Building an intuitive web-based musical instrument

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ABSTRACT

In this paper, I will describe the design of Pastelloops, which is a web-based musical instrument and an interface that can be used for composition and live improvisation using intuitive free-hand drawing on a canvas using a mouse or touch-based interaction.

1. INTRODUCTION

Sketching has been explored extensively as a natural interface for musical expression. Such sketching interfaces provide a simple way of synaesthetic expression of visual art to music or vice versa. When not used in artistic expression, they can be used in an easy and playful way to explore music by people with varying levels of understanding of music.

This application, Pastelloops, has been inspired by similar ideas. A user can interact with a canvas to draw notes freely along a musical scale with different sounds generated using machine learning for interesting timbral variations. A slightly different application called Music Mouse [1], conceptualized by Laurie Spiegel and recently adapted on web [2] by Tero Parviainen was an inspiration behind some pre-defined harmonic constructs in the application so that users who do not have a strong understanding of music can still use the tool and create something musical. These constructs can however be modified by experienced musicians who want more control over their creation. The real-time sonic feedback and the playback mode provides a way to the user for monitoring the musical result of their sketches. This makes Pastelloops a helpful tool which can be used as a musical instrument for learning music, improvising live and composition as well.

While the concept of making music through sketching isn't new in itself and there have been quite a bit of research and development on similar interfaces, Pastelloops aims bring many of these ideas together, and using Web APIs especially Web Audio, it does so in a distribution format which is very easy to adopt and extend. Pastelloops has been made with open-source libraries like Tone.js for handling most of the audio capabilities and P5.js for visuals. In this paper, we will go through the design of Pastelloops and later discuss possibilities that can be explored by tweaking its individual components and how it compares with similar tools that exist.

2. INSTRUMENT DESIGN

Thor Magnusson in his book [3], describes a digital music instrument mapping model which I've taken as a design guideline for the application. It has helped in approaching the application in terms of different components of a digital instrument which work in conjunction for the overall experience and results of the instrument. In this section, we'll talk about those components in Pastelloops.

2.1 User Interface

The interface to create sonic output in Pastelloops, as shown in Figure 1, is a drawing interface consisting of a 2D canvas on which the user can draw freely using a mouse or touch wherever enabled. The interface is web-based, which means it can be loaded on any device where a modern browser, supporting Web Audio APIs is available.

There are controls available which can be used for selecting texture of the brush which changes the color and thickness. Different shades of brushes are associated with different properties of the sonic output which are described in sound engine and mapping engine sections. Specific drawn sections on the canvas can be cleared with an erase tool like on other free-hand drawing interfaces or an entire canvas can be cleared. A few other controls are provided to change other musical properties, including a slider control for changing tempo and a slider for changing output volume of individual sounds.

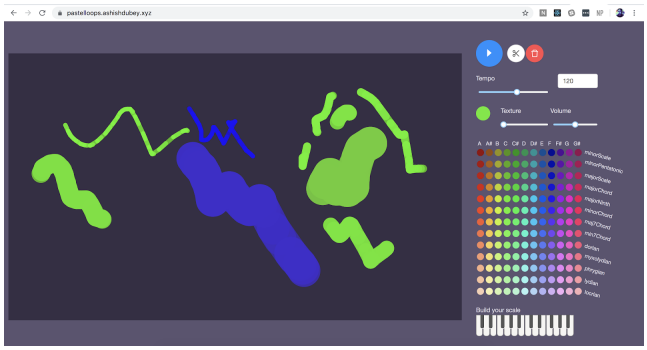

Figure 1: Pastelloops UI with all the controls: playback button, tempo, texture, volume, scale pallette and custom scale creator

2.2 Mapping Engine

Most of the mappings are connections between the visual and interactive elements on drawing on a canvas and the sonic properties of the output that is produced.

Each point on the Y axis is associated with one of the pitches arranged in a descending order. These pitches are chosen based on which musical scale the user wants to play. This scale can either be chosen from a predefined pallette where each color corresponds to a scale or can be constructed by the user themselves. The selection of a musical scale lets the user focus on

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drawing freely and still create an effect of the kind of musical harmony they intend. Of course, musicians who need more control can create their own sequence of notes that are played along the canvas.

While being able to choose a scale and playing through the notes along the canvas, the user can also control the timbral properties of the sonic output by changing the visual properties of what they draw on the canvas. Such a mapping is established between the texture of the brush, and the different sound samples that are mentioned in the sound engine.

2.3 Sound Engine

In Pastelloops, to allow the user to explore different and new possibilities of what they can create, several sounds can be chosen from. This gives the user to experiment with the timbral properties of the music that they produce with the application.

While the instrument allows giving the control to the user for being able to tweak sounds, some attention has been paid to keep the process simple for the user. Instead of something like giving the control over the properties of a synthesizer, the user is given an easy way to switch through sounds that smoothly morph between two sounds of different textures by changing the texture of the canvas strokes. These sounds have been generated by GANSynth [4], which is a deep learning model released by Google's Magenta team. These interpolated sounds do not just allow the user to easily vary the sound texture in a continuum, but also makes the experience a bit more interesting because of the unique acoustic characteristics of the sounds generated.

Since the process of generating the sounds is compute heavy, the sound samples have been pre-generated, fetched from the server, and loaded into a Tone.js instrument

2.4 Sonic Feedback

There are two interaction modes phases on the canvas - one is drawing freely on the canvas and the other is playback. When the user draws on the canvas, it's as if they are playing the instrument with free-hand brush strokes. The notes and sound corresponding to the shade of the brush and the position in the canvas can be heard immediately which aids the user in exploring the instrument. With the playback mode on the other hand, the user can listen to all the combined sonic artifact of their drawing as a playhead scans across the canvas from left to right at the default 120BPM unless changed by the user. This allows the user to use this tool to compose music from multiple structures and patterns they draw on the canvas.

3. RELATED WORK

Pastelloops is an amalgamation of different ideas, aiming to offer a versatile interface for musical exploration to different kinds of audiences for different purposes, which differentiates it from other tools.

Some well-researched and developed tools are Griddy [5] and Hyperscore [6]. With Hyperscore, the user can pen musical ideas as strokes and lines, store them for later use, and create new pieces—all in one expansive canvas. The graphical elements in the drawing are mapped to musical structures, allowing the user to interweave and shape musical voices and define harmonic progressions visually.

Another application is Griddy, which uses a background image for style-related features and applying an image sonification based method to probe the image to allow users to use the result as a base for their musical exploration.

Pastelloops differentiates itself from these tools in a way that while the above tools are mainly for composition use-case, Pastelloops can be used as a live musical instrument, making it useful for improvisation. As a musical instrument it also offers its users, an easy way to explore sounds with interesting acoustic properties generated through GANSynth.

4. CONCLUSION AND FUTURE WORK

Pastelloops as described in this paper is live[1] and the source code can be found on Github[2]. The project is under active development and there are several experience fixes and enhancements that are planned. Experience fixes mostly in terms of its usability on touch screen devices. As for known enhancements, one of them is that, instead of limiting the playback to an XY-scrolling playhead, allowing the strokes to be played as they were drawn over time. This would add a dimension of time while the user is sketching on the canvas, and allow them to play it back in the same order, and not necessarily from left to right in space. One of the limitations right now is that there is only one canvas which can be used for composition. With a capability to arrange multiple canvases in serial or parallel, an artist can maintain multiple musical structures which they can use for their compositions.

Because Pastelloops interface is designed for the web, it's also easy to build adapt the application to involve different users in the musical experience. Web APIs like WebRTC can be used to build a collaborative sketching interface towards an experience of music jamming using sketches for friends located in different geographies. Application of machine learning to melody generation would be another interesting experiment worth trying. Latent Loops [7] is an example of using MusicVAE for generation of interpolated melodies based on melodies input in a very similar sketching interface.

Besides some known changes as mentioned above, there is ample time to be spent doing user studies with the target users, including artists and musicians. That, I hope, will help generate ideas to enhance the musical aesthetics and interface in order to allow users to explore more musical possibilities as an instrument and a composition tool.

5. REFERENCES

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