Hybrid Instruments and New Media Performance

Jason Rothman
Parsons School of Design
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STATEMENT OF PURPOSE

The aim of this project is to design a quartet of hybridized organic instruments equipped with sensors that can send position, motion, and pressure data to a computer for real-time manipulation.

ABSTRACT

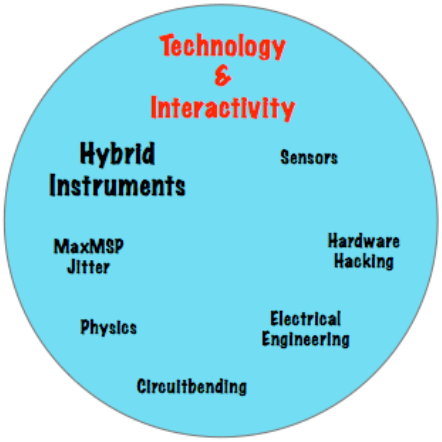
The custom designed instruments in this project will consist of a violin, cello, clarinet, and a mic'd piano. Though this has been achieved to some degree in the past, my aim is to create instruments that encourage the performer's rhythmic participation using the motion of his or her body in sync with the electronic elements of the composition. The focus here will be a dialogue between past and present where traditional forms of western classical composition are combined with narrative sound design and electronic music practices using instruments with extended capabilities. In addition to the instruments, the context in which the piece is played is important in creating a narrative and emphasizing the interaction between the "old" and the "new". To create a unified work with both sonic and visual elements, a series of visuals will be projected behind the performers that thematically mirrors the narrative found in the composition.

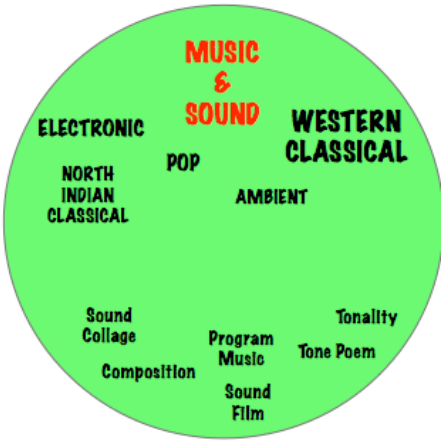
INTRODUCTION

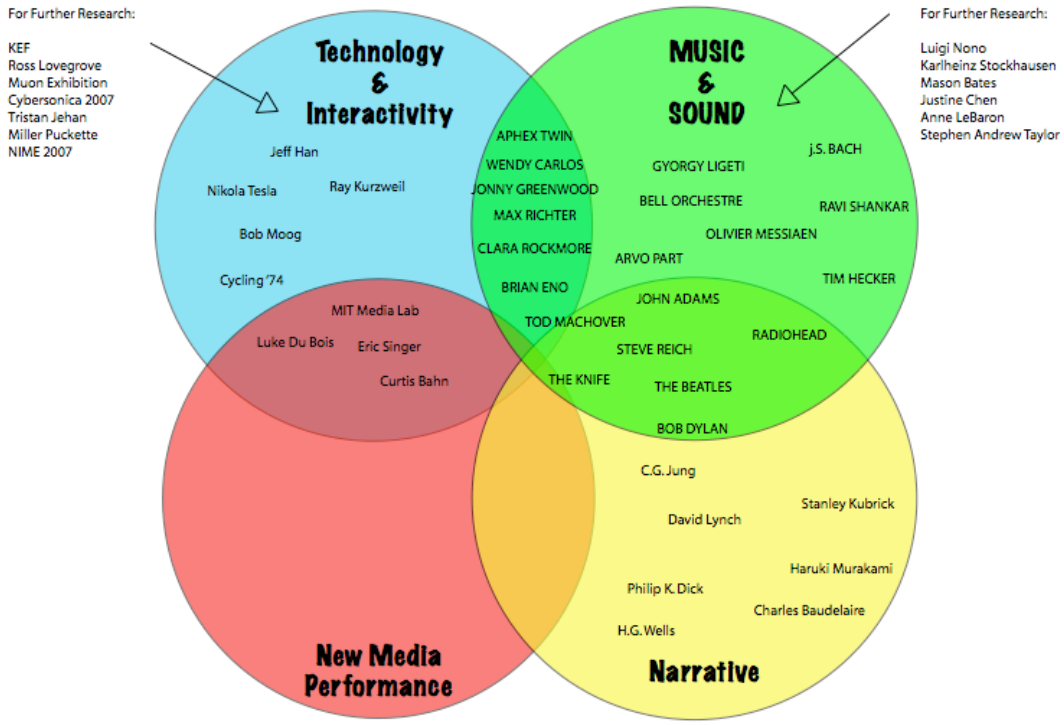
The impetus for this project is my dissatisfaction with prior art in the field of hybrid instrument composition. In the western classical tradition the main sub-genres within this domain are opera electronica, real-time manipulation of the orchestra, and chamber works for hybrid instruments. On the other side of the field there are myriad numbers of alternative controllers for computer musicians comprising everything from touch-screen consoles to wearable body-controllers. Hybridized composition in the western classical tradition has often steered clear of the more rhythmic elements of electronic music. Works written by established composers often lack a pulse or

structured electronic instrumentation including electronic percussion and/or bass. In the alternative controller / computer music medium there has been a scarcity of pieces that combine attention to performance practice, tonality, and purposeful, pre-determined composition.

The following Venn diagrams chart my motivations and influences going into my thesis project. The first diagram breaks my initial idea into 4 semi-distinct categories: Music/Sound, Technology, Narrative, and New Media Performance. Inside each category are sub-categories on which I'd like to focus. The second diagram puts these four main categories together and contains the individual influences relevant to my project.







The exponential growth of hardware and software-based technology in recent years has changed the way we produce and consume music in such a way that it seems the possibilities are limitless. Everyday, people are creating greater quantities and varieties of media, and in most cases regardless of form, sound and music are involved in some way. What I am most interested in right now is the development of music in a multimedia context where it is the focal point, but is also accompanied by and interacts with the moving image, an audience, and/or machines.

Another area of sound that I have been interested in exploring is its ability to tell a story. I have attempted to make a number of short "sound films" which I think of as the inverse of a silent movie. The visual element is taken away, and in its place, the sounds tell a story in a non-linear way. I have used dialogue from old radio programs, sounds designed to mimic the big bang, and audio clips from World War II, all in an effort to do with sound what the moving image does in film. My first exposure to the sound film was Revolution #9 by The Beatles, and I was struck at the way it was able to create a detailed

world filled with dense imagery and non-linear narrative transporting the listener to another place by piecing together disparate segments of sound.

The direction mankind seems to be taking in terms of blending with his creations is something I'd like to explore. We are at the beginning of a journey toward meshing biology and technology that will eventually change the natural fabric of our species, and it is within this framework that art will change dramatically as well. A great influence on my thinking in this regard is Ray Kurzweil (specifically his book The Singularity Is Near), who in addition to being a pioneer in the development of electronic music, is also a theorist and futurist. Integrating these concepts into music, I want to create instruments that give musicians greater control over the sounds they produce. When the violin was initially designed and improved upon there was no consideration given to altering pitch, timbre, DSP effects, or samples. Computers have helped music progress by leaps and bounds over the last 50 years offering a whole new sonic palette for musicians, but there is still a lot of untapped potential in terms of melding technology with physical instruments.

PROCESS AND PRECEDENTS

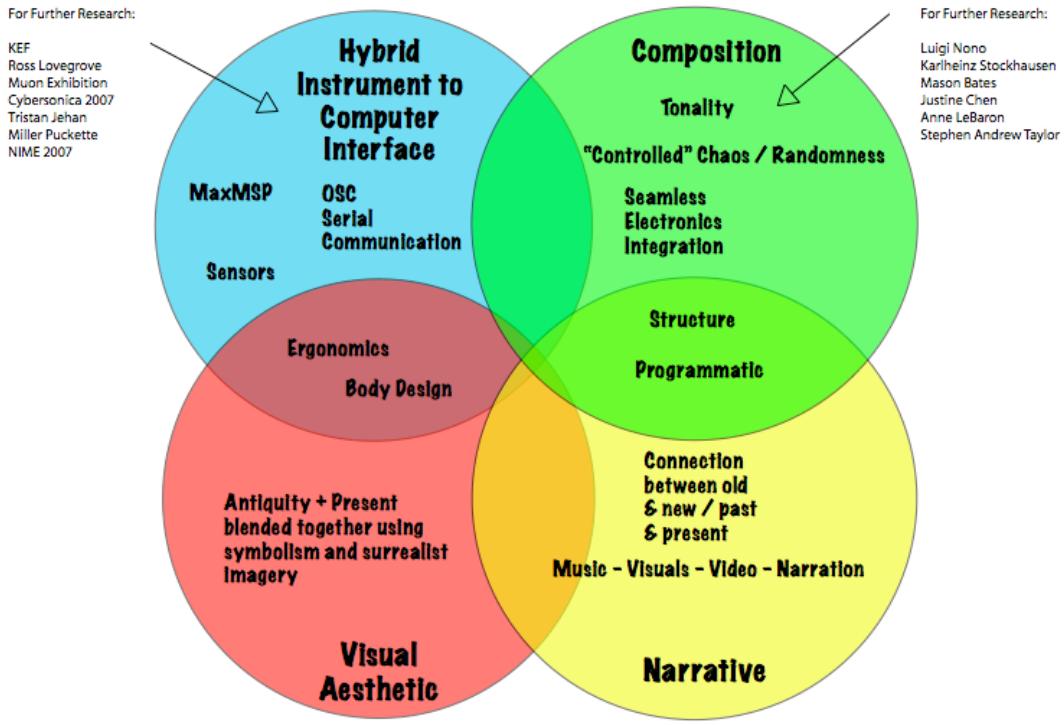
As an initial model for the piece I would like to put together, I have researched "Sparkler" by Tod Machover. Sparkler is an introductory movement to a larger work known as the "Toy Symphony" and employs the use of computers to manipulate the sound of a small orchestra in real-time. A specific arrangement of microphones is used to gather audio data from specific sections of the orchestra, and is sent to computers dedicated to a certain effect or algorithm which then becomes an instrument in its own right.

As for the narrative elements and visual aesthetic, I will maintain sketches and ideas as I work on the hardware and software for the piece, but clearly the narrative elements will have to be integrated after I get a better idea of what is sonically (and therefore, visually) possible so that the narrative elements are tightly and cohesively

integrated into the sound world created by the instruments, electronic manipulations, and sound design. Once the prototypes of the hybrid instruments are completed, refining the body design, ergonomics, and computer interface will be possible with crucial input from musicians / users. Once the tools begin to take shape I will go forward with composition and overall narrative.

Over the summer I will be researching precedents of the intersection between western classical composition, new media performance, and instrument - computer interface. In addition, I will choose 3-4 hybrid instruments to prototype, and have rough physical sketches completed by the end of June. Concurrently, I will be improving my programming skills in MaxMSP and have a rough mapping architecture completed by the end of August.

The Compositional, Hardware / Software, Design, and Narrative elements diagram:



In addition to using Western Classical music as a structural center of focus I am also very interested in incorporating elements of rhythm-based electronic music. Since I

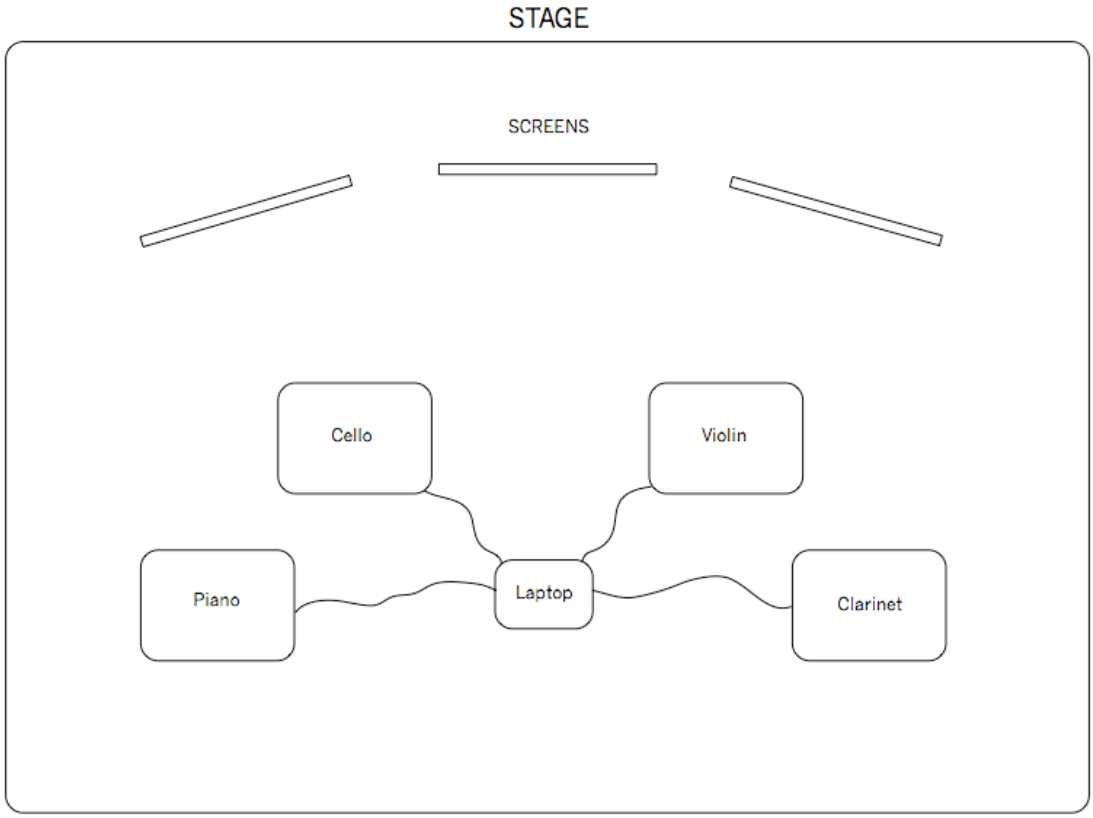
have conceived this work to be a dialogue between old and new practices, it follows that I should combine old and new styles of instrumentation and composition. Since the advent of rock n roll in the 1950's, music has become more an more rhythm-oriented, and the creation of electronic dance music that soon followed was directly related to the burgeoning computer technology of the 1970's and 80's. The precision and ease with which computers are able to arrange and quantize notes made them an integral tool in the creation of "beat" music. One of the main things that will be unique about this project and help differentiate it from its precedents is that I intend to design the instrument sensors and manipulation controls to exploit the rhythmic quality of electronic music. In the Western Classical cannon, the most rhythm-intensive sub-genre would be Minimalism, of which Steve Reich's music is representative. However, incorporating hybridized instruments in which sensors relay motion and tempo data to a computer would be a new way to incorporate elements of rhythm-based electronic music into a classical setting.

The technology being developed for musicians is becoming highly evolved and complex. There are seemingly infinite software DAW's and synths, alternative controllers, and effects units produced each year; however, the use to which these technologies are put are not often idiosyncratic. Very complex systems are often used to create amorphous soundscapes with little musical attention paid to their output in the name of the avant-garde aleatory tradition. In this project it is very important that the technology exist solely for the achievement of a compositional goal rather than gimmickry.

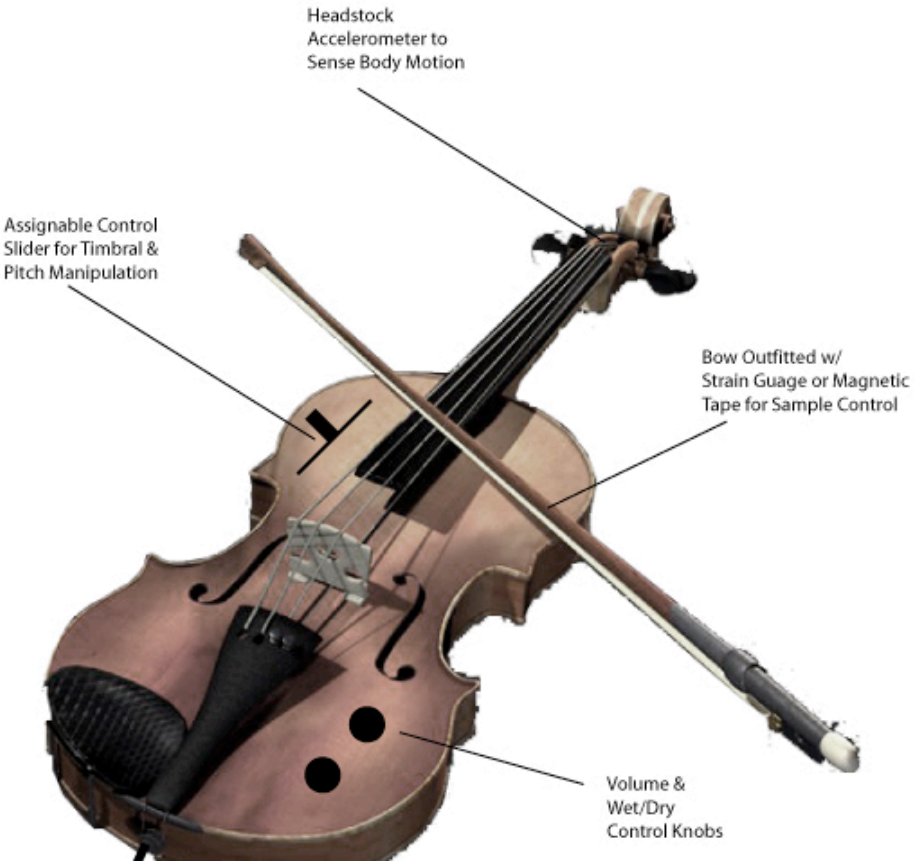
INITIAL IDEAS AND SKETCHES

The design for the violin can easily be transposed to work for the cello with a few variations, and the clarinet will present it's own unique challenges. The principle I'd like to keep in the forefront of my design priorities is for the musician to have ultimate control of real-time manipulation rather than having someone manipulating data from the computer. By giving the musicians onboard controls, they will be able to dictate the sound of their instrument while they're playing.

These considerations will be reflected in the score based on where the musicians' hands will be and what they will be doing at any given point. A preliminary solution I've thought of to deal with this is to implement a hold button which will capture that instrument's current output so that the player can stop blowing/bowing and manipulate the sample using a slider, tone/timbral controls, etc. with DSP effects. For example, while I violinist is playing, he/she might dip the head of the instrument downward that would trigger a filter sweep or a pitch dive in sync with the movement. Likewise, if they were to trigger the sample and hold function, they could manipulate the short sample in the same way. The following diagrams are initial sketches of stage setup, and design ideas for the violin and clarinet prototypes.




Mouthpiece Contains Air Pressure Sensor
Volume Control, Hold, & Wet/Dry Knobs
Horn Contains Piezo Vibration Sensor and Accelerometer for Motion Detection


Headstock Accelerometer to Sense Body Motion
Assignable Control Slider for Timbral & Pitch Manipulation
Bow Outfitted w/ Strain Guage or Magnetic Tape for Sample Control
Volume & Wet/Dry Control Knobs

USER SCENARIO AND FEEDBACK

For my user testing I did an interview with composer Roman Molino Dunn. I asked him to expand on the possibilities I have offered thus far and to talk about the intricacies of each instrument as they relate to the human-object interface:

MOLINO-DUNN: The thing that I have spent the most time thinking about is the way in which individual parameter controllers can be integrated into the design of the instrument. The most obvious one I thought of was for the clarinet. A clarinetist does everything with his/her tongue. All the subtleties in articulation come from the mouth/reed. But if there were sensors on top of the keyholes for pressure, which they apply to covering the holes (and even while they are still holding it down) can affect the sound. Other than the keyholes and the mouthpiece, a woodwind player (other than the low woodwinds who use their legs and knees for support) has no other physical contact with the instrument.

As for the strings, their bows already sensitively react to changes, as do their fret hands. So I was thinking, the only other place a violin, viola, cello comes into contact with their instrument is the thumb holding the back of the neck. If the back of the neck was pressures sensitive (starting at a high gauge, since usually you have to grip somewhat tight just to keep the instrument up) you could have a whole other plane of expression. Another option for the strings has to do with where they bow the strings. For example, if they are playing sul ponticello (near the bridge) the sound is much different then in normal bowing position. You could exploit this by applying different types of pickups.

Also, there is always the option of getting really crazy with this by making the mouthpiece of the clarinet a controller, and the strings of the bow a controller. There are a few different options for that. You could have the strings of the bow be a Y-axis for pitch. So at any given time you would have the pitch of the regular strings plus the pitches coming from the bow.

EVALUATION

The main problem I have found with my project is its scale. The broad scope of the piece, the number of different media elements incorporated, and the amount of work it's going to take to put all these things together is too large to be properly fit into the constraints of a thesis project. Going forward I am going to scale down the size and focus of the project, and limit it to one hybrid instrument with a specific set of goals required of it before I even start building. The most important thing to me is the end result in terms of the sounds it is capable of producing and the manner in which gestures are connected with the produced sound. Once I have solidified a sound concept I will move into the building phase. After the completion of the hybrid instrument itself I can then branch out into the other aspects of the piece including composition for supplemental non-hybrid instruments for accompaniment, narrative sound design, and visual elements. It is important that I am able to stay focused on the efficient design of one element from which I can build a solid foundation, and that I stay true to the principle that the musical output is of primary importance.

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