Promoting Underrepresented Culture through Media Arts Collaboration

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Abstract

This paper presents the practice of designing mediation technologies as artistic tools to expand the human repertoire. Three art-science collaborations: *Mandala*, *Imagining the Universe*, and *Resonance of the Heart* are elaborated as proof-of-concept case studies. Scientifically, the empirical research examines the mappings from (bodily) action to (sound/visual) perception in technology-mediated performing art. Theoretically, the author synthesizes media arts practices on a level of defining general design principles and post-human artistic identities. Technically, the author implements machine learning techniques, digital audio/visual signal processing, and sensing technology to explore post-human artistic identities and give voice to underrepresented groups. Realized by a group of multinational media artists, computer engineers, audio engineers, and cognitive neuroscientists, this work preserves, promotes, and further explores underrepresented cultures with emerging technologies.

Keywords

Art-science collaboration, multimedia live performance, mediation technology, body movement, sensing technology, machine learning, HCI, augmented-reality, posthuman, artist identity and ownership, underrepresented culture, cultural arts

Introduction

Cultural hegemony is a form of domination that gives little opportunity to minority cultures like Tibetan culture to survive and grow (Leavis 1930; Sautman 2006). Tibetan culture, which uniquely embraces the legacy of both Indian and Chinese Buddhism (Stein 1972), has stunning arts such as the Mandala Sand Art (Anderson 2002), monastic throat-singing (Smith et al. 1967), and Cham dance (de Nebesky-Wojkowitz 1976). Compared with its contribution to the world, such as its contemplative techniques and improvement of well-being (Kumar 2003; Marom 2004; Thompson 2006), Tibetan intangible heritage is highly underrepresented (Bishop 1989; Goldstein and Kapstein, 1998; Dodin and Räther 2001; Lopez 2012). In fact, the underrepresentation is an issue that affects all cultures of marginalized groups in our time. As a media artist and an interdisciplinary researcher, my ultimate goal is to promote underrepresented cultures through my work in music composition, vocal expression, multimedia performance, and technology development.

Deeply anchored in Tibetan culture, my research situates the design, development, and evaluation of media technologies. These innovative technologies are then used as artistic tools to create novel expressions to make a social impact. By exploring the healing power of the voice, I focus on how vocalists can enhance their vocal expressions with technology that facilitates cross-cultural communication and contemplative practices; by initiating and fostering art-science collaborations and turning the research into art practices, I hope to inspire other artists, technologist, and scholars to join me on the journey of promoting underrepresented cultural values through their work.

Related work

From an engineering perspective, I design and develop Digital Musical Instruments (DMI) and human-computer interactive systems, which implement machine learning techniques and 3D tracking to capture and identify the body movement of a vocalist. The vocalist's gestural data are simultaneously mapped into audio/visual events that activate vocal processing effects, such as reverberation and chorus, and manipulate computer graphics in a live performance.

From a theoretical perspective, I investigate existing theories in the context of music subjectivity (Cumming 2000; Patel 2010; Beard & Kenneth 2016), affordance (Gibson 1966; Reybrouck 2012; Krueger 2014), aesthetic and economic efficiency (Simon 1969; Roads 2015), culture constraints and social meaning-making (Hirschfeld and Gelman 1994; Meyer 2008; Dillon 2009; Chagas 2014), and conceptualize this body of knowledge into a series of DMI design principles, which are currently absent in electroacoustic vocal performance.

From a scientific perspective, I facilitate quantitative and qualitative human subject research to evaluate my design principles and examine the body-mind mappings from gestures to sound perception. Different from typical DMI evaluations that examine mapping relationships through user studies (Wanderley and Orio 2002), my original evaluation framework provides scientific justification for validating DMI and body-sound mappings in electroacoustic vocal performance from the audience's perspective (Wu et al. 2016). This unique approach provides empirical evidence for identifying the audience's degree of musical engagement from synchronization, to embodied attuning, and to empathy—the human connections (Leman 2008).

Art-science Collaboration

Given the interdisciplinary nature of my work and my long-term engagement with international computer science, music, and media arts research institutions, such as Center for Computer Research in Music and Acoustics (CCRMA) and Artificial Intelligence Laboratory at Stanford University, I often work closely with researchers in computer science, electronic engineering, and neuroscience fields. I aim to connect research and artistic practices within and outside of academic settings.

As the engineer Richard Hamming pointed out (1997, cited by Roads 2015), it is insignificant if the novelty and innovation make no cultural impact on human history. Through implementing our designed innovative technologies to compose proof-of-concept multimedia art pieces, I strive to create intriguing work that translates ancient Tibetan contemplative philosophy and culture to both a musical and a spiritual experience. The aspiration of my work is to capture the natural forms of human expression and embody them artistically in real-time by bringing an ancient Tibetan art form and its contemplation to the digital world and the 21st century.

In the following sessions, I will elaborate three case studies and a scientific research on body-mind connection to demonstrate how my proof-of-concept audio-visual pieces serve as a direct result of interdisciplinary collaborations between musicians, visual artists, technologists, and scientists. Our collaborative goal is to address the questions of how media arts technology and new artistic expressions can expand human repertoire, and how to promote underrepresented culture and cross-cultural communication through these new expressions.

The Mandala

In Tibet, as part of a spiritual practice, monks create mandalas with colored sand (Bryant, 2003). The creation of a sand mandala may require days or weeks to complete. When finished, the monks gather in a colorful ceremony, chanting in deep tones (Tibetan throat singing) as they sweep their Mandala sand spirally back into nature. This symbolizes the impermanence of life.

In this project, I aim to create an intriguing piece that translates this ancient philosophy to a multimedia arts and cultural experience through augmented reality and music composition. I computer-simulated and choreographed Tibetan Sand-Mandala vocal and instrumental composition. The performer activates with her arms 4.5 million particles using a physical computing and motion-tracking system (Wu, 2015; Wu & Conti, 2015).

To realize this piece, my collaborator introduced me to an open-sourced graphic and dynamic modeling framework CHAI3D (Conti, 2003), to simulate in real-time the physical interaction between the captured hand motions of the performer and the small mass particles composing the virtual Mandala. The mapping between the hands of the performer and their models in the simulation is performed using a mapping technique (Conti and Khatib. 2005) called *workspace expansion* that relies on progressively relocating the physical workspace of the devices mapped inside of the virtual environment towards the operator's area of activity without disturbing his or her perception of the environment. This approach allows me to interact with high accuracy in a very large virtual environment while moving my hands within a reasonably small workspace.

The piece includes three movements: *Construction*, *Climax*, and *Destruction*. At the beginning of the piece, hand motions from the vocalist were directed to initiate the *Construction* of the virtual Mandala. During the *Climax*, musicians were focusing on musical improvisation while the virtual Mandala was self-directed and presenting animation, such as rotation, twisting and glitter effects. Experimental low-tone throat singing and explosions of violent soprano interjections, comes to symbolize the extreme conflicts and ecstasy in life, the extraordinary highs and lows, the sharp rises and falls of life as it is experienced, ending with a sharp fade out into the deconstruction of the mandala. The *Destruction*, which underscores the eternal nature of impermanence, occurs near the coda of the audio-visual piece through the hand motions from the singer.

Figure 1: Live performance of the *Mandala*.

In 2013, as part of a multimedia live performance created at Stanford University and an invited performance at the Third International Buddhist Youth Conference in the Hong Kong Institute of Education, an interactive display of sand Mandala was dynamically simulated and choreographed with the vocal and instrumental compositional-improvisation. The first performance at Stanford University took place before an audience of Silicon Valley entre-

preneurs and researchers, while the second performance occurred in Hong Kong, before an eastern, Buddhist audience. Both audiences showed enthusiasm for the culture content, and the science and technologies behind the scene that creates the magic, both during and after the concerts.

In 2017, I completed the postproduction and realized a fixed audio-visual piece of this work. In March 2018, this fixed-media piece was presented at the national conference of The Society for Electro-Acoustic Music in the United States (SEAMUS) 2018. The performance piece and the fixed-media piece were well received by both the Western audience and the Tibetan diaspora. Through this media art collaboration, I innovatively provide a quick, yet rich presentation to simulate the Tibetan Mandala sand arts with musical expression; I aesthetically explore the ancient Buddhist philosophy of impermanence; and the visibility of traditional Tibetan cultural practices have been increased to the "twitter generation", who has less patience to rediscover those transcendent human treasures. A video of this multimedia live performance piece's premier can be viewed at: (http://tinyurl.com/ku5cg4f). A fix-media audio-visual piece can be viewed at: (https://goo.gl/5TgjJF).

Imagining the Universe

Sponsored by the National Aeronautics and Space Administration (NASA) and Stanford University [1], a live-performance telematics concert named "Imagining the Universe – Music, Spirituality, and Tradition" was held at the Knoll Hall at Stanford University. The concert was an international collaboration in real time that was broadcast live via the Internet, connecting musicians and scholars at six research institutions from Stanford, Virginia Tech, UC Santa Barbara, University of Guanjuato (Mexico), to Shangri-La Folk Music Preservation Association and Larung Gar Five Sciences Buddhist Academy (Sichuan Province, China). The concert was dedicated to the Venerable Khenpo Sodargye Rinpoche[2], an influential Tibetan Buddhist scholar, who attended the concert along with approximately 400 other audience members. It combines research, artistic creation and performing art in connection with the integration of cutting edge technology, building cross-cultural relationships through the lens of artistic and contemplative practice and interdisciplinary collaboration (Wu & Heauermann, 2016).

The technology component of this project explores ways of connecting cultures and collaborative artistic partners over long distances, through the use of the Jacktrip[3] application for online jamming and concert technology. Jacktrip was first developed in the early 2000s. It is an open source, Linux and Mac OSX-based system, used for multi-machine network performance over an Internet connection. Jacktrip supports any number of channels of bidirectional, high quality, low-latency, and uncompressed audio-signal streaming (Chafe and Gurevich 2014). More and more musicians have started using this emerging technology to play tightly synchronized music with other musicians who are located in different cities or countries. Without paying significant transportation costs, we exchanged musical ideas, rehearsed, recorded, and improvised together in different geological locations and for the final concert presentation. A link of the concert can be reviewed at: https://youtu.be/OaBNyAgiQP8

Figure 2: Live performance of the *Imagining the Universe*.

As part of this concert's research contribution, my research team and I built the *Tibetan Singing Prayer Wheel* (TSPW), combining both the meditative and musical associations of two Tibetan sacred instruments into one novel Digital Musical Instrument (DMI). The cultural heritage and meditative associations of the Tibetan prayer wheel, Tibetan singing bowl, and Buddhist chanting inspired this instrument (Wu et al., 2015). In this design, I hope to preserve these associations while adding digitized gestural mapping and control. At the aesthetic and compositional level, inspired by the thematic connection of the similar circular gestures of spinning a prayer wheel and rubbing a singing bowl, I designed a physical-motion-sensing controller that maps sensed circular motions (wheel spinning) and a steady raising/lowering gesture to a variety of outputs, including corresponding virtual circular motions (exciting the modeled bowl), changes in vocal processing, and amplitude modulation, as shown in Figure 3.

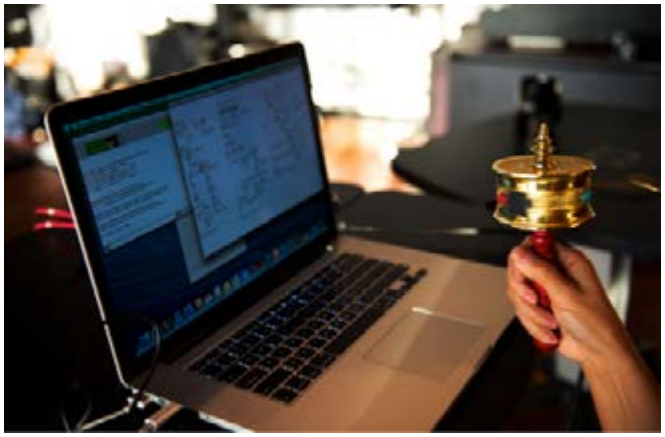

Figure 3: A Tibetan Singing Prayer Wheel

[1] https://news.stanford.edu/features/2014/imagining-the-universe/
[2] http://www.khenposodargye.org/
[3] https://ccrma.stanford.edu/groups/soundwire/software/jacktrip/

As a novel DMI, the TSPW was successfully integrated into multiple pieces with Western classical instruments, Tibetan traditional instruments and a variety of electronic/digital instruments. The concert provides evidence of strong theatricality when using TSPW; it also shows the added expressive possibilities that TSPW provides to the musician. Interestingly, 36 audience members came by to spin the TSPW after the performance, and showed great interests in playing the TSPW. This positive feedback from the audience motivated us to conduct two follow-up projects: one is a series of sound installations, and the other one is an empirical research on human research.

In early 2015, we first applied the TSPW to a sound installation at the Maker Faire4, at the Silicon Valley, in Northern California. A broader user group of around 200 people, including laypersons, children, and people who enjoy technology at all age participated in this sound installation. Another three similar sound installations were realized later in the same year, respectively exhibited at the California NanoSystems Institute (CNSI), UCLA, and Louisiana State University's Digital Media Center. Around more than 500 people participated in these three sound installations. They were mostly students and faculty members, researchers, and community members at the research institutions. An illustration of the sound installation at the Maker Faire is presented in Figure 4.

Figure 4: A TSPW installation at MakerFaire2015

From my observation, using real-time body movement/gesture to control and modify a sound's properties helps people to experience sound in an intimate, conscious, and meditative way. Most of the participants seemed to be able to catch subtle changes of the sound that the prayer wheel made with their own gestural control and physical interaction. With the haptic feedback that the TSPW naturally provides, participants can easily pick up the instrument and play around with it, understand what it does, and how to be creative with it in an engaging way.

Overall, participants' engagement with sound by using the TSPW was positive when they generated and affected sounds by using their own gestures and body movements. . Playing TSPW provides an intuitive way to connect users' physical movements to their own sound experience, as they are making, and "aesthetically" to appreciating, perceiving, and enjoying sound with their own physical form. This series of installations was the first step towards the rigorous scientific validation of the TSPW and my research on (bodily) action–(sound) perception mapping strategies for real-time electroacoustic vocal performance, especially for identifying the audience's degree of musical engagement.

Resonance of the Heart

The third case study, *Resonance of the Heart*, was inspired by a "Kōan" story in Chinese Zen Buddhism, called "印心", which describes a Zen master and his disciple's thoughts resonant without any verbal communication. This means these two enlightened human beings only communicated through their body-mind attuning in a profound lucid way. I have found this phenomenon specifically interesting, as this ideology aligned with my long-term investigations on body-mind connections through mediation technology development and media arts collaborations.

Indeed, with the assistance of the innovative mediation technology, nowadays' artists are entering into an "augmented human" era–some scholars called it "posthuman era" (Fukuyama 2003; Hayles 2008). Although many scholars concern challenges of artistic identity, ownership issues, and body boundaries in the posthuman era and some may even have a negative view upon these challenges, I perceive them as an opportunity to help our human species move forward. For this debate, I support Marcos Novak's view point, that with setting the humanities as the ultimate goals and ends, and with the technology as means to promote/accomplish excellence in the humanities[5], we human can overcome and go far beyond our current human condition. Therefore, posthumans could potentially become better humans, if we put great efforts and faith in this direction. This is also the overall goal of my ongoing research in "Embodied Sonic Meditation", where I examine how bodily activities can help increase our sonic awareness and open up our creative mind, and how an augmented body equipped with mediation technology can become part of the art itself or part of the artists him/herself.

To realize *Resonance of the Heart*, I used an infrared sensing device and a series of touchless hand gestures to control a real-time tracking system that I developed producing various sonic and visual results. I collaborated with AI researchers to design and implement machine-learning algorithms and techniques to capture complex and subtle ritual hand gestures called "Mudras" (Wu et al. 2017a). Mudra data were then mapped in real-time to control Tibetan throat singing effect, overtone singing effect, vocal reverberations and granular effects, and a 4-dimensional

[4] https://makerfaire.com/

[5] http://themas.mat.ucsb.edu/

Buddhabrot fractal deformation (Situngkir 2005). Figure 5 shows a glimpse of this ongoing project.

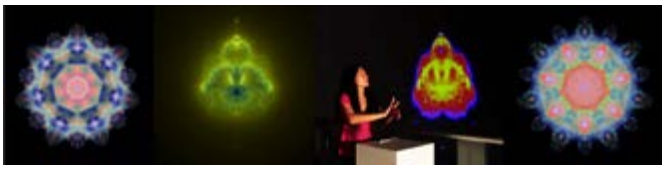

Figure 5: Mudras-conducted Buddhabrot deformation

In spring 2017, I used this audio-visual system as well as the TSPW as pedagogical tools to teach fifteen undergraduate students a course called "Embodied Sonic Meditation" at the College of Creative Studies[6] at the University of California, Santa Barbara. The unifying theme of this course is an engagement with sonic awareness, music technology, self-exploration, and non-hierarchical social relationships of music creation and appreciation.

I invited my collaborators to give guest lectures and play telemetric network gigs with the students during the course being taught. Students participated in listening, singing, improvisation, field recording, and interactive music making using the mediation technology that my research team and I developed. I aim to open up a safe and non-judgmental space to touch, move, and inspire students to express their creative nature, embrace their inner selves, and genuinely connect with others by enhancing their sonic awareness and their ability to listen, understand, and communicate cross-culturally through novel music expressions with embodied experience. As a result, most of the students demonstrated mastery of contemplative reflection, creative expression, transpersonal and cross-cultural practices, and scholarly thinking. Figure 6 shows a moment at one of the "Embodied Sonic Meditation" class, where students were online jamming with my collaborator at Stanford University, using Jacktrip application for online jamming and concert technology and the audio system of *Resonance of the Heart*.

Figure 6: "Embodied Sonic Meditation" class activities

6 https://www.ccs.ucsb.edu/

Embodied Sonic Meditation

The three case studies provide the fundamentals of "Embodied Sonic Meditation" (Wu et al. 2017b), an artistic practice rooted in the richness of the Tibetan contemplative culture, embodied cognition (Varela et al. 1991; Lakoff 1999), and "deep listening" (Oliveros 2005). This sonic art practice is based on the combination of sensing technology and human sensibility. Through this practice, we encourage people to fully understand and appreciate abstract electric and electroacoustic sounds and how these sounds are formed and transformed (cognitive process), by providing them interactive audio systems that can tightly engage their bodily activities to simultaneously create, sculpt, and morph the sonic outcomes themselves, using their body motions (embodiment). This ongoing project aims to further explore gesture-controlled, vocal-processing DMI design strategies and experimental sound education.

To further examine this artistic practice and formulate a body-mind sound theory, in 2016, I collaborated with cognitive neuroscientists at Stanford University to scientifically study audience perceptions for (bodily) action to (sound) perception mapping strategies. Specifically, we used TSPW as an evaluation case study to conduct human-subject research. We examined the way it maps horizontal spinning gestures to vocal processing parameters. We facilitate quantitative and qualitative research to evaluate the design principles and examine the body-mind mappings from gestures to sound perception. My proposed methodology differs from typical DMI evaluations that examine mapping relationships through user studies (Wanderley and Orio 2002) because mine was built on O'Modhrain's (2011) framework. It evaluates a DMI and body-sound mappings from the audience's perspective (Wu et al. 2016). This approach has been little studied and our research is the first empirical evaluation of a DMI for augmenting electroacoustic vocal performance from the audience's perspective.

We hypothesize that the levels of perceived expression and audience engagement increase when the mapping is (1) synchronized (such that the sensed gestures in fact control the processing in real time) and (2) intuitive. I composed and filmed six songs with the singer simultaneously using the TSPW. In two experiments, two alternative soundtracks were made for each song. Experiment 1 compared the original mapping against a desynchronized alternative, Experiment 2 compared the original mapping (faster rotation causing a progressively more intense granular stuttering effect on the voice) to its inverse. All six songs were presented to two groups of participants, randomly choosing between alternate soundtracks for each song. This method eliminates potential variability in perceived expressiveness of different performers and videos. Responses were evaluated via questionnaire. 50 viewers reported higher engagement and preference for the original versions, though level of perceived expression only significantly differed in Experiment 1. This methodology is proved to be effective

to be used as a research framework in future DMI evaluation both in design and mapping strategies from bodily action to sound perception.

Conclusion

Throughout this series of art-science collaborations and scientific investigation, I have demonstrated how music, art, science, culture, spirituality, tradition, and media technology can connect people, especially when used with a clear and conscious intent of building cross-cultural exchange. Our work also shows that media arts have the potential to open new windows onto underrepresented cultural groups, such as Tibetan people. During this six years of collaborating with researchers in both Humanities, STEM and Social Science field from different cultural, ethnic, and racial backgrounds, I have discovered that the crucial key which leads to the success of these interdisciplinary collaborations is to be open-minded, to be humble, to be grateful, and to be accountable. This way, mutual trust and respect can be cultivated effortlessly.

Through meditative cultural and art practice, my collaborators, my students, and I become more connected with ourselves, rippling out with a larger intent to connect in an open way to others, bridging cultural divides as well as art and science. Most importantly, our work not only preserves and promotes Tibetan contemplative heritage with emerging technologies but also projects the marginalized Tibetan cultural values and group identity into the cutting-edge art and technology context of contemporary society. Overall, this practice-based research leads to the emergence of entirely new fields of scholarship and artistic creation result in significant changes on how concepts are formulated in disciplines of the humanities.

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Authors Biographies

Jiayue Cecilia Wu: Originally from Beijing, Jiayue Cecilia Wu is a scholar, composer, multimedia performer, and audio engineer. Cecilia earned her Bachelors of Science degree in Design and Engineering in 2000. Upon winning the MTV Asian Beat contest, Universal Music Group identified her talent and hired her as a music producer in Hong Kong. She then worked as a professional musician for ten years. In 2010, Cecilia produced her original album of spiritual electronic music, Clean Your Heart. In 2013, Cecilia obtained her Master’s degree in Music, Science, and Technology at Center of Computer Research in Music and Acoustics (CCRMA) at Stanford University, where she focused on computer-assisted composition and audio engineering. Since 2013, she has worked with Dr. Curtis Roads at Media Arts and Technology Program at University of California, Santa Barbara, where she is completing her Ph.D. degree. As an audio engineer, she received a research grant award from Audio Engineering Society. As a musician, she received an award from the California State Assembly for being a positive role model in sharing Chinese culture. As a multimedia artist, she received the “Young Alumni Arts Project Grant Award” from Stanford University. As a scholar, she has been awarded a UC Central Campus Diversity Fellowship, a UC Central Campus Humanities Research Fellowship, as well as a National Academy of Sciences Sackler Student Fellowship. She recently has been appointed to a tenure-track position as an Assistant Professor at the College of Arts and Media at University of Colorado, Denver.