes them:

1. *Small display/interaction area:* V2 will have a 4x larger display and sensing area.
2. *Low display resolution:* V2 will increase spatial resolution 4x by using a 4 projector array.
3. *Less accurate far-distance sensing:* V2 will provide more accurate sensing by using a 4MPix camera.
4. *Slow sensing speed (30Hz):* V2 will provide much faster sensing and more fluid interaction by using a high-speed camera (100Hz+) and optimized software.
5. *Slow CPU rendering:* V2 will provide much faster rendering, with a GPU-based point renderer able to handle more complicated scenes.
6. *Diffusor sparkle artefacts:* V2 will provide a display with less distracting sparkle artefacts.
7. *No haptics/no buttons on pen:* V2 will provide haptic feedback as the user paints in 3D - intersecting existing content in free space will cause the light pen to rumble - and V2 will also provide function control buttons on the pen.
8. *Limited painting tools:* V2 will add curves, primitives, scene hierarchy, selection tools, a eraser, etc. - more and better painting tools.

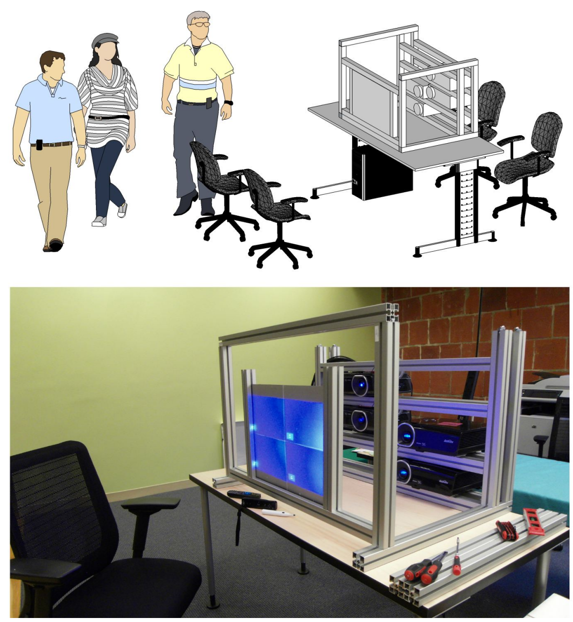

Figure 2: Top: *Scale sketch of our model as we expect to present it to attendees.* Bottom: *Photograph of our improved system in construction. A small camera (not visible) lies between the projectors.*

References

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