THE MOBILE PHONE ENSEMBLE AS CLASSROOM

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ABSTRACT

In Fall 2009 the University of Michigan offered a course called "Building a Mobile Phone Ensemble". In the spirit of using commodity hardware as teaching platforms, we report the outcome of this first attempt at teaching on this topic. The course was offered to seniors and graduate students in Electrical Engineering and Computer Science as well as Music. The student had to learn to design their own mobile phone instruments hence learned developing and designing software for mobile phones, they then learned how to write, conceptualize, conduct and perform pieces for such an ensemble. The course ended with a public concerts of pieces written by the students.

1. INTRODUCTION

Building a Mobile Phone Ensemble is an interdisciplinary course, which was offered for the first time in Fall of 2009 at the University of Michigan to both senior and graduate students in Performance Art Technology (School of Music, Theater and Dance) and Electrical Engineering and Computer Science (College of Engineering). The goal of the course was to fully integrate the technical aspects of the topic with musical and artistic concerns.

The concept of the course very much is related to other developments. One is the emergence of the mobile devices as full computational device. In this light there has been a push towards looking at mobile devices as desirable platforms to support pedagogy. For relevant discussion of the field for pre-college learning see the recent review by [6]. On the college level numerous courses have appeared that either teach programming for, or interactions with, mobile devices. Such courses were and continue to be offered at Stanford University, University of Michigan and other places. The second related development has to do with classroom teaching of computer music on laptops [5, 8, 11, 1, 4]. There are many important similarities to teaching with laptop ensembles. In both cases working with and developing on and for commodity technology is merged with consideration for performance practice. There are also substantial differences that are introduced by using mobile devices as primary platform. Furthermore the mobile device has seen accelerated interest as a platform for musical expression [7, 3, 10, 12]. The course is directly related to the emergence of mobile phone ensembles, which use mobile smart phones as primary musical instruments [9].

On the technological side, mobile devices offer a new setup. Rather than emphasizing large displays, keyboards and mouse, mobile devices are an intergrated multi-sensory and multi-media platform that requires a new approach. On the artistic side, mobile devices offer very literally mobility in performance. While laptop orchestras have to plant themselves in a given location for a performance, performers using mobile devices are not bound in this way. This requires a change in teaching both on the technological side, as well as on the performance aspects.

Figure 1. Equipment needed to set up the ensemble: iPod Touches, portable speakers, tennis wristbands, y-collectors, lots of batteries, external microphone (left to right, top to bottom). Completed ensemble instruments after sowing the wristbands to the speakers. All equipment can easily be transported in laundry crates (right)

2. PREPARATION

We chose iPod Touches as primary mobile platform. The main reason to use iPod Touches as opposed to iPhones is purely financial and logistic. Currently iPhones are either very expensive or bundled with a telephone plan.

The associated cost, especially given that the telephone connectivity was not needed made the iPhone option prohibitive. In the future one can hope that mobile smart phones can indeed be purchased and used without telephone plans for educational purposes. This is not currently the case. In order to recover the microphone as a possible input we used external microphones.

A second important aspect is amplification. While iPhones and iPod Touches are loud enough for personal use, they are not able to create audio levels suitable for performance venues. Hence there is a need for additional amplification. While it is possible to use venue-bound amplification, this is not the most flexible solution. Ideally one want to have amplification that can move with the performer. The idea to have hand-bound speakers originally goes back to Ge Wang and Nick Bryan who sew portable speakers onto finger-less biker gloves. The Berlin Mobile Phone ensemble instead used tennis wrist-bands to support the speakers. This is the setup used for the class. We used Altec Lansing Orbit portable speakers and inexpensive tennis wrist-bands. In order to connect a pair of speakers to the iPod Touch we used 3'5mm stereo audio Y-splitters.

Software development is enabled through an educational iPhone developer license of the University of Michigan. As development platform we offered reserved computer clusters with installed development environments but this turned out to be largely unnecessary all but one participant in class had a MacBook laptop and opted to develop on their own computer. The limitation to one operating system and platform could be more of an obstacle in other settings but we found that the limitation was not noticeable in our case.

3. THE CLASS

The goal of the class was to start from scratch and build up all aspects of the ensemble until at the end of the semester the students would perform a concert featuring pieces they wrote for mobile phone instruments they had developed. In general the week was split into two course sessions of 1.5 hours. The first session was usually a more traditional lecture format, where new concepts were introduced. The second session was used for more hands on experiences, such as programming, building speaker systems, discussing and conceptualizing pieces, discuss and rehearse choreography and so forth.

The semester started off focusing on learning how to program iPhones, focusing on digital audio and sensor-based input. The goal was to design iPhone instruments from scratch. This involves programming in the C family of programming languages as well as teaching some familiarity with Objective-C. This is necessary because the iPhoneOS libraries are written in this language. The syntactic difference of Objective-C compared to C, C++ and Java does pose an additional challenge that needs to be overcome by the students. Overall the iPhone SDK is a rather attractive environment to teach multi-media programming on mobile devices. The audio pipeline, especially if used at the Audio-Queue level is rather straight-forward and allows to teach about hardware-relevant issues such as buffering, and delay without too much extra complexity. Also accessing sensors such as accelerometer, compass or multi-touch data is sufficiently simple that it can be thought rather directly.

Next the course went to synthesis methods emphasizing the importance of interactive controls. This is also an opportunity to review practical aspects of pyschoacoustics and digital audio, as some parameter changes can have undesired perceptual outcomes that have to be dealt with algorithmically. For example if one links the amplitude and frequency of a sine-oscillator to accelerometer input, the

Figure 2. Class reheasing.

Figure 3. Owen Campbell conducts his piece Owen's Lament.

frequency will be largely robust to artifacts even if not otherwise treated, whereas non-smooth (jump-like) changes in the amplitude will lead to audible clicks, hence requiring some smoothing if the input us such. At this time one can introduce computational performance considerations and give practical demonstrations of latency due to buffer size as well as the relationship of available computation for synthesis versus buffer size.

Next the students built the wrist-band speakers. This involved drilling holes into the lids of the speakers and sowing them onto wrist-bands. At this stage the class was ready to start thinking about performance.

The first major project involved writing an instrument in Objective-C/C/C++, then conceptualizing a piece for it. The remaining of the course pursued two goals. One was to engage with a higher level environment for musical instrument design called UrMus [2] that was developed to help focus instrument design on its core component. UrMus is in many ways comparable to general sound generation environments for the desktop such as Max/MSP, pure data (pd), Super-Collider or ChucK, but written specifically for the mobile devices. It uses a graphical patching paradigm with a co-existing script layer to offer high-level yet Turing-complete scripting of instrument behavior. The main reason to use UrMus at this stage in class was to simplify the graphical interface design of musical instruments without having to teach lower level UI or graphics programming. One of the functions of UrMus is to allow layouting and interaction design directly matched for the mobile device without having to go through programming in a low-level programming language. UrMus is described in more detail in a separate publication [2].

The second branch of the course set its focus on getting towards performance. Spatial arrangements, compositing for distributed instruments, dramaturgy, choreography all were topics of discussion. Practical aspects of performance practice are also very important. Students engaged with different forms of performance, free-form unguided improvisation, guided improvisation through conducting, traditional, graphical and computer-guided scores. We explored possible postures that can be used with the devices to convey the intended meaning to the audience. At this stage the second course session each week focused on performance and iPod Touches and speakers were used throughout. As a practical matter we found that the iPod Touches, which having a practical life-time of about 4 hours, often needed to be recharged each week, especially if programs were not exited. However the 3 AAA batteries required to power the speakers lasted the full semester and were replaced for the final concert only as a precaution to avoid any mid-concert problems. So the main maintenance activity for the class was weekly, late in the semester bi-weekly charging of between 11 and 20 iPod Touches.

As a second project all students designed a second instrument in UrMus, where the focus was on the visual interface to the performer or the user. At this point students were encouraged to not only design the instrument, but at the same time co-develop a piece that will go with the instrument.

4. THE CONCERT

The last two weeks of the semester were concerned with developing actual performances for the final class concert. Students formed groups of two to jointly develop a piece to maturity, including scoring or conducting, choreography and stage appearance, piece concept and technological considerations. All compositions generated up until this point formed a brainstorming basis to pick the six most intriguing ideas to bring to stage. In some cases an instrument strongly suggested a piece whereas in other cases the concept of the

piece demanded certain instrument which were developed for this goal.

Along the standard class sessions, we also had one long in-venue dress rehearsal about a week before the final concert and a one hour final run-through on concert day. The concert was publicly advertised and the students played their pieces to a full house of about 220 people. The concert lasted for about 50 minutes featuring only pieces written and performed by the students. The author participated in the first piece following a request by the students. Students were responsible to draft their own liner notes for the program. The concert was video taped by the University of Michigan News Services and also local and international news programs. The video is available at:

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http://www.youtube.com/watch?v=Qp3dMbI94_
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5. CONCLUSIONS

In this article we reported on a first class that teaches how to build up and make music with a mobile phone ensemble at the college level. Mobile phone ensembles are attractive compared to laptop ensembles for numerous reasons. Some are very practical. For example the whole equipment can be transported in a standard size laundry basket or equipment crate and can be carried by a single person. Laptop orchestras either need a dedicated space where things can be set up for the duration of the course or require substantial effort to move. Mobile phone ensembles also extend the possible performance practices by allowing for performance-in-motion. Didactically mobile phone ensembles are interesting because mobile phones are emerging as an important technological platform of the future with many tangible technical skills to be learned by the students. The ensemble offers a new way at looking at electronic ensemble performance by emphasizing freedom-of-motion, distributed-yet-personal instruments and the promise of access to a very large group of possible future players. Details on the ensemble can be found at:

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http://mopho.eecs.umich.edu/
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6. ACKNOWLEDGEMENTS

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