Sketching for the Refinement Stage of Design

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Abstract

This workshop paper summarizes the motivation for my forthcoming PhD proposal on *computational support for sketching during the refinement stages of design*. I will explore this space by (1) building a tool empowering people to easily design artifacts by concurrently sketching alongside traditional interaction methods, and (2) evaluating interaction and engineering issues associated with it. This work is preliminary, and I welcome constructive criticism in shaping my proposal.

1 Introduction

Early phases of design can be characterized by idea generation and exploration [**?**, **?**]. Sketching readily supports these activities. This is why many sketching systems have focused on early phases of design. Refinement phases are characterized by incremental revision and production—activities traditional computer design tools support well. However, designers continue to sketch on paper after they have begun revising computer models. These refinement-phase sketches help people solve subproblems that were not apparent or relevant during earlier exploration.

However, current software design tools are unable to directly leverage these refinement stage sketches. Instead, users manually translate sketches to the computer model. Design tools could be made to understand the user's informal sketching input by leveraging the formal representation already present in the model. It is not clear—from both technical and HCI perspectives—how a tool that concurrently supports formal and informal input should be made. In order to explore these areas, I propose to build such a tool.

First, I will produce a design environment called FlatCAD. The current version of FlatCAD supports users in making models by programming in a domain-specific language called FlatLang [**?**]. The next version of FlatCAD will also support traditional GUI operations and sketching input.

The second contribution explores challenges associated with concurrently using informal sketches with formal computer representations. In particular I am interested in (a) software engineering and (b) HCI aspects of these tools. In the following sections I briefly describe FlatCAD, discuss the technical and interaction challenges associated with adding support for sketching to it.

2 FlatCAD Use Scenario

FlatCAD is an environment for designing objects made of flat material for rapid prototyping. Currently, users define shapes by programming in the LOGO-like FlatLang domain-specific language. The output of a FlatLang program is a "cutfile" that is sent to a laser cutter. A simple FlatLang program for drawing a square is listed in Figure **??**.

FlatCAD has been used to design several classes of physical artifacts, such as construction kits to mechanisms to household goods like soap dishes and toothbrush holders. Here I detail the process I took when making the soap dishes shown in Figure **??**.