GemSketch: Interactive Image-Guided Geometry Extraction from Point Clouds

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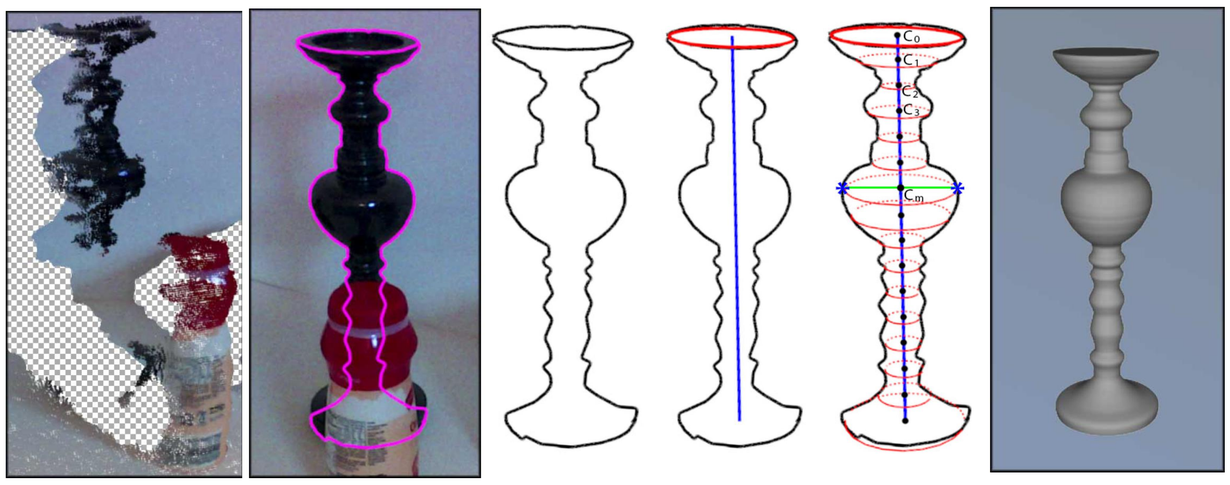
INTRODUCTION

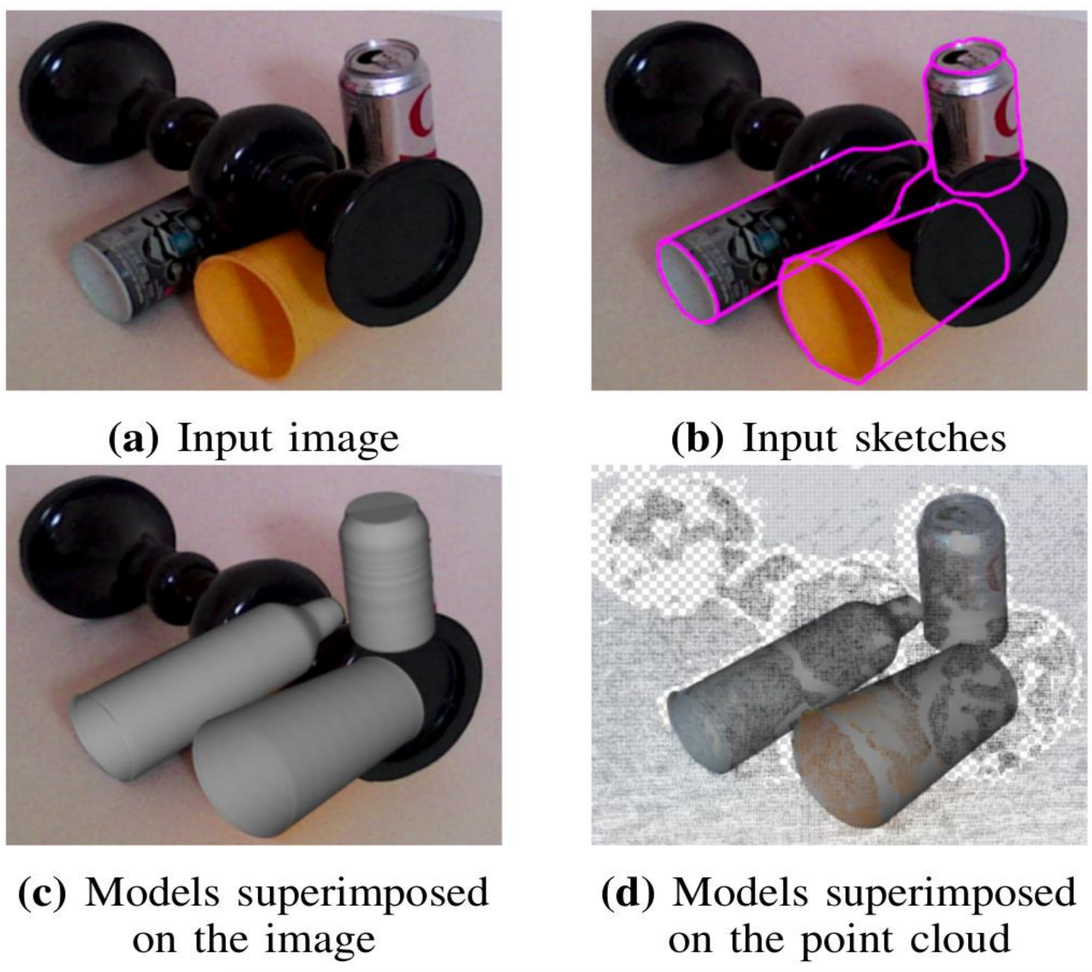
The need for the existence of accurate 3D mesh models has increased dramatically in recent years, in part due to the advances in generative approaches [1,2]. Such models are becoming necessary priors for grasping and manipulation tasks [3,4]. However, designing such objects from scratch is challenging endeavor. With these goals in mind, we propose GemSketch as a tool designed for extracting the 3D models of generalized cylinders and cuboids. GemSketch can estimate models from partial and occluded observations of single or multiple-view point clouds.

METHODOLOGY



Point Cloud | Contour Sketch | Profile and Spline Extraction Followed by Profile Propagation | Extracted mesh

After drawing the contour, copies of the estimated profile (cap) of the object are created along the object's spine to create the final 3D model.



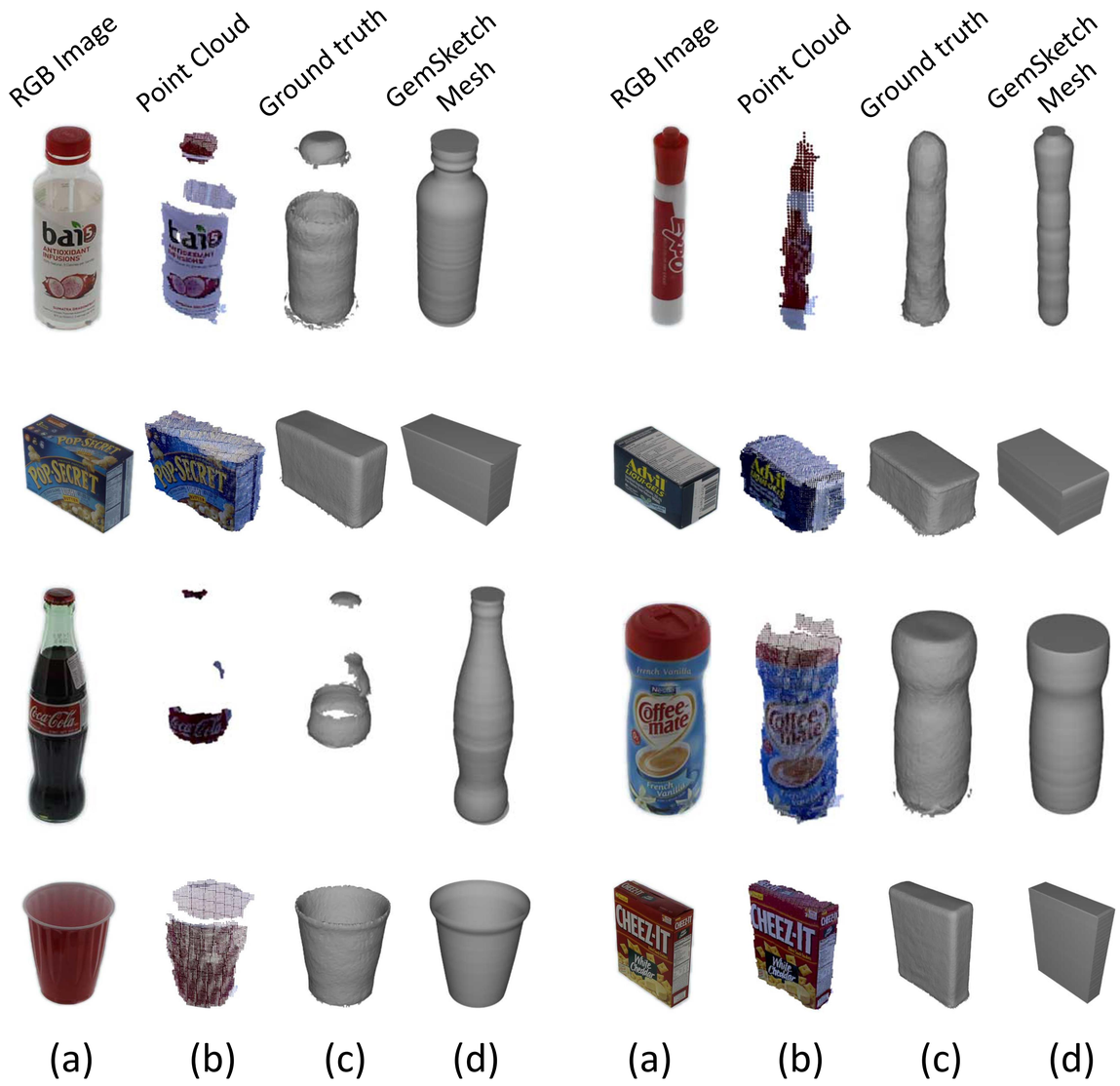
(a) Input image (b) Input sketches

(c) Models superimposed on the image (d) Models superimposed on the point cloud

RESULTS

We extracted 16 different objects from the BigBIRD [5] dataset and compared performed a qualitative as well as a quantitative comparison between out extracted models and the ground truths in the data set. GemSketch can leverage the availability of multiple-view point clouds and images of objects. Consequently, some objects were extracted with more than a single view.

Two metrics were used for quantitative comparison. Hausdorff distance was used to measure the dissimilarity of each object with its ground truth. Additionally, we computed the ICP errors of the alignment between each extracted model and its ground truth. We achieved a mean normalized Hausdorff distance of 5.66%.



The table below outlines the results of comparison of each object with its ground truth available in the BigBIRD [5] dataset.

Object Name	ICP Error (mm)	Hausdorff Distance (%)	Object Name	ICP Error (mm)	Hausdorff Distance (%)
3m_high_tack_spray_adhesive	6.20	3.40	expo_marker_red	3.89	6.95
advil_liqui_gels	8.04	6.50	haagen_dazs_butter_pecan	6.21	4.69
bai5_sumatra_dragonfruit	10.62	5.16	hunts_sauce	6.56	5.85
cheez_it_white_cheddar	8.78	5.94	krylon_crystal_clear	6.25	4.87
cholula_chipotle_hot_sauce	5.82	4.84	pop_secret_light_butter	9.42	6.37
coca_cola_glass_bottle	29.69	7.39	red_bull	6.10	4.57
coffee_mate_french_vanilla	5.59	4.63	red_cup	4.25	7.34
dove_beauty_cream_bar	6.67	6.67	v8_fusion_peach_mango	6.48	5.40

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