Griddy: a Drawing Based Music Composition System with Multi-layered Structure

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ABSTRACT

This paper suggests a novel approach to drawing interfaces for music composition, which provides multi-layered interface with different levels of abstraction and constraints. By reviewing previous drawing based composition systems, a common problem is discovered: insufficient support for creative exploration due to limited perspectives on compositional processes. Addressing importance of multi-layered design of composition software, three layers and corresponding interfaces are designed, for overall flow, chord map, and stylistic features respectively. The prototype application is implemented with HTML5 canvas element and Gibberish.js, providing easy accessibility on web.

1. INTRODUCTION

A number of composition tools adapting drawing interface have been emerged criticizing limitations of traditional approaches, which most of commercial software such as Protools, Logic, or Cubase have been taking. Frequently mentioned problems include unnatural interfaces, lack of abstractions of musical information and insufficient support of creative exploration. Works on drawing for compositional tools attempted to improve these points and made some achievements on effective expression of composer's creativity.

For professional uses, drawing interfaces usually come as complementary tools for existing compositional software, augmenting usability in limited areas of overall process. For instance, Inksplorer[1] is a system that reads drawings on real papers, mostly line or curve segments such as graph, and make the drawings be used in other software including Max/MSP and OpenMusic as amplitude envelope, melody line, etc. Musink[2] recognizes user drawings on music scores and interpret them as various notations that can give composers more creativity. On the other hands, there are some tools for sound design, which are basically based on spectrogram and additive synthesis, such as Metasynth[3] and Ovaltune[4]. The point that makes these research significant is utilization of a very natural interface: drawing. As J. Thiebaut et al. mentioned, drawing sketches take an important role in music composition processes to freely express complex idea [5]. Their system not only represents overall flow of musical pieces, but also provides a variety of mapping strategies between drawings and musical information, to expand the expressiveness of musical idea.

However, these attempts put their focuses on how composers' intentions are well expressed, and not on supporting exploration. Creativity can be obtained via free exploration of musical spaces, and composition tools can help the exploration process by reducing the complexity of musical spaces. B. Eaglestone points out the importance of creativity support in electroacoustic music composition software in [6]. Then he suggests adding "depth" to composition software, which usually takes the conventional pitch-based approach. This argument is elaborated in more detail in [7]. The author depicts role of various levels of abstraction and constraint, and suggests that plurality of layers such as operating levels or representational systems should be considered in music composition systems. In the perspective of creative exploration, layer separation with proper levels of abstraction and tasks, by limiting the amount of information that a composer should consider simultaneously, can lessen the cognitive burden of composer and reduce complexity of musical space, supporting the process of creative exploration in composition.

Griddy is a drawing interface for music playing and composition, which adopts the concept of multi-layer approach. It provides three layers of musical information, which have a) rhythm and note selection, b) chord map, and c) overall flow respectively. It introduces different representation methods for each layer, according to the information space of them. In the remaining part of this paper, related work will reviewed, then the design consideration of each layer is resolved. With all layers been designed, a prototype application implementation and some examples will be presented, followed by a discussion.

2. LITERATURE REVIEW

Previously mentioned works including [1] and [2] are examples of utilizing drawing interface in compositional processes, although they are complementary methods and not for tonal music. Some systems take pitch-time approach to generate melody lines from simple drawings or line segments [8,9]. Including these works, many primitive attempts that transform lines and curves to sequences of tones, i.e. melody lines, follow the traditional pitch-time paradigm. The paradigm is very familiar to most people since it is a metaphor of conventional musical scores. In contrary, it fails to promote explorative nature in compositional process, as it still has limitations of traditional scores have and provides only single layer.

A more advanced descendant of pitch-time based interface is Hyperscore[10]. It has two windows: in motive window, users can draw short melody lines just like the previous pitch-time systems; in sketch window, users use the melody lines drawn in motive as drawing materials and draw flows of motives. There are two notable points in Hyperscore. One is that more information from drawing such as sharpness of curves is extracted and used, extending degree of freedom of exploration from drawing activity. The other point is, more importantly, that it presents two-layered system, represented by two types of windows with different levels of abstractions. A common drawback of these approaches is that they assign one dimension for time; hence they provide only one-dimensional space for each layer.

On the other hand, there are systems that fully utilize the two dimensions. PaperTonnetz[11] allows users to create melody by drawing lines on tonnetz, a tiling of pitches. As time can be shown by length of drawn lines, its 2 dimensional arrangement of pitches unveils relationships and structure of tonal sound. In [12], a sonification method for musical application is suggested, introducing a concept of probing on image, which is analogous to drawing. If an image can convey complicated musical information such as style or timbre, probing around the image can create music by applying some sonification methods. A system presented in [13] let users navigate the structure of music with Venn-diagram-like representation of tree structure. Its level of abstraction is quite high, as it deals with structural information.

From the review, notable systems with novel perspective of composition can be found. However, very few of them provide only limited multi-level approach. Most examples provide a single view for melody, timbre or structure. Griddy aims to provide three separated-but-integrative layers with coherent interfaces.

3. LAYER DESIGN

In [14], M. Edwards says "formalization of compositional technique in software can free the mind from musical and cultural clichés and lead to startlingly original results". This is the most important point of layer separation: isolating limited kinds of information to user for each layer and provide more freedom of exploration. For example, by providing a layer of musical style, a composer can work with overall flow of music regardless of a specific style or change and review style independently. Systems such as [15] "allow composers to specify high-level control structure" and generate detailed musical components based on certain algorithms including genetic algorithm or Markov model. In this case, it can be said that musical style is a palette, patterns, techniques of painting and high-level feature is drawing itself. Hence, preparation of musical styles, or, drawing materials, can be separated from the way they are drawn on the canvas. Also, this can be helpful for untrained users, as they have less knowledge on musical techniques and sophisticated style features. In this case, experts or teachers can provide specific styles for students to draw their own music. Especially chord sequence plays an important role on musical styles and genres. In the field of music information retrieval, chord progression is a key factor of genre classification [16, 17]. Moreover, the chord progression is often used in representations of musical structure, such as [18].

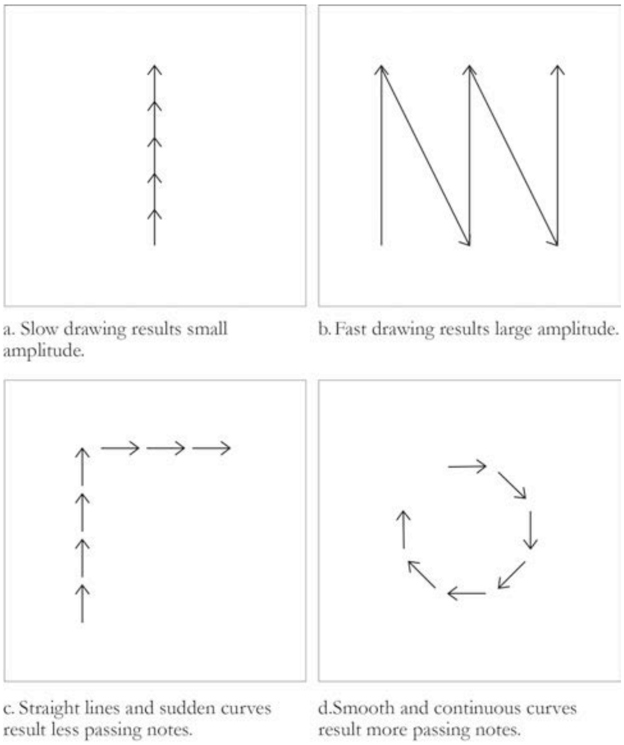

Figure 1. The effect of speed and curvature of drawing to generated music.

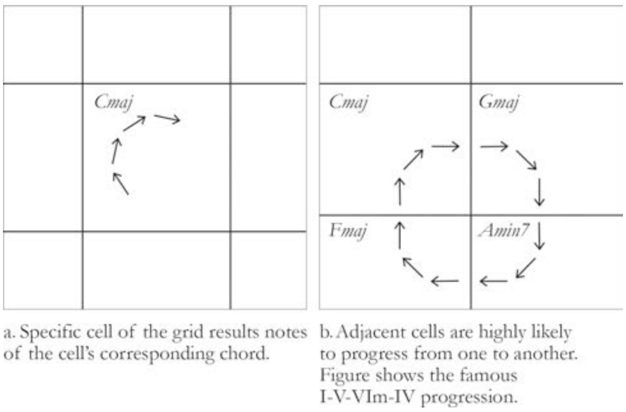

Figure 2. The effect of chord in drawing.

In this paper, the composition process is divided into three layers: 1. overall flow, 2. chord map, 3. rhythm and note selection. In the system, there are a canvas with background image and a grid on it, which forms a musical space with specific style. User can draw on the canvas freely, navigating the musical space, which results a musical piece. Here each layer is assigned to drawing, grid, and background image respectively.

3.1 Overall Flow

User drawn lines and curves are interpreted in two ways. First, characteristics of drawings such as drawing speed and curvature are considered. Speed of drawing determines the amplitude of respective melody. On the other hand, curvature, which is determined by average change of direction, determines use of passing notes. Figure 1 shows how the drawing is interpreted. Secondly, for each drawing, its reads the pixels of the background image and chord information of the grid under the line. This is used to retrieving information from other layers through exploration on them. As lines are drawn, the data under the line is processes every unit time, which is the length of a sixteenth note for given BPM. Then it determines pitch, duration and amplitude of a note or a rest. Also color of drawing is mapped to specific instruments.

3.2 Chord Map

Chord map is shown on grid, which is a tiling pattern of simple shapes such as triangle, square, or hexagon. Each cell has an assign chord, illustrating which chords are used and how they are related. As the user draw lines on each cell, notes are selected from its corresponding chord, considering other factors. This map also represents stylistic features, hence two adjacent cells make a chord progression more accessible. An example chord map is shown on figure 2.

3.3 Rhythm and Note Selection

This is the most complicated layer in the model. An image contains relatively larger data than drawings or a grid. Therefore the background image can contain information about more detailed stylistic features such as rhythm and note selection among notes in a chord.

Rapid variation of brightness along the drawing causes frequent notes, while slow variation of brightness results scarce distribution of notes in time domain. The difference of brightness itself is related to the attack of each note; crossing over large difference of brightness causes a sharp sound. Color value, represented by hue in HSV model, determines a playing note among a given chord. As hue value is circular, a natural mapping between color and pitch class can be derived. The octave is determined by the saturation, ranging from one octave lower to one octave higher. For very low saturation, where users often cannot tell the hue value, only the root note is played for a given chord.

4. IMPLEMENTATION

The prototype application is implemented using HTML and javascript to provide cross-platform accessibility. Gibberish [19] is used for sound generation and timing, and HTML5 canvas element is used for drawing. Basically it consists of a canvas, where users can put a background image, set a grid and assign chords or draw their own music; and three panels, providing core functions for each layer. Figure 4 shows a screenshot of the entire in-

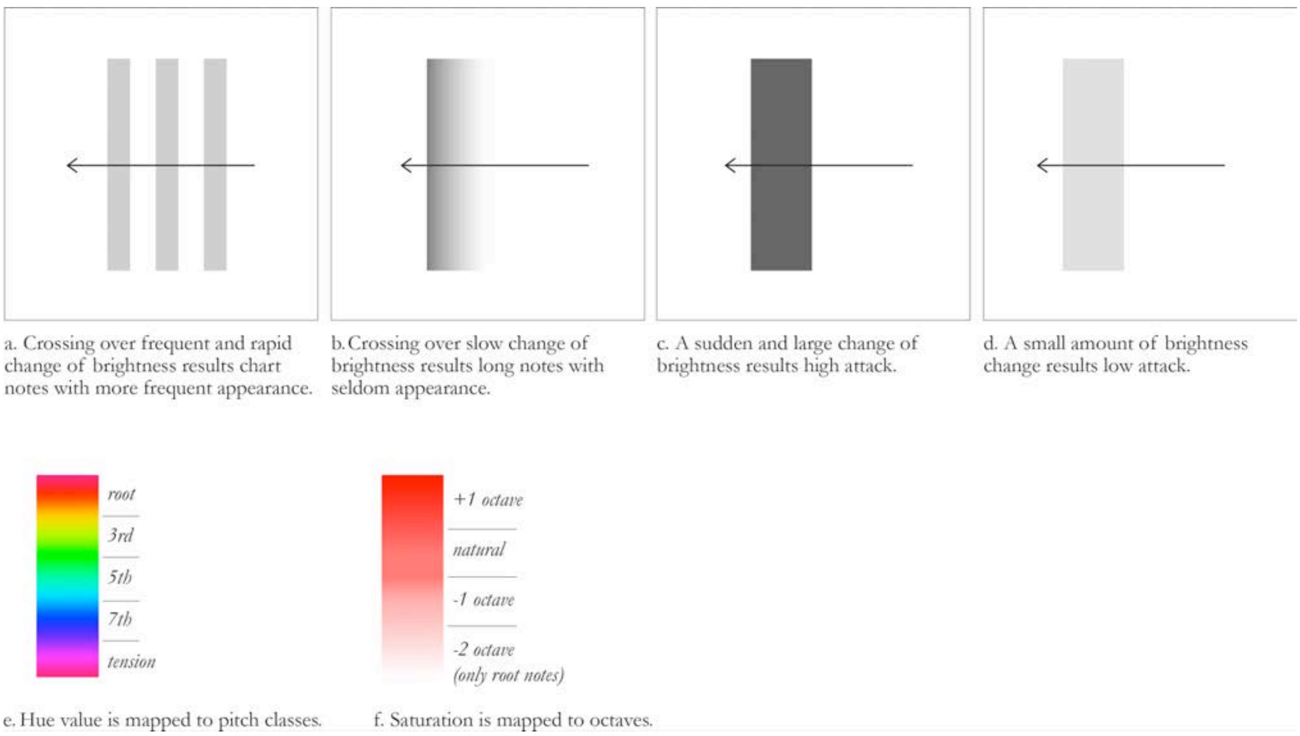

Figure 3. The effect of brightness, hue, and saturation value of a background image.

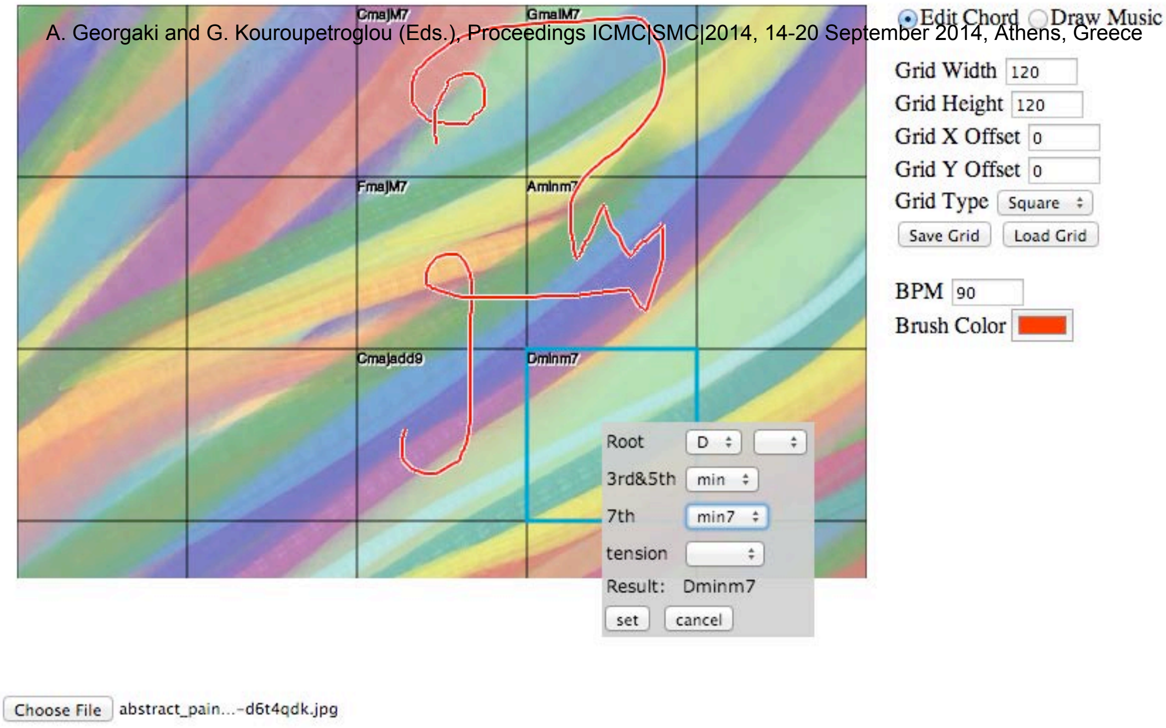

Figure 4. Screenshot of implementation of prototype application.

terface.

Interface for the background image is simple: choosing an image from user's local file system. Due to the limitation of web environment, it is important to remove computationally expensive and less important features to get stable audio processing. The application suggests using specialized image manipulation tools such as GIMP or Photoshop to create background images. Still, this shows the separated and modularized model's power, adopting use of other software in the composition process. Also the image is distributed to other users, sharing their musical style constraints.

There are three groups of grid manipulating interface. One is manipulating the grid itself. It provides control for grid size and offset, also the shape of each cell. Another interface pops up when a user clicks on a cell, which provides chord entry. Also there are buttons for saving the current grid and loading pre-defined one. The grid and chord information is saved using json format, so it can be easily reused and shared between users too.

The last part of the interface is music drawing. It provides BPM modification and color selection. In the modification mode, user can move, redraw, or delete drawings. Also timing and repetition of each drawing can be controlled. The recent version of the application is accessible at the author's website: `http://dilu.kaist.ac.kr/research/griddy`.

5. CONCLUSION

Griddy is a music composition system that uses drawing as its main interface, along with chord map and background image. With its power of layer separation, users can explore the musical space for creative results. As it provides a novel approach that uses a background image for style-related features and applying an image sonification based method to probe the image, even untrained user can develop their idea with drawing interface with images prepared by professionals.

Development of more sophisticated application will be the next step of this research. In theoretical point, how professionals and untrained people use the system to create music will be analyzed, to bring out more usability and creativity support. Case studies on collaborative composition and educational uses will be also meaningful to improving multi-layered design concept of compositional processes.

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