A Digital Mobile Choir: Joining Two Interfaces towards Composing and Performing Collaborative Mobile Music

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ABSTRACT

We present the integration of two musical interfaces into a new music-making system that seeks to capture the experience of a choir and bring it into the mobile space. This system relies on three pervasive technologies that each support a different part of the musical experience. First, the mobile device application for performing with an artificial voice, called ChoirMob. Then, a central composing and conducting application running on a local interactive display, called Vuzik. Finally, a network protocol to synchronize the two. ChoirMob musicians can perform music together at any location where they can connect to a Vuzik central conducting device displaying a composed piece of music. We explored this system by creating a chamber choir of ChoirMob performers, consisting of both experienced musicians and novices, that performed in rehearsals and live concert scenarios with music composed using the Vuzik interface.

Keywords

singing synthesis, mobile music, interactive display, interface design, OSC, ChoirMob, Vuzik, social music, choir

1. INTRODUCTION

Over the last five years, the handheld form factor (i.e. smartphone, portable gaming platform, e-reader, etc.) has grown in potential by several orders of magnitude in various aspects. Particularly, local computational power, human interaction sensing capabilities, and connectivity have made a remarkable leap forward, leading to devices with a broader awareness of their overall context, including user intent, location, and social surrounding [7]. This progress in available resources brings handheld devices to take a dominant role in the emergence of digital media ecosystems, encompassing other types of form factors such as tablets, large interactive displays, tabletops, or wearable technologies. Therefore the concept of mobility is now ascribing to a broader definition than its "pocket device" predecessor. It now refers to the pervasiveness of the computational power, towards the aim of creating an enriching medium of communication and expression, wherever and whenever the user desires it.

The potential of this facet of mobile technology yields exciting promise for musical applications. We can design for mobile devices to serve as interfaces for musical expression by taking advantage of their mobility, touch sensors, and accelerometers. This trend has been vastly explored in the last few years [7, 5]. But the power and pervasiveness of these digital technologies in our society also affords an unprecedented ability to design tools for collaborative musical experiences. Indeed, we can also consider designing for the complete musical experience that mobile technology affords, which is equally about the context in which music is made, i.e. actual participants, their social relationships, and their setting, as it is about the individual instrument. There is a growing number of initiatives looking for a more holistic design of mobile-based collaborative instruments [14]. Since the emergence of electronic instruments, and particularly computer-based instruments, various questions have been brought to our attention regarding the design criteria to be used in the development of collaborative interfaces for musical experience. A review is given in [1].

When it comes to orienting the design of a collaborative music-making system, the choice of an underlying music ensemble paradigm can be helpful, at least as a starting point for addressing the social aspects of envisioned experience. Existing computer-mediated collaborative music-making systems often – explicitly or implicitly – make clear connections with historical ensemble types. The choice of such a music ensemble paradigm has a direct impact on various properties of the collaboration, e.g. how or if the piece is composed and displayed, how or if the piece is conducted and performed, the presence and prominence of hierarchy and leadership, the amount of of control allocated to individual performers vs. leader and composer, etc. In this work, we have chosen the choir as the music ensemble paradigm to orient our design. The choir has a highly hierarchical structure. Singers mainly work with pre-composed material. They use codified vocal registers and standard vocal effects. We also highlight the strong leadership from the conductor, in both timing and dynamics.

Based on the choir as our design choice, we introduce a new system for bringing the choir musical experience into

NIME'12, May 21 – 23, 2012, University of Michigan, Ann Arbor.

the mobile space[1]. This system is comprised of two contributions: a mobile device application for singing synthesis, ChoirMob, and a large interactive display application for composing, visualizing and conducting music made on the mobile devices, Vuzik. In Section 2, we give further examples of collaborative music-making systems using mobile devices. Then we detail the design choices and the implementation of our mobile choir platform, in Section 3. Finally, Section 4 gives a first feedback on composing and performing with the mobile choir platform, resulting from nearly one year of using the mobile choir platform in concerts.

2. RELATED WORK

Music-making using mobile platforms has been a strong emerging community for a number of years, with a variety of structures of use being explored [7]. A few of these have specifically focussed on the use of mobile platforms as musical instruments in a collaborative music-making setting. Tanaka [13] presented an early system for collaborative music-making that allows performers controlling streaming audio over mobile wireless networks via accelerometer-based augmented PDAs to participate in the real-time creation of a piece of music. In this project, pre-existing musical content was controlled by the mobile devices rather than generated by them, but it identified the potential for such devices to be able to send and receive control messages via networks, as well as highlighted the importance of incorporating collaboration into mobile music-making. CaMus2 [11] is an extension of the CaMus instrument, where the camera of mobile phones is used as a sensor input for tracking information, that allows several of these devices to communicate with each other and with an external computer via an ad hoc Bluetooth network. This system also relies on an external computer to generate sound, as well as to act as a conduit through which the the devices can communicate between each other as well. Both Tanaka's work and the the CaMus2 involve collaborative music-making with a low level of structure in the relationships between devices and performers involved, and do not specifically incorporate methods of composing for the groups of devices. MoPhO [14], a mobile phone orchestra based at CCRMA, offers a well-defined configuration of hardware, software and performers within the structure of a musical ensemble, as our mobile choir platform does, that performs original repertoire that ranges from scored to freely improvised compositions. Sound is produced locally by each mobile device. As the variety of their repertoire suggests, the type of sonorities achieved by the ensemble and the roles of each of the performers vary greatly with the needs of the composition.

3. MOBILE CHOIR PLATFORM

In this Section, we describe our mobile choir platform. We first extend the motivations around the choice of the choir as our music ensemble paradigm. Particularly, we explain how it influences several properties of a collaborative music-making system. Then we present the implementation of the two main components of the platform, ChoirMob and Vuzik.

3.1 Design

Among available music ensemble paradigms, this platform explores the choir as a social structure that brings people to practice and perform together. The first motivation for this choir model is using artificial voice as the exclusive sonic material. Not only is voice the most ubiquitous musical instrument, we know that voice (speech and singing) has a specific cognitive impact on human beings. Our brain is hardwired to distinguish subtle variations in voice qualities, making nearly everyone an expert listener of vocal performances [9]. Therefore, we think that creating a mobile singing instrument offers expressive qualities to which many people can relate. Secondly, the choir is a more constrained performance configuration , with a composed piece written for several typical voice registers (soprano, mezzo, tenor, bass), a strong conducting leader, and expressive performance practice that is idiomatic for the singing voice (rubato, legato, vibrato). These formal rules allow us to explore various balances of control, addressing both the expression of individuals and their role in the ensemble, in ways that could not be as easily explored with less hierarchical music ensemble paradigms.

In our design, we aim to preserve the path from discovery to virtuosic use. Indeed, we think that the desire for personal progress results in social rewards within the ensemble, through mechanisms such as the sharing of expertise, the respect of one's role or the challenges between performers. By bringing the choir ensemble paradigm to the mobile space, we propose that we can preserve this path, but we use the affordance of mobile technologies to reduce its length. Reducing the time to reward helps to engage casual performers, without reducing potential expressivity.

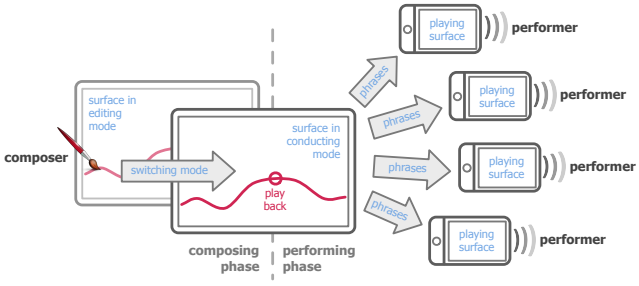

Figure 1: The mobile choir platform: the composer writes the choir music on a control surface in editing mode, then switched in conducting mode.

In our system, the melodic phrases of the choir music are written in advance by the composer using an interactive surface-based interface for creating a graphical score of music. When this work is finished, the interface can be used in a live performance setting to "conduct" the music, , where the display scrolls through the melodic phrases, following the playback of the music in real-time. Simultaneously, these melodic phrases are sent wirelessly to the mobile devices that are connected to the same local network. The application on the mobile device allows the performer to select voice or part to play, and thus which melodic phrases will be distributed to her device. The distributed melodic phrase controls the reference pitch of the singing voice being synthesized on the mobile device (Figure 1). The performer has control over four expressive parameters:

- note onsets and offsets: as inter-player synchronization is a critical aspect of expressivity in collaborative music-making, we leave the full control of note onsets and offsets to the mobile device performer;
- the dynamics of the singing voice: the performer can continuously control the so-called *vocal effort*, i.e. a combination of the sound loudness and the spectral effect of vocal folds tension in loud phonation [8];
- pitch deviations: the performer has a continuous control of frequency within a standard range above and

[1]http://www.youtube.com/watch?v=BNzV7lvgJjI

below the reference pitch being sent to the mobile device, which allows a variety of "fretless" deviations beyond the received melodic phrase. From simplest to advanced, these techniques could include: intonation adjustments, vibrato, grace notes and improvisation;

- the vowel space: the performer can browse within the vowel space, similar in the DiVA system [6]; this feature allows modulation of the singing voice according to Slawson's dimensions: openness and acuteness [12].

3.2 ChoirMob

The ChoirMob mobile device application is an interaction layer on the top of the RAMCESS singing synthesizer [2]. It enables the coupled manipulation of pitch, vocal tension, and vocal effort under a single fingertip, with a high level of naturalness, following the HandSketch mapping [3]. The non-quantized access to these voice production properties allows the performer to subtly control vibrato, legato, and dynamics, which are idiomatic gestures for the singing voice. The tilt of the device is mapped to several vowel properties, like openness and acuteness. The large amount of voice production parameters as compared to the limited space on screen led us to integrate focus strategies in the design [4]. For example, only ten semitones of the singing pitch range are accessible at a time. When lower or higher notes need to be produced, an OSC message can be sent to the device from an external source, such as a central conducting device, for shifting the central reference pitch, thus recentering the range of semitones available. Various properties of the singing voice can be remotely controlled by OSC, such as reference pitch, dynamics, voicing, voice quality, vocal tract shape, and voice register. A representation of the user interface is given in Figure 2.

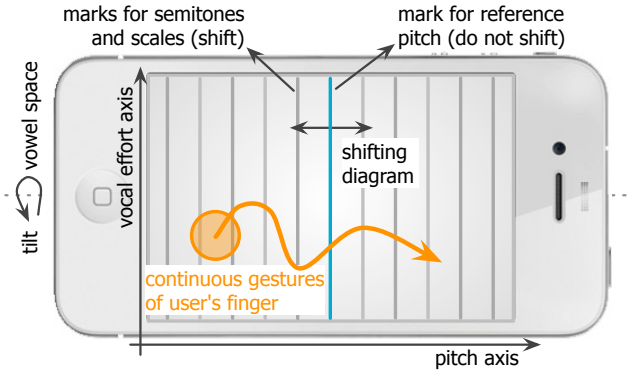

Figure 2: ChoirMob playing diagram : pitch is horizontal axis, vocal effort is vertical axis, device tilt is vowel space. New note shifts the diagram.

This approach places the ChoirMob application at an intersection where individual performing choices on the device are merged with compositional and conducting choices that are streamed over the network by a central conducting device. This means that each performer could bring their own mobile device to a common location where a composed piece of music is currently being conducted.

3.3 Vuzik

As ChoirMob is a platform that responds to generic network control messages, one can envision any number of devices that can serve as the central conducting device for a choir of ChoirMob performers. At minimum, such a device would require network control message output compatible with ChoirMob, but beyond this, other features could offer the potential for the device to serve multiple roles in a music-making scenario beyond just basic control.

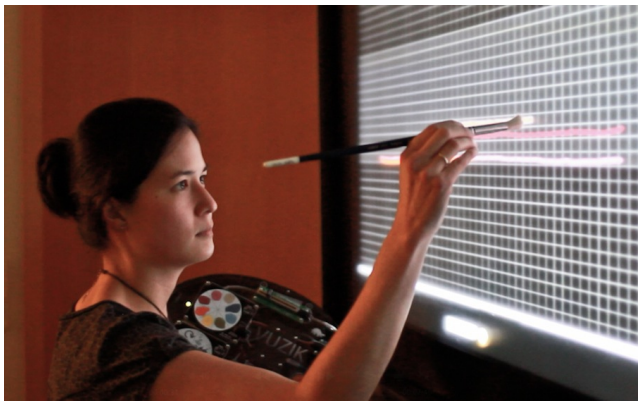

Figure 3: Vuzik is an application for large interactive display that affords the creation of a graphical score through painting interaction.

Towards this increased functionality, we choose Vuzik, an interface for composing and visualizing music through painting-gesture input on a large interactive display [10]. Not only do the visibility and increasing pervasiveness of large displays afford a relationship conducive to the mobility aspect integral to the ChoirMob experience, but the Vuzik interface offers unique capabilities in the composition and performer-directing stages of music-making. Through a simple mapping of visuals to sound within a music-painting metaphor, Vuzik enables the gestural creation of a graphical score on the large display, through which it aims to demystify the structure of music for a broad viewership. Its simple visual language for representing music provides a visual reference to experienced musicians and novices alike that then enables the composed score to be "read" by performers and provide timing information functionally similar to a conductor's role within a traditional choir. Above all, it sends control messages over the network, corresponding to the musical instructions that the composer has graphically communicated in the score.

4. APPLICATIONS AND EVALUATION

Because this system is striving to incorporate the essential elements of music-making in order to foster rich musical experiences for the music creator, performer, and audience alike, it was essential to evaluate the combined ChoirMob and Vuzik system in a real music-making scenario. Through the generative and creative process of composing music using Vuzik and performing it using an ensemble of ChoirMob musicians to rehearse and perform in a live concert performance, we were able to gain valuable insights into the application, success of design choices, and best performance practices for this system. We assembled a chamber choir-like ensemble of ChoirMob performers that ranged from 4-10 members[2]. Seven of the members had formal musical training, while three would be considered music novices. A 13-minute, 3 movement composition for 4 independent voices was composed for this ensemble using the Vuzik interface. This piece incorporated strictly notated material as well as controlled improvisation sections. Four members of the ChoirMob ensemble performed this piece in a live concert setting at the East Vancouver Cultural Centre on

[2]http://www.voxtactum.com

November 7, 2011, to an audience of over one hundred people, following personal practice time and rehearsals.

The particular performance setup was designed to provide the performers and their devices what they required while still remaining visually engaging for the audience. The quartet performed standing up facing the audience with localized sound sources via loudspeakers placed at each performer's feet. They faced a laptop running the Vuzik application that was displaying the graphical score of the piece for their reference, while the same display was projected on a large screen behind them for audience viewing and insight into the music being performed. A dedicated WiFi router was used to provide an uninterrupted wireless network for OSC messaging between the Vuzik laptop and the iOS devices.

Although this performance was the most thoroughly documented, others followed using the same system and setup, including a repeat performance of the same piece by different performers, and a performance of a 3 minute work using one solo ChoirMob instrument accompanied by an additional sound engine controlled by Vuzik. Other mobile device choirs have also been spreading in various towns (Calgary, Bruxelles, Mons), facilitated by the open messaging protocol, and particularly one implementation of it, connecting a regular MIDI score to the iOS devices.

5. FUTURE WORK AND CONCLUSION

As the system continues to be used in future performances and techniques of use are further perfected, it will become important to conduct further formal evaluations of the success of the interfaces in creating a rich musical experience. One significant big step in this project is the evaluation of the scalability of this concept, i.e. how the mobile choir platform and the overall musical experience are scaling up to eventually hundreds of participants. Another axis of development is actually what can of information would be meaningful to take the backwards path, from the mobile devices to the large interactive display, i.e. what personal data has a positive impact on the ensemble's experience, other than the sound produced by the mobile devices themselves. Finally, it is important for us to keep in mind that this platform is open on both ends, and therefore either part could be replaced by an alternative compatible interface . We look forward to exploring how this entire paradigm can benefit from a more heterogenous setup, with different individual sound-generating devices or a totally redesigned composing/conducting interface.

In this paper, we have described the full process of bringing a new music ensemble paradigm – the choir – into the mobile space, its design and implementation choices, and significant feedback through practicing and playing this system live on stage. The complete process confirmed that mobile-based collaboration is a powerful approach for developing musical applications. Moreover, it showed that combination of a large screen for composing and conducting tasks vs. small touch screens for performing affords to create a highly engaging musical experience. Additionally, the project explored the balance of control between the composing and conducting interface and the performer. Finally, it demonstrated that if expressivity and the path to virtuosity are defined as core design aspects, casual participants can quickly move to a more committed role and work on the mobile devices as on real musical instruments.

6. ACKNOWLEDGEMENTS

The authors would like to thank the Institute for New Media Art Technology of the University of Mons, the Media and Graphics Interdisciplinary Centre of the University of British Columbia, and the Interactions Lab and Music department of the University of Calgary for their support of this project. Additionally, we would like to extend our gratitude to Dr. Junko Ichino of the University of Electro-Communications, Chofu, Japan, who was co-developer of Vuzik, and Vox Tactum ChoirMob performer Martin Ritter of the University of British Columbia School of Music.

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