The Generative Visual Renku Project: Integrating Multimedia Semantics, Animation, and Interface Design

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CHI 2010, April 10–15, 2010, Atlanta, Georgia, USA.
ACM 978-1-60558-930-5/10/04.

Abstract
This paper presents Generative Visual Renku (GVR), a new genre of visual interactive/generative art form inspired by Japanese renku poetry and generative contemporary art. GRIOT, a system for composing generative and interactive multimedia discourse, is used to semantically constrain generated output both visually and conceptually. GVR utilizes GRIOT to implement constraints for visual composition, revealing new technical and aesthetic challenges. Since modular animated graphical systems are ubiquitous in computing culture, ranging from avatars to GUIs, GVR works pose a contribution to a breadth of HCI research and to the development of new theory and technology for integrating AI and the arts.

Keywords
Multimedia, animation, interface design, interactive, generative, artificial intelligence, visual art

ACM Classification Keywords
H.5.2. User Interfaces: Graphical user interfaces (GUI).
J.5 Arts and Humanities: Fine arts

General Terms

Design, Experimentation, Human Factors

Introduction

The Generative Visual Renku (GVR) project presents a new genre of generative and interactive visual art inspired by renku, iconicity of Chinese character forms, generative models from contemporary art, and conceptual metaphor and blending theories from cognitive science. GVR works generate poetic (expressively meaningful) compositions of images differently upon each instantiation through interactive co-creation between the user and the system.

Traditional renku is a type of linked poetry, consisting of a series of links between topical elements in verses. The visual renku described here uses animated images rendered in an iconographic and/or calligraphic style in place of traditional written text. It is interactive, accepting users' motor action inputs (e.g., via mouse or multitouch pad) to guide linking of subsequent imagery. It is also generative in that subsequent imagery is dynamically and divergently composed using a computational system, GRIOT, which provides both perceptual and conceptual constraints.

The GRIOT system was designed to support semantics-based interaction and generation for multimedia works. [1] Initial cases, however, were primarily textual. The GVR project extends the GRIOT architecture to implement constraints for visual composition, revealing new technical challenges. This paper presents the theoretical framework for our project, examples of generative visual renku, and discussion of technical and theoretical challenges and results.

Theoretical and Artistic Framework

The GVR project draws upon an interdisciplinary theoretical framework including generative visual and literary arts, Chinese character forms, cognitive science, computer science, and renku poetry.

Generative visual and literary arts

Generative art or literature generally refers to a type of works that strongly emphasizes the processes giving rise to specific instances. The process is usually designed by the artist or writer in terms of a set of rules, a computer program, or a machine, and then is executed automatically [2]. The Oulipo (Workshop for Potential Literature) group is perhaps the most prominent proponent of this concept in literature. In the case of visual art, many contemporary art practitioners have created inspirational exemplary work, such as Frank Stella's *The Protractor Series* (1967-69), and Jennifer Bartlett's *Rhapsody* (1975). In such works, the aesthetic sensibility focuses on directing viewers to consider processes rather than individual instances of output. Meaning is embedded in the form as opposed to content.

Iconicity of Chinese characters

In [3], Masako Hiraga describes a significant relationship between C. S. Peirce's semiotic notion of iconicity and the recent cognitive science results mentioned above. She first reviews Peirce's categorization of signs as icon, index, and symbol, and the division of icons into image, diagram, and metaphor, a trajectory moving from perception to conception. We found a parallel between Peirce's typology as articulated in Hiraga's framework and the categorization of Chinese characters. Simple characters like pictographs correspond to images and ideographs

correspond to diagrams. Compound characters, which are composite of two or more simple characters, usually generate new meanings by association of paradigms or iconic moments, many of which are metaphorical icons. This compositionality of meaning has proved inspirational for the graphical composition framework in the GVR project.

Conceptual metaphor & blending theories and the GRIOT system

George Lakoff, Mark Johnson, Mark Turner, and others have studied metaphors as mappings between domains and have shown that many basic metaphors are based on everyday life experience [4]. Gilles Fauconnier and Mark Turner have extended this framework in their conceptual blending theory, which describes how concepts are integrated both unconsciously in everyday life and in more complex thought such as in art and literature [5, 6]. Based upon these hypotheses, Joseph Goguen's theory of algebraic semiotics to provide a method for formalization [7], and a novel framework for computational narrative, Fox Harrell designed and constructed the GRIOT system for implementing generative and interactive narratives [8]. The GRIOT system allows authors to create narratives where user interaction drives a wide range of guided and structured, but not scripted, eventualities of discourse content and style [9, 10].

The link and shift in renku

Linked poetry is a kind of collaborative literary work. It requires two or more poets to alternate in the creation of verses to form a complete poem. In Japan, renku, a form of haiku with linked verses in the style of the Basho school, is highly praised as a national heritage and is growing in popularity in international literary circles [11]. To compose a poem, renku poets have to create "links" between successive verses through object, meaning, or scent, which means a consistency in mood or emotion. Meanwhile, "shifts" are used to avoid throwbacks or too many repetitions of ideas or themes. The key is to balance connection and diversity. The poet's choice of words then depends not only on personal aesthetic sense but also the context.

Examples of Linking and Shifting in GVR

An example work of the GVR project described here presents linked disposition of topographic tiles, interactively co-determined by the user and the system. The arrangement of the tiles is constrained by the structural (diagrammatic) properties along the edges and linked perceptually (imagic) or conceptually (metaphorical) to one another in response to the user's successive choices. The output is like a topographic map of poetic landscape "picturing" the particular user inclination bouncing back and forth an opposition of socially or culturally established conventions (modular vs. organic objects) with visible association in graphic or cinematic forms.

Perceptual and conceptual qualities of tiles

Perceptual qualities include shape, color, stroke style, and the like, while conceptual qualities span topics such as industrialization, urbanization, mass production, nature, cultural heritage, and others (figure 1).

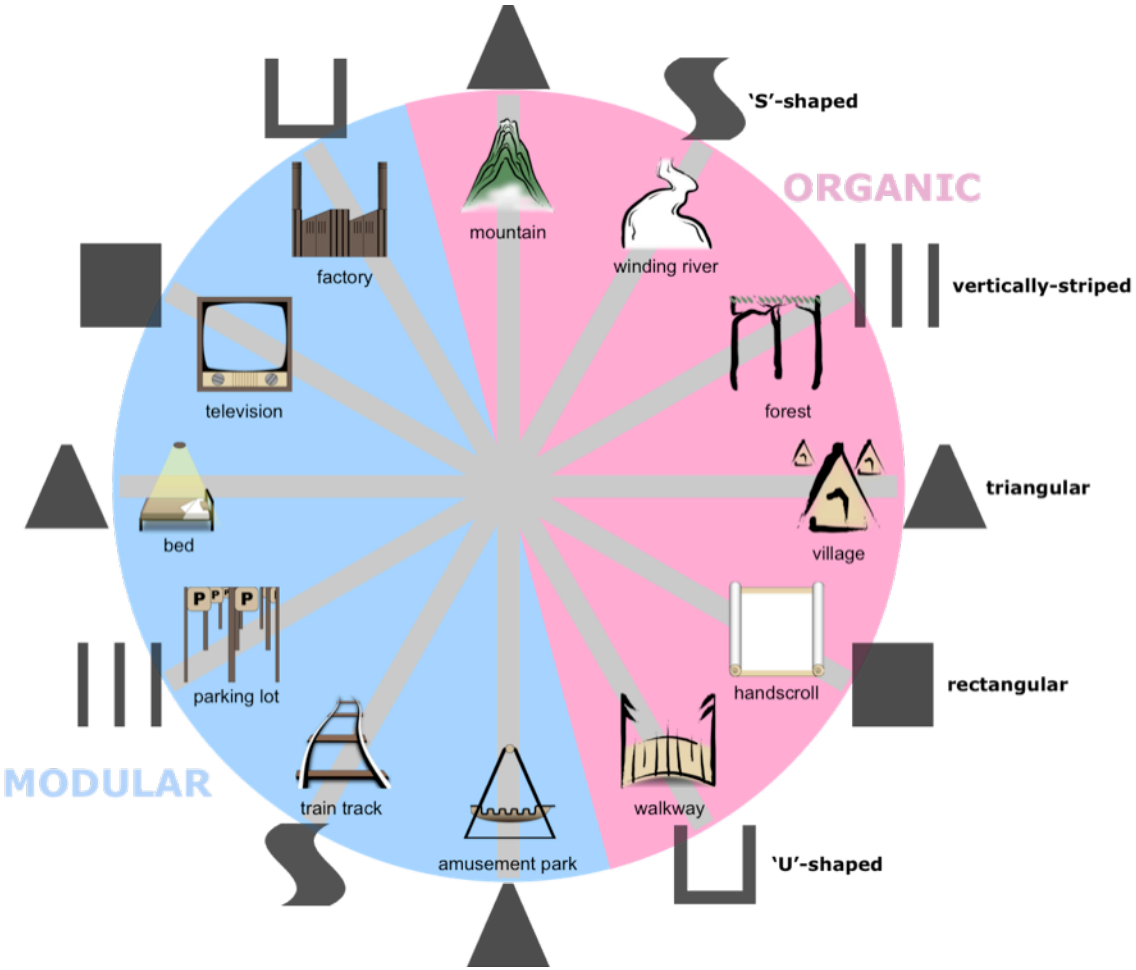

Figure 1. A diagram showing the associational (link) and oppositional (shift) relationship between the tiles

Structural qualities of tiles

Structural qualities determine how tiles may or may not be conjoined. They implement a combination of cinematic and graphic design conventions considering shot distance and angle, figure/ground relationships, closed/open edges, and the like (figure 2).

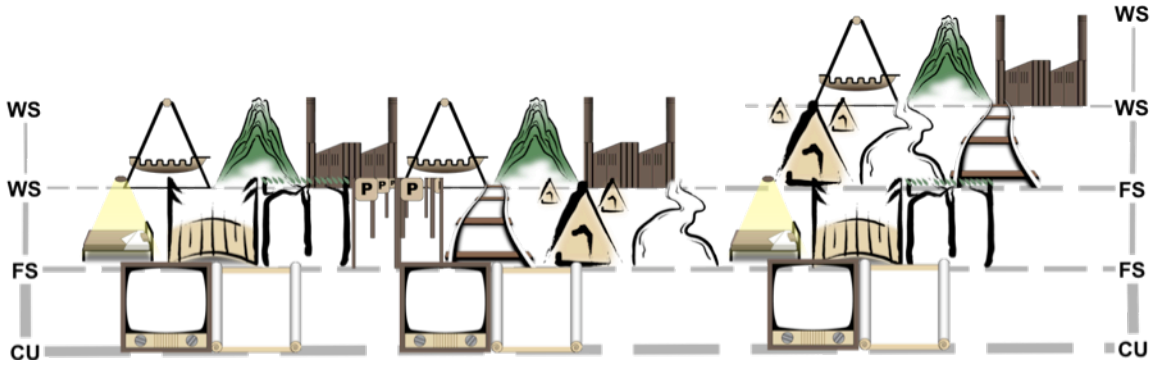

Figure 2. A graph showing the edge qualities of the tiles in cinematographic convention: close-up (CU), full shot (FS), wide shot (WS), etc.

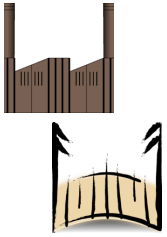

Figure 3. A perceptual link (conceptual shift) from factory to walkway, with a structural constraint from WS to FS

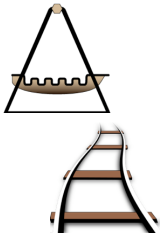

Figure 4. A conceptual link (perceptual shift) from amusement park to train track, with a structural constraint from WS to FS

Matching of Tiles

The juxtaposition (either link or shift) of tiles is constrained by the structural qualities, while the perceptual and conceptual qualities, along with user input, are used to determine whether the juxtaposition is a link or a shift (figure 3 & 4).

Technical Overview of GVR

The core of the GVR system consists of a server (implemented in LISP) to handle semantics and discourse structuring and a client (implemented in Processing/Java) to handle graphics processing and user input as depicted in figure 5.

In the system, graphical tiles are actual image data files. These assets are described on the server side using semantic annotation, which describes the perceptual, structural, and conceptual content of the graphical iconic images. For example, the annotation describing the imagic/perceptual aspect of a "mountain" tile could contain the following (in XML):

```
<imagic>
        <shape>triangle</shape>
        <perspective>flat</perspective>
</imagic>
```

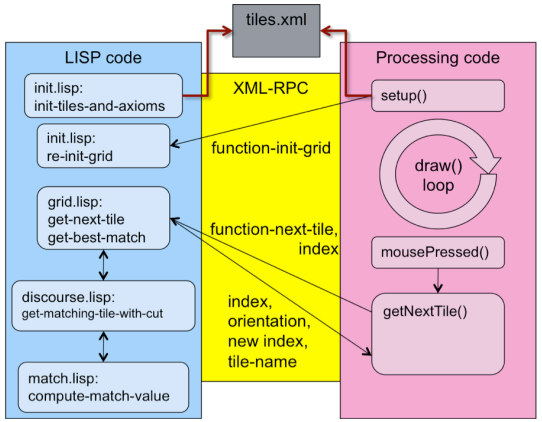

Figure 5. A diagram showing the communication between different modules in the GVR system

Such metadata describes visual qualities of the image such as its triangular shape. Similar metadata is included for the structural and conceptual aspects of the image along with weightings for each aspect. For example, conceptual aspects of the mountain tile are represented as follows:

```
<conceptual>
        <conventional>organic</conventional>
        <adaptation>backpack</adaptation>
</conceptual>
```

Without describing all of the details, the XML text indicates that the mountain is considered to be organic according to the author's subjective convention, and is a place for backpacker. The XML code is parsed by the system and logical axioms in LISP. The matching code (or "priority preserving morphism" code using the terminology of algebraic semiotics) determines matches between image tiles. The topological data structure keeps track of the current layout of tiles and is duplicated on the client side to keep track of where images are displayed in relation to one another.

Summary

The Generative Visual Renku project aims at extending the possibilities of generative artistic approaches to incorporate emotional meanings and induce poignant moments from a formalized system of visual and poetic micro-narrative content. Technically this required formal annotation of multimedia semantics (perceptual, structural, and conceptual content), and semiotic morphisms (mappings) from this annotation to animated graphical representations. Meanwhile, we believe that the interaction model between the user and the GVR system sheds new light on the development of animacy-oriented and semantics-based human-computer interfaces.

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