Real-Time 3D Model Acquisition

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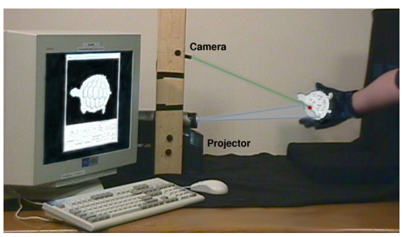
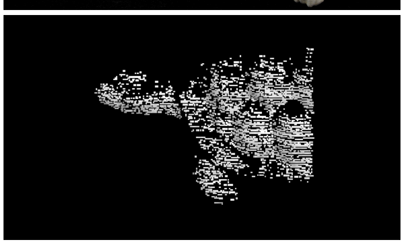
Abstract

The digitization of the 3D shape of real objects is a rapidly expanding field, with applications in entertainment, design, and archaeology. We propose a new 3D model acquisition system that permits the user to rotate an object by hand and see a continuously-updated model as the object is scanned. This tight feedback loop allows the user to find and fill holes in the model in real time, and determine when the object has been completely covered. Our system is based on a 60 Hz. structured-light rangefinder, a real-time variant of ICP (iterative closest points) for alignment, and point-based merging and rendering algorithms. We demonstrate the ability of our prototype to scan objects faster and with greater ease than conventional model acquisition pipelines.



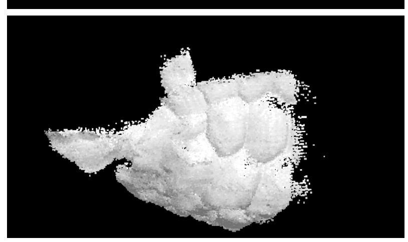
(a) Layout of our system. It consists of a DLP projector that displays structured light patterns, and an NTSC video camera. The green and blue lines have been added in this visualization.

(b) Photograph of a turtle figurine, approximately 18 cm. long.

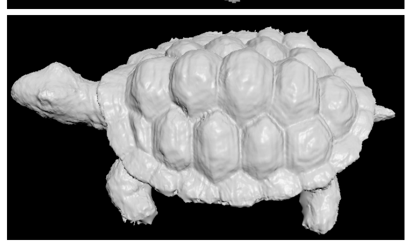


(c) Shortly after the start of scanning, data has been accumulated relatively sparsely. The individual point primitives used by our merging data structure are visible.

(d) After a few seconds of scanning, the front part of the turtle has been covered relatively well. However, the user sees a few remaining holes.



(e) The user turns the object to fill the holes. The user may try a number of different positions until the holes are filled – immediate feedback is available about the effectiveness of each orientation.



(f) Once all the data has been gathered, high-quality offline global registration and surface reconstruction algorithms are used to produce a final model.

Figure 1: Our real-time 3D model acquisition system was used to scan a small turtle figurine. The total scanning time was 4 minutes and the final model, at 0.5 mm. resolution, contains approximately 200,000 polygons. (c) through (e) are rendered using splats, and (f) is rendered as a polygon mesh.