FORMALIZING GENERATION AND TRANSFORMATION IN DESIGN

A Studio Case-Study

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Abstract. This paper is an integration of two substantial endeavours. One is a general purpose 3D modelling system, ICE that introduces a new notation and an entire family of graphic design functionalities based on generative structures and manipulation handles. The other is an exhaustively annotated design studio, in which the entire graphic output of students and the annotations of their faculty have been ethnographically recorded. In this paper, we are using the ICE notation to represent the key graphic products of a selected student and the transformations between these representations. Our goal is to demonstrate that, through ICE’s formal notation (1) graphic entities in complex design sequence can be unambiguously represented, (2) transformations between graphic entities in complex design sequence can be unambiguously represented, and (3) the various design sequences can be formally captured for subsequent process or cognitive analysis.

1. Motivation

This paper is motivated with the goal of codifying design (taken both as a noun and a verb) unambiguously and formally. We believe this will lead to quantifiable representations that can help analyse designs and design generation for cognition and intent capture in design. There are two motivating ingredients of this study. One is a general purpose 3D modelling system, ICE (interactive configuration exploration) that introduces a new notation and an entire family of graphic design functionalities based on generative structures and manipulation handles, (Moustapha and Krishnamurti 2001). The other is an exhaustively annotated design studio in which the entire graphic output of students and the annotations of their faculty have been ethnographically recorded. We will briefly introduce these ingredients below. In the following sections, we will elaborate each one and
conclude with a discussion of the implications of our approach for design cognition and intent capture.

1.1. THE ANNOTATED STUDIO

A vertical design studio in the School of Architecture, at Carnegie Mellon University was offered during the summer of 2002, by Professor Omer Akin. There were six students taking the studio, one having completed the 2nd year, two the 3rd year and three the 4th year of their college education. The entire studio work was recorded through digital photographs of student work brought to each class session and the midterm and final reviews (Akin, 2002). These graphic records were accompanied by daily diary annotations kept by the instructor for each student’s progress as well as the overall progress of the studio.

Students were invited to define their own design programs or continue with a previous design problem either they experienced or experienced by their peers. Three different problems emerged, international housing prototype, dormitory housing, and a toy manufacturer’s headquarters building. The studio work was complemented by visits by external faculty on a weekly basis. They gave feedback to students on their work through critics and presentations of their own work. The same faculty served on the midterm and final reviews of the studio. A typical annotation for a studio day contains segment for each student and some directed to the general issues in the studio like the one in Table 1.

<table>
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<th>Subject-W’s has created a swirling shape that expresses the housing hierarchy: rooms, units, unit-clusters, wings, buildings, building-clusters. I tell her(^1) to examine her ideas spatially vis a vis a model. I remind her of her own narrative about the new dorm lounge spaces that do not attract any social gatherings due to being out of the way. Making a conceptual diagram about social hierarchy does not always work in actual spatialization because connectivity must be solved in another medium, namely a physical model.</th>
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1 We used “she” or “her” to refer to all subjects--students and critics--of the annotated studio for the purpose of anonymity. No gender implications are intended.