Creating a Context for Musical Innovation: A NIME Curriculum

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ABSTRACT
This paper presents the approaches and expectations of a recently launched course at New York University (NYU) in the design and development of musical controllers. The framework for the course, which is also entitled "New Interfaces for Musical Expression," is largely based on the proceedings of the first NIME workshop held in Seattle, WA in April 2001.

Keywords
Musical controllers, creative expression, input devices, courses.

INTRODUCTORY NARRATIVE
The participants in the first NIME workshop succeeded in articulating a general set of issues concerning the invention of new music-making devices while presenting an impressive array of innovative musical controllers. It became evident during our highly energized discussions that the field of musical interface design is becoming a full-fledged discipline in its own right. Laden with the abundant materials generated by the workshop, the author resolved to form a curriculum that would capture the spirit of our discussions and further formalize a general set of design issues for musical interfaces.

I approached the chair of my department at NYU, Red Burns of the Interactive Telecommunications Program (ITP) with a proposal for a course in NIME, who received the idea enthusiastically. ITP has a strong tradition in physical computing and has recently made this a core focus of the program, requiring all first year graduate students to become conversant in microprocessor programming and sensor technologies. The musical instrument class fits in well as a second-year advanced course.

"A Course on Controllers," presented by Bill Verplank and Max Mathews at NIME01 and based on their class at Stanford's Center for Computer Research in Music and Acoustics (CCRMA), offered a valuable boilerplate for curriculum development. Bill Verplank generously gave permission and encouragement to use the CCRMA course as a model to start from, while mentioning that ITP's background in physical computing makes it an ideal environment for a course in NIME.

Finally, the original organizers of NIME01 — Ivan Poupyrev, Michael J. Lyons, Sidney Fels, and Tina Blaine (Bean) — each gave their blessing to use the workshop name and the class was off and running.

Since the announcement of the course, student interest has been keen and the class is fully enrolled. The first semester of NIME at ITP begins in mid-January 2002. In brief, the plan is for each student to develop a working prototype of a musical controller over the course of 14 weeks, culminating in a public recital at semester's end in early May 2002.

MUSICALITY
While no formal musical background is required for the class, musicality will be positioned as the driving force of the design process. The class is an experiment with an educational approach that requires each inventor to set their own standards of musicality, however nascent, as the basis for musical interface innovation. The design challenge is to articulate expressive goals based on these musical standards and then work back to the tools and technologies required to achieve them. This approach grounds the design of the controller in a sense of musical purpose from the start.

Early discussions on the qualities of music and what constitutes musical expression will help students articulate the musical direction they choose to pursue. Our notion of music will be open and egalitarian. The class will encourage sensitivity to how musical styles vary across cultures, over the course of history, from the sacred to the profane, within popular and classical settings and with the advent of new technologies.

However flexible and open our definition of music is, it will nonetheless be essential that each student adopt some sense of musical style in which to root the invention of their new instrument.

We will also review how musical qualities vary with musical context. For example, solo music has different qualities when compared to ensemble music, while musics intended to accompany song, dance or film each have their own qualities. These qualities eventually translate into performance requirements of the musical instruments that fulfill them, so the students will be encouraged have some sense of the musical function they are aiming for from the start.

Inspired in part by Perry Cook's principle, "Make a piece, not an instrument or controller,"[3] this musically grounded approach is important to introduce to the students at ITP, who are prone to experiment with sensors and sound makers without always having enough time to consider the eventual application of their musical devices. In these cases, the musical results are often flat and unarticulated, with the lion's share of the student effort pouring into the novelty of the controller.

COURSE OVERVIEW

The goal is for the musical results to be as innovative and compelling as the controllers that produce them. Students work individually over the course of the semester to design and prototype a musical instrument — a complete system encompassing musical controller, algorithm for mapping input to sound, and the sound output itself. The assessment of work will be based on the whole system — from the originality and effectiveness of the controller as an expressive interface to the originality and effectiveness of the musical results as a form of creative expression.

The class will develop controllers for live performance, where deliberate gestures by musicians produce sonic results. The class will *not* be creating generative art pieces, asynchronous compositional environments or responsive musical installations.

The main topics covered in the class are:

An Historical Survey of Musical Instrument Types

To provide a grounding in the tradition of music making devices, we will review a classification of instrument types. Devised by Curt Sachs,[14] this taxonomy tracks the evolution of music making from hand clapping and foot stamping into musical instruments of four main types — chordophones (creating sound through the vibration of strings), aerophones (through the vibration of air), membranophones (through the vibration of stretched skins) and idiophones (through the vibration of the object itself). This lays the groundwork for a discussion of how recent sound making technologies have opened the door for new classes of musical instruments that break from traditional models.

Attributes of Musical Expression

We will review attributes of musical performance — pitch, harmony, melody, timbre, rhythm, dynamics, tempo — as well as qualities of musical expression — emotionality, immediacy, intimacy and temporal precision. Sampling performances from a broad range of cultures, we will then explore how these attributes of musical expression vary from style to style.

Music Theory and Composition

The class will cover the rudiments of Western music theory — studying basic harmony to provide a framework for organizing musical sound. This will provide a springboard for compositional exercises. One important exercise will require student to create a scale — of any number of pitches, timbres and/or samples — on a simple musical controller, and then use the scale to make a simple "tune."

Responsiveness

Because the tolerance for latency in musical interfaces is extremely low, we will explore methods of measuring human performance and assessing minimum requirements for musical responsiveness. We will begin with materials from Perry Cook's HCI course[4] demonstrating Fitts' Tapping Task and Zhai's Steering Task.

Discrete vs. Continuous Controllers

Here we will discuss the relative musical merits of discrete event versus continuous gesture controllers, and debate the choice, as framed by Bill Verplank,[18] between "buttons and handles."

Meaningful Mappings for Musical Gestures

The crux of the course will lie in the successful capturing of physical gestures and the creation of meaningful algorithms for mapping them to sound output. Electronic music opens up an unprecedented separation between musical controller and resultant sound. This capability is both a blessing and curse in the design of computer-enabled musical instruments: a curse because it often results in obscure and inexpressive mappings; a blessing because it offers, perhaps, the greatest potential for the evolution of musical expression.

Spectacle and Visual Feedback in Performance

Computer-enabled controllers sometimes rely on gestures that are less than dramatic and visually compelling for audiences (such as a mouse click or a key stroke). The class will address the importance of visually engaging expressive gesture, as well as the potential for spectacle and on-stage visual feedback using video and computer graphics.

Novice vs. Expert Interfaces

We will frame the design goal of creating musical interfaces that have a "low entry fee with no ceiling on virtuosity" (Wessel and Wright).[17] Many interfaces are either so easy to master that their expressive possibilities are quickly exhausted, or they are so difficult to get started with they are quickly discouraging. We will explore this issue as it relates to the design of instruments, musical learning devices, musical toys and public space musical exhibits.

Collaborative Interfaces

We will look at the potential for musical interfaces that facilitate group interaction, both in co-located and distributed performances. We will discuss the relationship of new interfaces to the various social contexts of music making.

Musical Borrowing and Recycling

From mixing to scratching to sampling of pre-existing recordings, we will review the phenomenon of musical "recycling" and explore possibilities for interfaces that further enable this relatively recent and innovative form of musical expression.

Tools and Technologies

Because the class requires coursework in microprocessor programming and sensor technologies as a prerequisite, and recommends some prior understanding of MIDI programming environments such as Max/MSP and Digital Performer, review of digital music technologies is not a primary focus of the course. It is assumed that students will research and master, with the help of the instructor, the technologies they need to fulfill their design goals. Specific attention will be paid to the Multi-Touch Controller from Tactex (to be employed for early mapping exercises) and to relevant musical instrument components (such as condensor microphones, flex sensors, force-sensing resistors, piezo-electric sensors, accelerometers, etc.)

Design Methodology

Throughout the arc of the course, the students will follow a rigorous design methodology the author has found effective in previous design courses at ITP. Students will advance their concepts through a stepwise series of design specification and prototyping assignments. Students will be encouraged to form ensembles, if they choose, as they develop their musical inventions.

THE RECITAL

The class will culminate in a public musical performance at NYU where students (or musicians invited by students) will demonstrate their instruments by playing brief original compositions, either individually or in ensembles. This recital will keep the goal of new controllers — innovative musical performance — in the forefront of the design process.

PRESENTATION MATERIALS

As a workshop participant, the author proposes to briefly review the pedagogical approach of the first semester of NIME at ITP. Video (and perhaps, hands-on demonstrations) of exemplary student work, drawn primarily from the May 2002 recital, will be used to evaluate the effectiveness of the educational approach and the musical inventiveness of the results. The complete syllabus for the course can be found at http://fargo.itp.tsoa.nyu.edu/~public_places/nime.htm.

RELEVANT BACKGROUND

After completing a music degree at the University of Chicago, the author worked for several years on the development of the Global Jukebox, an intelligent database of world song and dance style directed by ethnomusicologist Alan Lomax and funded by the National Science Foundation, Apple Computer, Interval Research Corporation and many others.

As a designer with Edwin Schlossberg Incorporated (ESI) in New York, the author has worked on a wide range of public space projects; among them a series of interactive music-making activities with a custom-programmed tangible interface for the Chicago Symphony Orchestra and a modular, interlocking composition for a responsive sound environment (with 10^{13} unique musical permutations!) presented at the NIME01 workshop.

The author collaborated with ESI and Ben Rubin of EAR Studio to create a prototype of a musical toy which employs a tangible, interlocking interface to teach principles of composition. Currently, he is working with ESI on musical expression activities for the new Children's Museum of Los Angeles, slated to open in 2004.

MID-SEMESTER UPDATE

At the time of the acceptance of this paper, the semester is just over half completed and the students are in the midst of prototyping their concepts. The proposed instrument concepts fall into some general categories. For example, there are several "open-ended" instruments that derive their raw sonic material from the room or from the airwaves. Another class of instruments augments the capabilities of existing acoustic instruments. In yet another approach, one student is creating a tool to accompany singing, combining the immediacy of the human voice with the algorithmically mediated voice of the computer-enabled instrument. Finally, there are those instruments that explicitly seek to break from the traditional paradigm of musical instruments ("one gesture equals one sonic result")[17] and lay the groundwork for new models of musical expression.

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