Computer Music Interface Evaluation

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INTRODUCTION

The old computing is about what computers can do, the new computing is about what people can do. Ben Schneiderman, HCI Researcher (1997)

One of the most intriguing fields of human-computer interaction (HCI) involves the communication aspects of computer music interfaces. Music is a rich communication medium, and computer music is the amalgam of interface science and musical praxis forming a dynamic subset of HCI.

There are structural similarities between the job of a music composer and that of a *user interface designer* (although their objectives may be different). While sound has been used in general purpose interfaces as an *object*, its use has been deteriorated at a primary level, that of a signal-processing approach. However, music composition and performance are highly abstract human activities involving a semantic and a symbolic mechanism of human intellectual activity.

This article analyzes the unique problems posed by the use of computers by composers and performers of music. It presents the HCI predicates involved in the chain of musical interaction with computer devices, commencing from the abstract part of symbolic composition, then coping with usability issues of the graphical user interfaces (GUIs) implemented for musical scripting, and concluding to a synthesis stage which produces digitized sounds that enhance or replace original analog audio signals. The evaluation of HCI elements for computer music under the prism of usability aims at the development of new graphical tools, new symbolic languages, and finally better user interfaces. The advance in technology on this area creates the demand for more qualitative user interfaces and more functional and flexible computer music devices. The peculiarities of computer music create new fields in HCI research concerning the design and the functionality of computer music systems.

BACKGROUND

Computer Music Interfaces

In the early stages of the microcomputer evolution, various protocols had been developed in order to achieve interconnection between computers and instruments. The milestone of computer music proved however to be the musical instrument digital interface (MIDI), which is a communications standard used for transmitting musical performance information (Aikin, 2003). It was developed in 1983 in response to the increasing sophistication, and corresponding complexity, of commercial electronic instruments, especially synthesizers. Therefore, MIDI is a protocol specifying how electronic musical instruments may be controlled remotely. In brief, MIDI is a very successful and inexpensive protocol that has reshaped the computer music landscape. However, it cannot overcome easily its representation limitations, especially on alternative music notations. The common music notation (CMN) scheme along with the MIDI specification is Western music oriented. The problem with CMN has been taken into account in several works: Although CMN is supposed to furnish a model for traditional music in a European style, it is not absolutely supposed that this model is also convenient or suitable for music coming from outside of Western traditions (East Asia, Middle East countries, etc.) (Bellini, Barthelemy, Nesi, & Zoia, 2004). As a result, they are not able to clearly depict alternate musical forms and traditions.

Almost all music recordings today utilize MIDI as a key enabling technology for recording music. In addition, MIDI is also used to control hardware including recording devices as well as live performance equipment such as stage lights and effects pedals. Lately, MIDI has exploded onto the scene with its adoption into mobile phones. MIDI is used to play back the ring tones of MIDI capable phones. MIDI is also used to provide game music in some video games.

MIDI is almost directly responsible for bringing an end to the "wall of synthesizers" phenomenon in 1970-1980s rock music concerts, when musical keyboard performers

were sometimes hidden behind banks of various instruments. Following the advent of MIDI, many synthesizers were released in rack-mount versions, enabling performers to control multiple instruments from a single keyboard. Another important effect of MIDI has been the development of hardware and computer-based sequencers, which can be used to record, edit, and playback performances.

A number of music file formats have been based on the MIDI bytestream. These formats are very compact; often a file of only 10 kilobytes and can produce a full minute of music.

MIDI, albeit the dominant, is not the most expandable and modular interface. Also, other interfaces like the Synthesis toolKit Instrument Network Interface (SKINI) physical modeling interfaces have appeared (Cook, 1996). These interfaces are purely computer software inventions and lack the hardware orientation of MIDI. However, they are more adaptive in expressing alternate musical forms and interfaces.

Computer Music Languages

An *audio programming language* is a programming language specifically targeted to sound and music production or synthesis. Such languages are: ABC, ChucK, CMix, CMusic, Common Lisp Music (CLM), CSound, Haskore, HMSL, Impromptu, jMusic, JSyn, Loco, designed to be for sound what Logo is for graphics, Max/MSP, Music I, Music-N, Nyquist, OpenMusic, Pure Data, Real-time CMix, Soundscrape, SuperCollider, Q-Audio. Each of thoses languages has its own features and objectives. For instance, JSyn is used by JAVA programmers and makes use of simple methods, which are written in C language, for real-time audio synthesis.

Score Writing and Notation Creation

This category of interfaces consists of state-of-the-art, easy-to-use GUIs that provide ways to create, enter, edit, hear, view, lay out, and ultimately print music in staff notation. Usually these programs have complete control over every aspect of music printing and publishing. Generally, they are perceived as mature products, satisfying the musician in the same sense that a good word processing system satisfies the author enough to shift from handwriting to electronic processing.

However, their expression format is staff based, and therefore they can satisfy users' needs as long as the CMN can satisfy the expression of the melody accurately. A typical interface for CMN composition is shown in Figure 1. Figures 2 and 3 show two applications for music notation: Sibellius and Quitar Pro.

There are several methods used to enter music data into notation editors and sequencers.

An attractive method for keyboard players is to enter music by playing it on a MIDI keyboard. Most commercial notation editors allow this method. Unfortunately, automatic identification of rhythms is difficult, so the user must carefully check all notes in order to correct errors. Furthermore, each voice must be entered separately.

Optical music recognition (OMR), the musical equivalent of optical character recognition (OCR), has been used in building some music collections. Unfortunately, OMR is less accurate than OCR, and the scanned music must be carefully checked for errors, a process that often requires a considerable length of time (Rossant & Bloch, 2004).

The most common music entry method is by handling a GUI, using a mouse. The problem is that a mouse provides two-dimensional data entry, with horizontal and vertical coordinates. Music notation, however, is inherently three dimensional, with the horizontal dimension indicating time of note onset, the vertical dimension indicating the frequency of the note, and the shape of the note indicating rhythm, or note duration.

Musical Interfaces for Alternative Music Systems

For Western music users, or for systems that have adapted to CMN, there seems to be little or no problem. However, the world of music is not unified. Especially in the East, we do have alternate musical interfaces which use different semantics. A classical example is that of Byzantine music. This kind of music, apart from having a significant diachrony, serves also as an intuitively alternate interface, since it uses the notification methodology of ancient Delta systems (Margounakis & Politis, 2005).

In Figure 4 ARION is presented, which is a prototypal visual client, the first of its kind, that has served for composition with Ancient Greek music semantics (Politis, Vandikas, & Margounakis, 2005). ARION uses real-time physical modeling, voice reproduction techniques and provides ethnomusicology with an easy-to-use and functional interface for notation-based Ancient Greek music synthesis.

Recording Systems and Production Systems

This category of products, undoubtedly the flagship of the computer music industry, produces complete professional music recording systems. Usually they combine high resolution MIDI recording channels with audio recording in either 16- or 24-bit formats. This way they offer state-of-the-art multi-track, digital input capabilities and thus simulate and gradually replace classical analog recording studios in the meanwhile having the advantage of inherent communication with digital instruments. Although the hardware and