

Interactive Image-Based Modeling and Walkthrough Planning

by

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Submitted

in fulfillment of the requirements of the degree of
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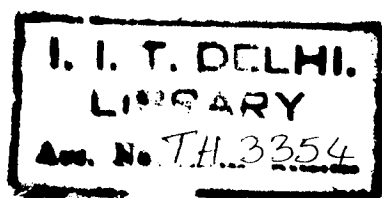
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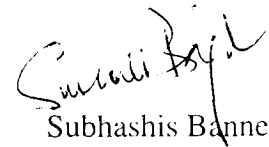
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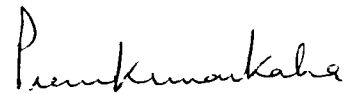
Certificate

This is to certify that the thesis titled “ Interactive Image-Based Modeling and Walk-through Planning” being submitted by Subhajit Sanyal to the Indian Institute of Technology Delhi, for the award of the degree of Doctor of Philosophy, is a record of bona-fide research work carried out by him under our supervision. In our opinion, the thesis has reached the standards fulfilling the requirements of the regulations relating to the degree.

The results contained in this thesis have not been submitted to any other university or institute for the award of any degree or diploma.



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To my family
for their unwavering love and support

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Abstract

In this thesis we present image-based techniques to model and render real objects and scenes. In the first part of the thesis we present techniques for recovering 3D information from images and in the second part we address issues related to designing high quality walkthroughs. Our techniques are semi-automatic and meaningful inputs from the user are sought to obtain the solutions to the problems we address.

Our work on recovering 3D geometry from images addresses reconstruction of both structured scenes and free-form surfaces. For structured surfaces we present an interactive reconstruction framework based on a single view of an object. The framework enables setting up of a world coordinate system and complete recovery of the imaging parameters (camera intrinsics and extrinsics) based on simple, interactively specified constraints. We incorporate robust methods for recovering the geometry of arbitrarily oriented planar surfaces and surfaces of revolution. Our scheme allows inter-registration of reconstructed geometry from multiple views to ensure completeness of the model or to enhance the recovered structure.

We use the shading information in images for modeling free-form surfaces. Our shape from shading (SFS) approach handles different shading and illumination models in a unified manner. In contrast to most existing methods we allow for presence of specularities and shadows in the images. We use a game-theoretic optimization scheme to solve for the shape of the object. User interaction, in terms of providing an initial seed to the solution and occasional correction in the solution evolution phase, helps us to avoid the problems of local minima which is a severe delimiting feature of most existing schemes. Our results obtained with real images illustrate the efficacy of our

scheme.

The first part of the thesis describes object centric, image-based 3D reconstruction schemes. In the second part we give a framework for designing high quality walkthroughs. Our framework aids the content creator in designing tours where one sees interesting objects for the most part of the tour. Further, the speed of the tour is controlled by what is shown. In walkthroughs of a photo-textured scenario, the quality of rendering is directly influenced by the quality of the acquired images. We present a simple tool to plan acquisition of images such that they meet a certain quality threshold.

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