Celestia: A Vocal Interaction Music Game

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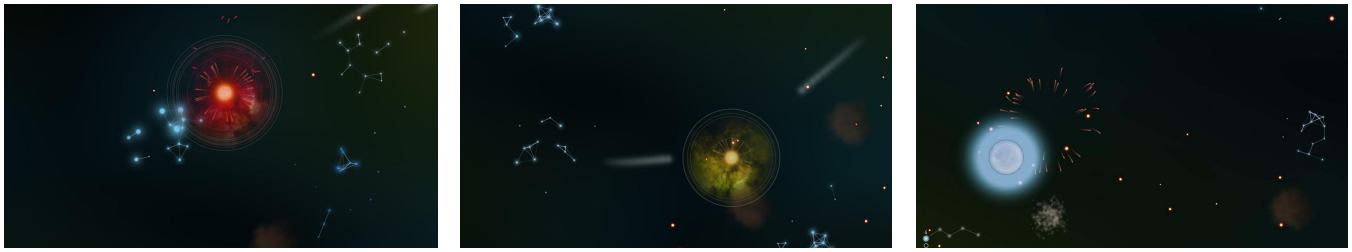

(a) (b) (c)

Figure 1: *Celestia detects three specific pitches which can trigger different events referring to several behaviors of planet in astronomical environment a) absorbing planets b) dodging comets c) explode nebulae*

1 Introduction

Voice is one of the most natural means of expression and vocal interaction is gaining popularity in game development field [1]. For example, a karaoke-style video game Sing Party published by Nintendo for the Wii U, Guitar Hero in which users use a guitar-shaped game controller to match notes scrolling on screen. Despite advances in the diversity of vocal interactive game, the majority on the market focuses on the task instead of visualizing complex, numerical pitch data as a form of aesthetic art.

Reflecting on musical artwork by Robert Hodgin, we created Celestia. Incorporating visualization technique, the game uses voice input based on pitch detection as a primary means of control, and provides insight into innovation of vocal interaction. In regard to gameplay, the purpose is to guide a newborn star through the universe with melody. The user's voice can enlarge the star to absorb smaller planets and survive encounters with comets, nebulae. Through the journey, the star gains more energy, displayed through series of changing colors. Every element of the experiential aesthetic is tied to the music; the background constellation is the music visualization with three different colors reacting to high, mid and bass range of the soundtrack in real-time. We introduced Celestia to a vocalist who volunteered to improvise the game for a live audience. The show turned out to be a great success and we received positive feedbacks like “it’s visually and aurally appealing”.

2 Our Approach

Celestia is a PC Console Game coded in Processing, an open-source programming framework extended from Java. Contributed libraries, Ani and Minim, are included to extend the core functionality. Celestia detects three specific pitches that are the roots of major chord of the background music. The purpose of the setting is to help users tune by guiding their ear to the tonic chord of background music. Users can improvise a melody by connecting these pitches together as game progresses. In addition to identifying pitch, Celestia responds to amplitude, the louder the volume is, the more powerful the effect will be on the premise that users hit the given pitch.

We optimized Celestia around how users can or want to play with it rather than forcing them to change their behavior for the game. We adopted two different pitch ranges to accommodate both female and male voices (pitches D3, G3, D4 for female, pitches A2, C3, D#3 for male). Users have the option to choose the register they feel more comfortable in the calibration settings. Additionally, Celestia is not confined to human voice, users can play instruments, such as guitar, piano or harmonica to run the game, or more flexibly, make customized vocal tool like whistle or water bells by filling drinking glasses with different amounts of water.

Celestia adopts Fast Fourier Transform (FFT, which provides fast way to transfer signal into frequency domain) [2] class in the built-in minim library of Processing for spectrum analysis. After buffering the line-in audio signal, we used logarithmic averages to group the spectrum into 10 octaves, and then divided each octave into 12 bands according to the Equal Temperaments. Through individual volume detection from 120 bands, we got the volume changes of every single semitone. We selected featured pitches as triggers according to the music chord feature and human voice range.

We exploited an entertaining way to artistically visualize acoustic input, conveying informative feedback to shape users' appreciation of their vocal quality and to encourage users to explore other musical input possibilities to control the gameplay. Additionally, pitch can be technically perceived as an intermediate signal between discrete and continuous, while Celestia defines one set of pitches according to the background music choice, more selections can be made based on different preferences of background music for future developing purpose.

3 Reference

[1] Sri H. Kurniawan and Adam J. Sporka. 2008. Vocal interaction. In *CHI '08 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '08). ACM, New York, NY, USA, 2407-2410.

[2] Rohde and Schwarz, Dr. Florian Ramian - *Implementation of Real-Time Spectrum Analysis*, p. 6, January, 2011, accessed August 9, 2011

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