

A Sketch-Based Interface for Collaborative Design

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Abstract

We present an interface for collaborative conceptual design that combines sketch elements, direct manipulation of 3D objects and non-photorealistic rendering. Such a combination results in a simple and intuitive 2D-sketch-to-3D modeling system suitable for novice users. It allows users potentially located in geographically distant areas to cooperate by sketching, exploring and modifying their ideas interactively, with immediate visual feedback. Our system prototype supports several modeling primitives and can be extended to handle user-defined objects. Potential applications of our system include early stages of urban and landscape design, rapid prototype of virtual environments, animation, education and recreational use.

Categories and Subject Descriptors (according to ACM CCS): I.3.6 [Computer Graphics]: Methodologies and Techniques - Interaction Techniques I.3.3 [Computer Graphics]: Picture/Image Generation - Display Algorithms H.5.2 [Information Interfaces and Presentation]: User Interfaces - Interaction Styles

1. Introduction

Sketching is frequently used during the early stages of conceptual design when ideas are still unfinished. The lack of precision implied by the strokes seems to increase the tolerance of the initial estimate of shape [ZHH96, LM95]. Thus, sketching has been recognized as an important tool for communicating ideas and concepts. While it is traditionally performed using pencil and paper, the ability to interactively explore and refine the original thoughts in a collaborative environment can provide a sense of shared design space, allowing the easy creation of different versions of the project and serving as a valuable teaching tool. Unfortunately, these benefits cannot be fully exploited with the use of pencil and paper. Traditional direct-manipulation 3D design systems (e.g., CAD systems), on the other hand, provide considerable editing support, but usually require accurate descriptions of the models, making them less attractive for brainstorming. Although computers can be used to assist in the sketching process [ZHH96, Pug92, BCF94, LM95], creating 3D models directly from a series of 2D strokes is an ill-posed problem, often leading to undesirable results. As

such, just a few applications have tried to mimic the process of sketching 3D objects and only do so under some restrictions [Pug92, ZHH96]. A more flexible approach for sketching 3D shapes of objects presenting symmetry and repeated substructures has been recently proposed [IH01].

We are interested in the use of sketching for conceptual design by distributed teams. In these situations, it would be desirable to allow project members and clients to remotely engage into collaborative design sessions. In practice, however, researchers have reported that distributed design often degenerates into co-located design, requiring participants to physically meet in order to overcome the expressive limitations of traditional communication media, such as phone, fax, e-mail and videoconferencing [LHF*98]. In order to face this challenge, we have designed and implemented an interface for conceptual design that supports collaborative work among groups of users over a network.

In order to be successful such an interface has to be easy to use. In particular, no artistic skills are required to effectively use our system. In order to avoid the difficulties of creating 3D models directly from 2D strokes, we constrain the use of free-hand strokes to the creation of 2.5D objects and to the drawing of 2D profiles that can be extruded to create 3D objects. In general, truly 3D objects are built from an available set of simple 3D primitives, or imported as polygonal

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