Thoughts on Virtual Reality Design for Musical Expression

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Abstract
This position paper ruminates on virtual reality's potential for expressive musical experiences, drawing from the author's personal mixture of skepticism and genuine curiosity as well as the author's existing work in computer music design, mobile music, and computer music software. A personal perspective is provided, leading into a broader discussion of the possibilities for new types of musically expressive experiences, and the potential challenges therein.

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Virtual Reality, Music Expression, Interaction Design.

ACM Classification Keywords
H.5.1 Artificial, augmented, and virtual realities; H.5.5 Sound and Music Computing; H.5.2 User Interfaces.

Where We Are
The history of computer music has seen, time and again, the creative adoption of technology in the service of musical expression. From synthesizing never-before-heard sounds, laptop orchestras that co-opt commodity personal computers as meta-instruments for large-scale ensembles [7,8], to designing musical expression for mobile phones [11,12] — as just a few examples — technology and music have always evolved hand-in-hand.

At the time of this writing in 2016, we are at the brink of potential wide adoption of Virtual Reality (VR) as a medium. The hardware is getting quite good and soon to be publically available (Oculus Rift, HTC Vive, Google Cardboard with mobile phone, etc.) and the computing power to drive graphics and interaction can be found in existing commodity computers, laptops, and mobile devices. While large corporations race to increase their foothold on virtual reality through new consumer devices, multitudes of startups have emerged to explore many different facets of VR. Research institutions — which have sustained VR's development and research through the past 3 decades before it was widely feasible (and fashionable) — have redoubled their focus and effort in investigating the research and educational possibilities of VR.

We might well be at the dawn of new Virtual Reality Age, with all of its possibilities and dangers. And if VR explodes as a medium, it will be big and all consuming. Arthur C. Clarke once said, "VR won't merely replace TV, it will eat it alive!"[5] Existing mediums — films, games, education, medicine, art, storytelling, entertainment, communication — all stand to be similarly shaken to the core. And yet for all the rumblings of VR technology, applications, and emerging literature ([2,3,6,7] to name few), there seems to be precious little on VR and music [1,4,9], and how we might design functional and aesthetically meaningful musical interactions in VR. As researchers of computer music (and someone who cares about where humanity is taking itself with technology and the arts), we should be curious about VR and its implications for musical things – even if we are skeptical about it.

Where I Come From

I love the physical world. I live, play, and work in it (even if I design things as abstract as software and computer music)! I have always been a skeptic of virtual reality. Over the years, having seen early demos of VR at conferences, exhibitions, and academic institutions such as Carnegie Mellon University's Entertainment Technology Center (back in 2001), I was always more impressed by the technology than the expressive/artistic possibilities – VR felt cumbersome and perhaps too much work for too little experiential and aesthetic reward (perhaps it needed another 10, 15 years to develop!). Some time later, I saw the movie *Wall-E* and its vision of humanity's future, where we all docilely sit in personal view screen-chairs with no desire to engage with the physical world. Combined with VR's ability (and singular goal) to transport us out of our physical surroundings, it further fueled my skepticism and apprehension about VR's implications.

I continued to work on computer music, largely without giving mind to VR. I designed a programming language for music [13], started laptop orchestras (physical people, gear, footprint, performance space), designed music on mobile devices [10] – which to me was more akin to Augmented Reality (AR) and based the context of the "real world" (the antithesis of VR). Interestingly, my work embodied a lot of elements that happened to be present in VR, including real-time graphics, interaction, design, and expressive audio.

It wasn't until I saw demos of musical visualizations on the recent consumer VR headsets that literally turned my head and music design mind towards VR (not fully, but enough for me to be curious)! I felt "there was something to it". I thought about this more and

realized what made the difference was having a visceral, aesthetic response to the music in a way that was connected to the immersive visual environment. There was something unique and expressive about it. I went from a 100% VR non-believer to a 90% non-believer, leaving room in my mind for genuine curiosity about VR. Is there something unique and compelling about VR for music after all? And is the technology mature enough to work with? Maybe!

There are parallels of VR today to the dawn of app-based, ubiquitous mobile computing (2007, 2008), before anyone expected it to become so pervasive so quickly. From a design point of view, the days of early mobile was a time when the rules were not clear because there were none, and everyone knew it. Thus it was OK (and extremely fun) to try unconventional things, to discover the rules. It was a vibrant time for designers and researchers precisely because of the open, unfettered invitation to tinker and explore. It was time to design and build from raw curiosity, borrowing from but not constrained by established ways of thinking. I reveled in it and now wonder if VR is at a similar stage, ready for creative tinkering.

A second, more "pragmatic" perspective is that no matter how I, or any one of us, feel about VR, it is going to happen (or not happen) on its own. That's just a function of technological momentum. And if VR is indeed going to "take over the world", I would rather it do so with more music than less! I also hope we would enter into a new technology age with understanding (technical, artistic, design, aesthetic, cognitive, social etc.) of its applications and implications for music – as well as its natural limitations.

Where We Might Go

As a researcher, I am always less interested in upcoming technology and more interested in the design principles (i.e., theories) and practices of creating meaningful musical experiences. Here are some nascent musings on opportunities and the challenges.

Possibilities and Opportunities

- ***New musical experiences*** that range from a virtual ensemble, to classroom, playgrounds and more. We might conduct a virtual ensemble that is situated in a full spherical formation around us in virtual space, where the sound spatialization is subject to our head motion as we move our focus, and the music is created under our direction.
- ***Novel instruments and interactions*** that take advantage of VR immersion. What are some principles of music interaction design for virtual reality? Which ones translate from our current and past practices, and which ones do no apply?
- ***New tools for computer music*** for exploring immersive visualizations of audio, expressive musical interaction in VR, and new programming environments for designing and programming musically VR experiences.
- ***Artful design of computer music***. Notions of form and function, of aesthetics, and how we might appreciate and evaluate beauty will have a new canvas and lens in virtual reality. What new hybrid musical art forms will the medium foster? New VR audiovisual *gesamtkunstwerks*?
- ***New modes of embodiment.*** How might we design for presence and representation (of self and our instruments) in musical VR settings?

Challenges

- ***Interaction, gesture, latency.*** The design of novel human-VR interactions will contend with a still nascent medium. Currently, viewing in VR (e.g., head tracking) is more understood than other interactions, include hand and body gestures. Also, *latency* is the eternal problem to address (or adapt to), as mass consumer systems (e.g., for games) may not subscribe to the same stringent latency requirements of certain types of music-making.
- ***Creating Satisfying and Expressive Mappings***. As with any new medium, we need to (re)discover design principles and practices that will lead to overall satisfying musical experiences. How might we take advantage of the *visceral* qualities that VR affords to create *sublime* interactions that map well into the virtual domain?
- ***Health (physical, mental, social)***. As researchers in an emerging medium, it is our responsibility to step back and consider all implications of the things we design. VR uniquely works on the principle of "hijacking" our senses and deliberately disconnecting us from the physical world. Even if we mean well, our VR creations cannot help but have "side-effects" on the physical and mental health of our users. Furthermore what social (and socio-musical) behaviors and etiquettes might certain design decision foster or dissuade?
- ***Musical Poignancy***. Ultimately, are the VR musical designs meaningful for the medium? Do they truly justify and take advantage of Virtual Reality? Does the work present a unique and truly novel form of musical expression? Will it help us learn something about ourselves in the process?

Concluding Remarks

As before with mobile music, and with no small amount of skepticism about the merits of the entire enterprise, I have set off exploring virtual reality for music, while there are no rules or conventions yet. For the past few months, a small research team has been quietly tinkering with VR and music design (principles, practices, tools) at Stanford University's CCRMA. We have been creating a set of tools for music VR design (including augmenting the ChucK synthesis language to control and map objects in VR). This academic term we have brazenly created a "virtual reality for music" course, knowing full well (and making it clear to students) that we are not experts in this field, and in fact there are no true experts to our knowledge, just as there were no experts of mobile music (or mobile app development) at the onset of modern mobile computing 8 years ago. The course is a vehicle for open-ended exploration of what VR means for music, and in particular musical expression, interaction, artful design. We continue develop our course, tools, and understanding of VR as a medium for music design.

I suppose I now count myself among the cautiously curious about VR, while not eschewing the (mostly) physical realm that I love and treasure dearly. My aim here is not to necessarily embrace or reject VR as an artistic medium, but to better articulate it for ourselves as artists, researchers, and designers. Because VR *is* potentially interesting and, in any case, it's on the way.

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