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Image-Guided Modeling for Accessible 3D Printing

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Introduction

Our project reimagines how 3D printable models can be created directly from simple 2D images, eliminating the need for complex design software or technical expertise. By integrating advanced image processing with an intuitive, web-based interface, we enable users to generate, customize, and export 3D models quickly and easily (Figure 2). These models support a wide range of use cases, including custom furniture design, protective case fabrication, and detailed topographical mapping. Users can access the system on both desktop and mobile platforms, making the creation process more flexible and accessible than ever before.

Traditionally, 3D modeling required specialized training in CAD tools and significant manual effort. Our system automates and simplifies that process using technologies like Apple's Object Capture API for photogrammetry and Hunyuan3D for structure and texture generation. The result is a streamlined, end-to-end workflow that converts everyday photos into printable 3D objects. By bridging the gap between image capture and physical fabrication, we aim to expand the reach of 3D printing—transforming it into a more inclusive, creative, and practical tool for students, designers, professionals, and makers of all kinds.

Topographical Map Modeling

For our topographical modeling system, we convert elevation data into highly detailed 3D terrain models (Figure 1(B)). The result is a physical map that accurately represents the features of a landscape. These models are especially valuable for civil engineers, urban planners, and emergency response teams who rely on accurate terrain visualization for land development, infrastructure placement, and route optimization. The 3D printed format enables direct, hands-on planning and helps teams better understand elevation, slope, and other critical geographic features. Unlike traditional maps, these models offer depth and texture, enhancing the quality and clarity of spatial analysis.

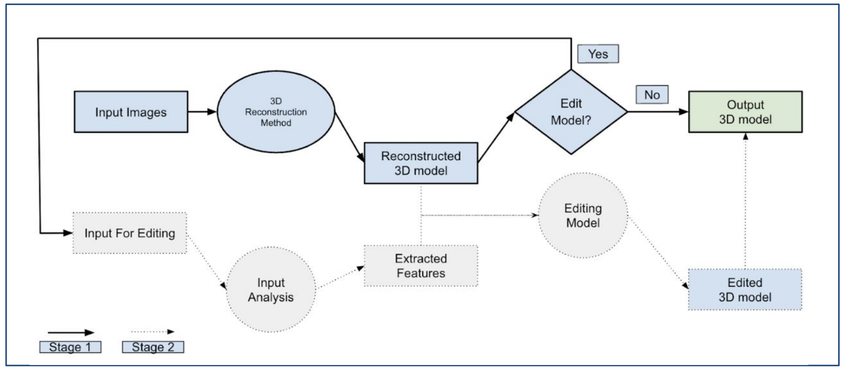

Figure 2: General Systems Architecture

Custom Case Creation

Our custom case creation tool uses a photogrammetry-based workflow to generate precision-fit protective cases from user-provided images (Figure 1(C)). On the website, photos of an object are processed through Apple's Object Capture API to produce an accurate 3D model, which is then refined in Blender to ensure it matches the object's exact dimensions and geometry (Figure 3(B)). The finalized model is exported as an STL file and sent directly to a 3D printer, resulting in a fully customized case. This streamlined process eliminates the need for manual measurement or CAD design, making it ideal for quickly producing protective enclosures for electronics, tools, or fragile items. The integration of modeling and printing enables rapid prototyping and cost-effective, on-demand manufacturing.

Conclusion

Our platform transforms the process of converting 2D images into 3D printed models, offering practical solutions across product design, architecture, and spatial planning. The case creation system enables fast, customized manufacturing of enclosures without the need for traditional CAD tools. Interior design modeling enhances collaboration by turning ideas into physical models clients can see and touch. Topographic mapping brings terrain data into a tangible format, improving clarity in planning and development. By combining image processing, modeling, and 3D printing into one accessible pipeline, our system simplifies workflows and makes digital fabrication achievable for a broader audience. These use cases show how image-guided 3D modeling can lower barriers, accelerate work, and unlock new creative and technical possibilities.

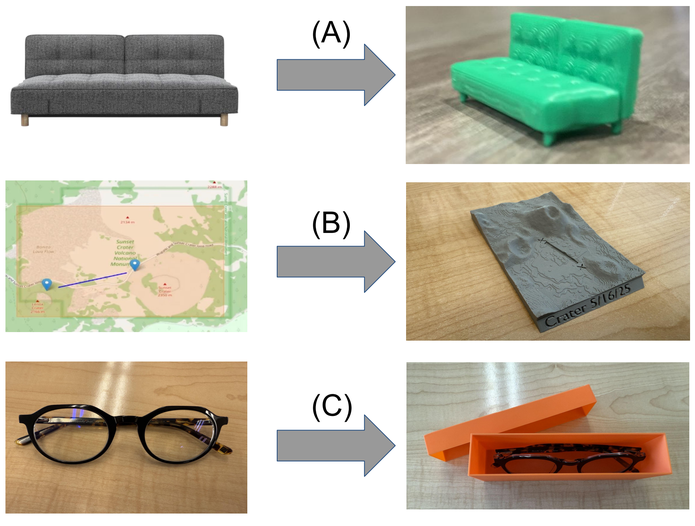

Figure 1: Use Case Demo

Interior Design Modeling

In our interior design application, we convert images of furniture and room layouts into 3D models using the Hunyuan3D API (Figure 1(A)). This model is then viewed in a virtual environment, where users can visualize space, scale, and make natural language edits to the model, as if they were in a modeling software (Figure 3(A)). When ready, designers can produce scaled-down 3D prints of the modeled spaces or furniture pieces. This allows clients to physically interact with the proposed layouts, making the design process more collaborative and intuitive. The ability to reprint revised models encourages experimentation and faster iteration, ultimately improving design outcomes while saving time and reducing guesswork.

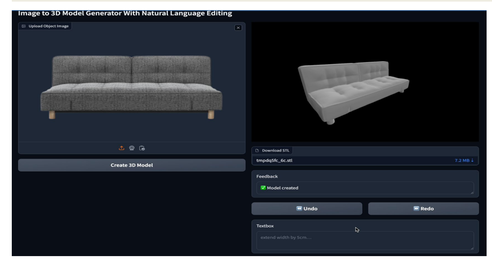

Figure 3(A): Interior Design Website

Figure 3(B): Case Creation Website