Generative Design Methods for the Tangible Social Interfaces (TSI)

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Abstract
Interdisciplinary design methods used in the development of the *Constructed Narratives* project, which is a *tangible social interface* (TSI). The TSI is designed to enable users to collaboratively construct and negotiate their social and knowledge networks based upon their preferences and user profiles. [13]

Keywords
Tangible Social Interfaces, Design Methodologies, Shape Grammars, Visual Semiotics

ACM Classification Keywords
H.1.2 User machine systems; H.5.2 User Interfaces;J.5 Arts and Humanities

Introduction

Fig. 1 Demo at the Kiasma Museum of Contemporary Art Helsinki, Finland (2004).

Fig. 2 Stages of iterative prototype

Constructed Narratives is a construction kit of tangible blocks that form a mesh-network when connected. This *tangible social interface* is designed to respond to each player based on his/her profile, which is logged into the system prior to game play, interactions with the blocks and interaction with other players in a collaborative design activity. Each action performed by a builder is recorded and cycled back into the environment as a real-time collective narrative. Participants collaborate in constructing a world in which their player profiles coupled with their collective design decisions are the materials that give form to the emerging physical and semantically signified block construction.

Research in Electronic Construction Kits

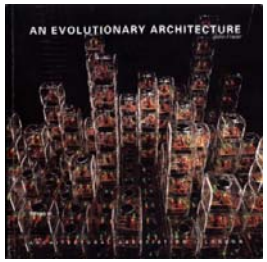

Fig. 3 Front Cover of Jonathan Fraser's book "An Evolutionary Architecture"

Constructed Narratives project joins a lineage of projects based on the early work of Architect Jonathon Frazer's *Universal Constructor* generative system. [1] Many of the projects influenced from Frazer's work have focused on developing three-dimensional screen-based interfaces that replicate and/or augment the physical construction made by networked tangible user interfaces (TUI). [2,3]

Electronic construction kits reviewed in the design of the *Constructed Narratives* project fall into four categories; (1) **historical electronic construction kits** [1]; (2) **sensorial interfaces** that map light, sound, or color onto the screen-based digital media component of the TUI, or directly on the physical objects. [4,5,6]; (3) **information navigation interfaces** that maintain a one-to-one relationship between the manipulation of the TUI and information output from a database, in most cases a web site [7,8,9,10]; and (4) **shape analysis systems** that interpret the shape of a physical construction with pattern finding algorithms. A three-dimensional texture map is applied to the screen replication of the construction that roughly mirrors the TUI physical construction. [11,12]

Generative Design Methods

The technical goal for this project has been the development of a software and hardware platform that can process a dynamic flow of logistical and profile data from multiple users. The block design supports forty connectable degrees of freedom. The methodology for generating the block shapes is based on the architectural design theory Shape Grammars. [14,15] Shape Grammars have been used to understand generative design systems in many fields including architecture [16], art and design [17] , and engineering [18]. The *Constructed Narratives* shape grammar rules where developed from an iterative design process that included prototypes made from wood scraps, hand drawn shape grammar rules, and the development of a shape grammar rules calculating software.

Software Development

The software architecture includes: the system interfaces including the tangible blocks and builder's profile application; the host application which keeps a dynamic graph of all data as the construction emerges; the semantic engine that applies a series of rules and iterative searches to find patterns in the data to be used to seed a word search using the WordNet API; and the virtual build application that prints the word search results onto a three dimensional real-time navigable model of the physical block construction. The result is a reconfigurable language machine that reflects a dynamic collective profile of the group of builders who are participating in the game. The design has been compared to a tangible Oulipo (Exquisite Corpse) as made by the experimental 20th century DADA artists.

Semantic Engine

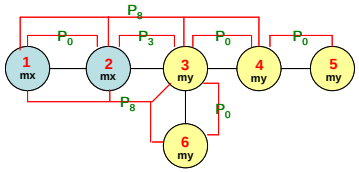

Fig. 4 Diagram of a pattern search session with the CN Semantic Engine.

The semantic engine is the heart of the *Constructed Narratives* projects and is the key component that separates it from other electronic construction kit research projects. Jacques Durand's visual semiotics system has been interpreted into

software code and applied to the semantic engine for the rules-based pattern search algorithm and word search. Durand's system is based on the theory that rhetorical operations though generally thought of in linguistic domains, can be applied to photographic images to understand the relationship and implied meanings between objects and compositional style used in the image. [19,20]

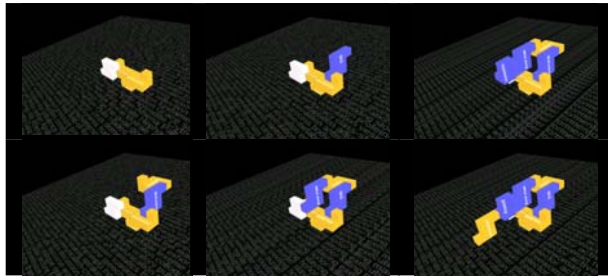

Fig. 5 Screen Grabs from the CN Virtual Build Application.

The semantic engine uses patterns found in the physical constructions, made with the blocks, coupled with information about the participant responsible for attaching the block to the construction. It processes that data, based upon rule structures from the visual semiotics work sited above, to form keywords for a word search using the WordNet API from the Cognitive Science Laboratory at Princeton University. [21] The current Semantic Engine software application incorporates a simplified WordNet search. The search is not pre-determined. Rather it incorporates a keyword look-up table of meta-level terms that are aligned with the four topic areas of the Builder's Profile application – self-identification, origins, environments, and values. This alternative search procedure serves as a functional placeholder while research continues with the WordNet API and other software agent systems that can be used to search rhetorical tropes as identified in Durand's system, and cultural signifiers (e.g. images and text) that are available in other databases such as the internet. [22]

2007 Design Updates

With the assistance of a grant from the National Science Foundation, the *Constructed Narratives* project is being redesigned to: (1) develop a robust design for continual direct manipulation, game play and evaluation; (2) implement the Zigbee wireless network protocol; (3) continue development of the software architecture.

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