ESP: Expression Synthesis Project

1. Research Team

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2. Statement of Project Goals

The Expression Synthesis Project (ESP) aims to create a driving interface that will enable nonexperts to create expressive musical performances. Anecdotal evidence amongst musicians suggests that generating an expressive performance is very much like driving a car. Not everyone can play an instrument but almost anyone can drive a car.

3. Project Role in Support of IMSC Strategic Plan

The research supports IMSC's research in sensory interfaces and user centered sciences through the design of a driving (wheel and pedals) interface for controlling and rendering expressive musical performances. It is an interdisciplinary undertaking that combines human computer interaction with the performing arts. In addition, it augments IMSC's current projects in modeling, analysis and generating of facial expression.

4. Discussion of Methodology Used

In the first instantiation of the ESP interface, the pedals will allow the user to control the tempo (speed). Other scientific studies have revealed human preferences for tempo smoothness (smooth changes in velocity) [2], an attribute that is enforced by the driving interface.

The display will show landscape that directly map to musical content (extracted through computational analysis) so as to guide the user to make informed expressive decisions (see Figure 1). The computational analysis tools will include the pitch spelling, chord recognition and key tracking algorithms developed as part of the MuSA and MuSA.RT projects (see Volume Two reports on Pitch Spelling Technology and MuSA.RT).



Figure 1: The Expression Synthesis Interface

There is evidence to suggest that the dynamics (loudness) in expressive performance is often linked directly to the acceleration [3]. In the current instantiation of ESP, we have made loudness directly proportional to the acceleration parameter.

5. Short Description of Achievements in Previous Years

N/A

5a. Detail of Accomplishments During the Past Year

We implemented a prototype of ESP using the SAI architectural style developed at IMSC (see Volume 2 report on SAI) [4]. Figure 2 shows the application graph for the ESP system.

This prototype uses a Logitech MOMO Racing Force Steering Wheel with sequential stick shifter and realistic gas and brake pedals. The wheel has six programmable buttons, two paddle shifters and 240 degrees of rotation.

The current capabilities include

- acceleration/deceleration control via the pedals.
- visual display of current position along terrain, speed and acceleration.



Figure 2: Application graph for the ESP system

6. Other Relevant Work Being Conducted and How this Project is Different

ESP is unique in its use of a driving interface for expression control. The cognitive overhead in learning to use such a device to generate expression is low as most of us already know how to drive a car. The ESP driving interface allows the user to make expressive choices based on structural knowledge mapped to the road curvatures.

Creating interfaces for controlling musical expression is not a new endeavor. There is an entire conference devoted to such creations – the International Conference on New Interfaces for Musical Expression.

Other groups involved in such endeavors include:

• The MIT Media Lab. Expressive control projects originating from the Media Lab include Teresa Marrin's Digital Baton [6], a study on synthesizing expressive music through the language of conducting, and Gil Weinberg's squeezable embroidered balls [9.10] that use hand squeezing and stretching as control mechanisms.

• Roberto Bresin of the Music Group at the Department of Speech, Music and Hearing in KTH has used neural networks to learn a professional pianist's expressive gestures [1]. Rules are used to induce variations on performance timing and dynamics with respect to a nominal performance [8].

• The Austrian Research Institute for Artificial Intelligence, led by Gerhard Widmer. In particular, Werner Goebl has focused on computational methods to discover general principles of expressive performance [3].

• The MMM group let by Henkjian Honing in the Netherlands has numerous projects devoted to studying and generating expressive performance, including an environment for analyzing, modifying and synthesizing expression called POCO [5].

• The MultiMedia Laboratory at the University of Zurich and the Mathematical Music Theory Group at TU Berlin through their Rubato software [7]. Rule-based and manual (piecewise) control of tempo and dynamics is part of the software capabilities.

7. Plan for the Next Year

Implement a graphical interface that generates a road and terrain that correspond to musical structures. The structures will map directly to the road curvature and surface and serve as cues for better decision making in expressive control.

Currently, the user controls the acceleration and deceleration. Future versions of ESP will include an autopilot option.

Other future plans include user studies to test the effectiveness of the driving interface in generating expressive performances.

8. Expected Milestones and Deliverables

Create autopilot option and study the effectiveness of the driving interface.

9. Member Company Benefits

A device for controlling musical expression. There will be numerous ways to apply this technology to the gaming, animation and movie industries.

10. References

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