THE DESIGNOSAUR AND THE FURNITURE FACTORY

Simple Software for Fast Fabrication

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Abstract. We describe two domain oriented design tools that help novice designers design three-dimensional models that they can build using rapid manufacturing equipment. By embedding domain and manufacturing knowledge in the software and providing a sketching interface, novice designers can acquire and practice skills in modeling and manufacturing, without first having to master complicated CAD tools.

1.1. INTRODUCTION

We want to make it easy for ordinary people, especially children, to design and manufacture three-dimensional models using planar components as an entrée to learning to design. We believe that the experience of designing and making things is a powerful vehicle for learning. For many people, designing and making something can be rewarding and engaging, and, we think, can motivate more general learning in science, technology, engineering, and mathematics. Further, we think that in its own right, designing is an intellectual capacity that, once acquired in one domain, can be widely applied. Sadly, many people view design as an innate talent for creativity that they lack. Our project to build lightweight software to engage young people and naïve users in designing and manufacturing simple 3-D models aims to open the door to design and the rich universe of learning that design affords.

Three-dimensional physical models are powerful devices that help people see and understand designs. One can hold a physical model in the hand, take it apart, and reassemble it, perhaps in different ways. This ability to interact physically with a model and its parts is important, we think, for thinking about a design; and the experience of designing with 3-D models teaches
spatial skills that designers cannot easily acquire through other means such as drawing or computer graphics modeling.

Making models in the traditional way demands considerable manual skill and dexterity, for example cutting wood parts with a razor knife. The advent and adoption of rapid prototyping and manufacturing (RPM) machinery has made it possible for ordinary designers, students, and even children, to produce physical artifacts using computational means. Although most RPM hardware is as simple to use as a printer, the software tools that designers use to produce representations for output require a great deal of expertise. To produce a 3-D model designers must create a computer graphic representation. Typically designers do this using powerful general-purpose CAD modeling tools that impose a significant learning curve. Requiring of professional designers this degree of sophistication and expertise may be acceptable; however, the tools bar entry to casual and novice users.

Our goal in this work is on one hand to explore and populate the space of computationally enhanced craft activities for teaching and learning design; and on the other hand, to develop interaction techniques appropriate to the domain and the intended users. We aim to exploit characteristics of specific design domains to build relatively simple special-purpose modeling tools that novice users can easily and quickly learn. The computational design environment can help a designer by building in some requirements of the manufacturing method (e.g., the method of joining parts and sizing of joint features) as well as circumscribe the design domain through the methods and options the tools present. Our method is to explore this territory through constructing working prototypes that illustrate ideas and possibilities.

1.2. FURNITURE AND DINOSAUR MODELS

We describe two projects that explore this territory of easy-to-use domain-oriented tools that help naïve users design three-dimensional models. Using the Furniture Factory users sketch, model, and produce a class of furniture models. The Designosaur enables its users to make models of dinosaurs, both real and imaginary. Both projects enable users to begin by sketching a design and both employ a laser cutter as the output medium, to cut model materials from flat material such as wood or plastic sheets. Both use embedded knowledge about the design domain and manufacturing process to implicitly help users make design decisions or add detail to the model.

Figure 1 shows a store bought model furniture kit. It is packaged as flat panels with pre-cut parts that can be punched out and assembled into furniture models. A simple joining system (note small holes and slots in the laid-out parts in Figure 1) keeps the assembled parts together without glue or additional hardware. If permanence is desired, the parts can be glued and the model can be painted. Some furniture models are cleverly designed. For example, the cabinet doors in the piece shown below are hinged to open and