

# Authoring 2.5D Designs with Depth Estimation

## An Initial Investigation

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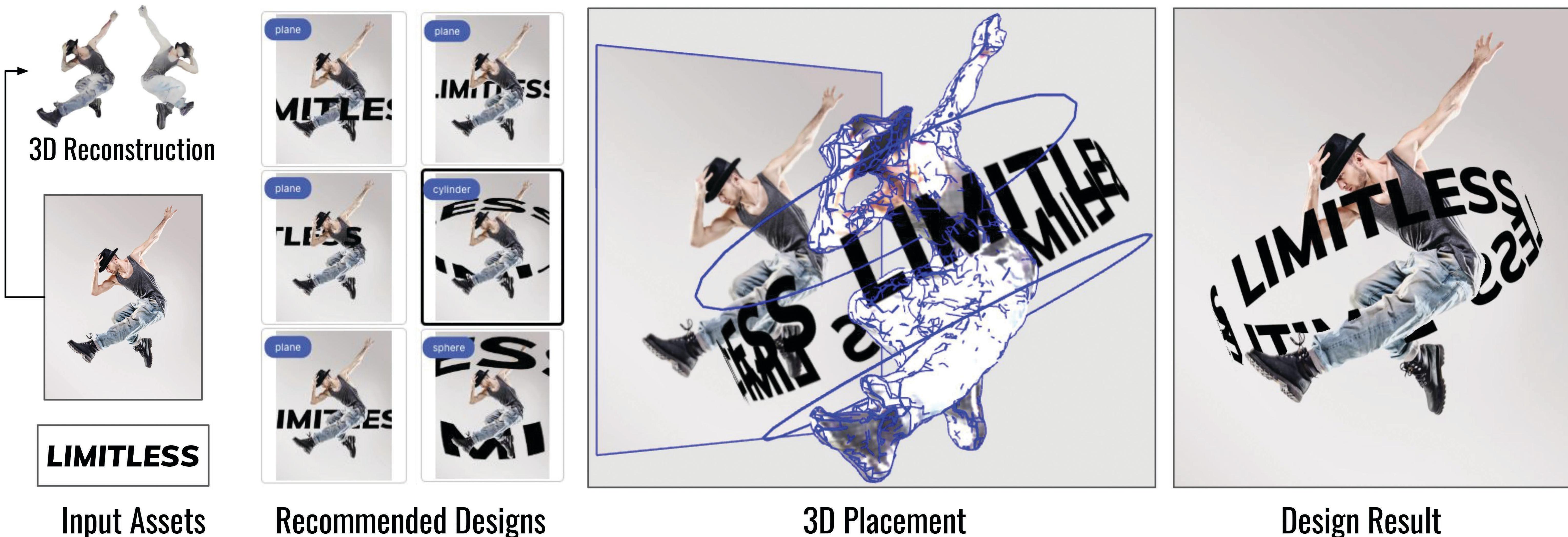
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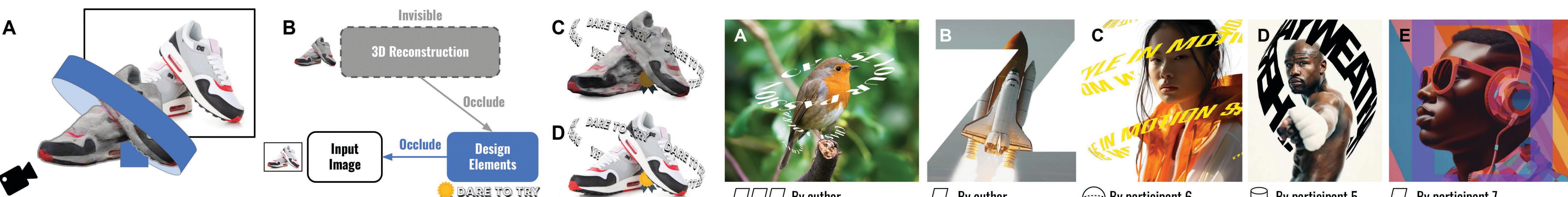
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**Figure 1: Overview of the DepthScape System's Pipeline**

We introduce DepthScape, a Human-AI collaborative authoring system for 2.5D visual designs. DepthScape takes input images and use 3D reconstruction to estimate its inherent depth information. With AI-assisted design recommendation, users can quickly layout design elements in the implicit 3D space. The output is a visual design with realistic perspective and occlusion effects following depth cues in the input image.



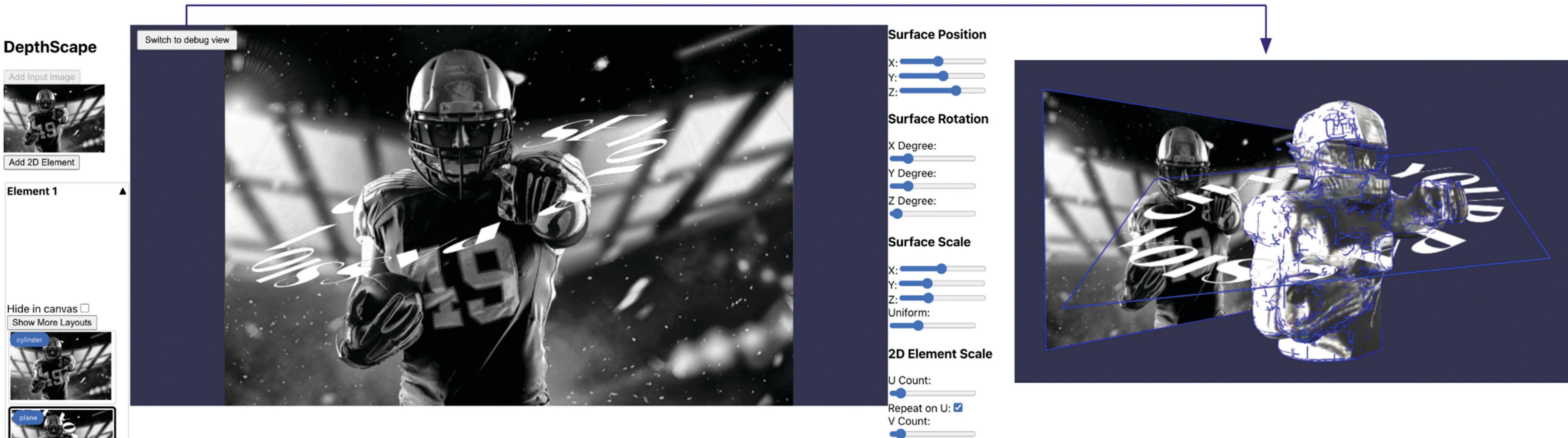
**Figure 2: DepthScape's implicit 3D space and rendering setting**

(A) A diagram showing the composition of the implicit 3D space, including the raw input image, the 3D reconstruction model, design elements, and an orthographic camera generating design results. (B) The occlusion relations in the rendering pipeline. (C) A design result in default render setting. (D) A design result in engineered render setting.

**Figure 3: DepthScape's Design Results Gallery**

DepthScape supports three types of primitives: Plane, Cylinder, and Sphere. Here we show example designs created by the author and study participants.

Design A, B, E are created with plane primitives. C is created with sphere primitive. D is created with cylinder primitive.



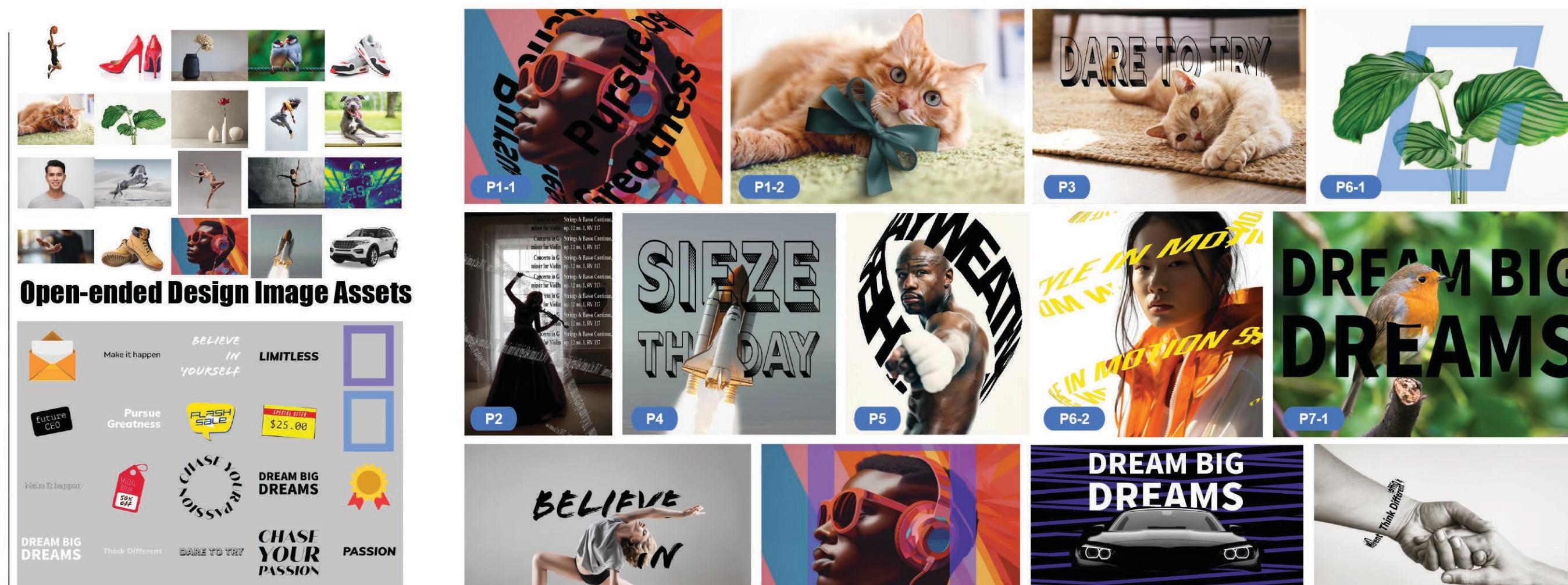
**Asset Panel**

**Canvas**

**Edit Panel**

**Figure 4: DepthScape's User Interface and Debug View**

The DepthScape interface is currently implemented as a web-based prototype. The interface has three main parts: (1) the Asset Panel manages imported assets and shows suggested design thumbnails; (2) the canvas renders the 2.5D effects, (3) the right sidebar, the Edit Panel, enables fine-tuning of the design via a series of categorized sliders to change the 3D primitive's position, rotation, scale or the 2D element's placement, repetition. To begin using DepthScape, the user first imports an input image, which gets processed into a 3D reconstruction within 15 seconds. Then the user can import other 2D elements with a button in the asset panel. Each imported 2D asset is treated as a separate layer. For each 2D asset, the user can click "Create Layouts" to generate a series of AI recommended layouts, each shown as a thumbnail image in the Asset Panel. By clicking these thumbnails, the user can instantly apply this selected design and view the element placement in the canvas. Based on the selected design, the user can further adjust the element placement with the Edit Panel on the right side of UI. All parameters, except for the primitive type, are grouped and listed in the edit panel as sliders. To better support placement, we also include a debug view, which shows the current canvas with a perspective camera.



**Figure 5 (left): DepthScape's User Study Assets**

We evaluate DepthScape with a 2-part user study among 9 designers. We ask them to replicate existing 2.5D designs with provided assets, then also freely explore DepthScape and create freeform designs. See our paper for more details.

**Figure 6 (right): User Study Open-ended Creation**

Design experts created diverse and visually compelling designs in the open-ended designs stage, including designs with simple depth cues that achieve realistic partial occlusions due to accurate depth reconstruction, and also more complex designs leveraging repetition and surrounding effects. Some designs achieved serendipitous effects, like a helix of text and a purple haze of boxes, which are created beyond expectation when exploring the parameter sliders.

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