Pocket Gamelan: swinging phones and ad hoc standards

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ABSTRACT
In this paper, we discuss how mobile phones have been used as devices for active music making, how mobility affects sound and how communication between phones has been integrated into the fabric of a new genre of interactive performance by groups of musicians. We identify some of the issues that stood in the way of developing two new musical applications for mobile phones, discuss aspects of performance works developed so far using this technology and point the way to future development.

Categories and Subject Descriptors
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Doppler shift, Bluetooth, j2me, java 2 micro edition, microtonal.

1. INTRODUCTION
Computer music has had two persistent technological legacies. One is its dependence on performance interfaces designed around 12 equal divisions of the octave. The second is the desktop computing environment where musical resources are concentrated in the hands of a single user. As technological development shifts away from this towards mobile computing, new computer performance paradigms have begun to emerge.

The Pocket Gamelan project is motivated by a desire to explore the features of microtonal intervals found in many non-Western musical traditions and seeks to develop applications that allow microtonal music to be composed and performed using mobile phone technology. The combination of flying sound sources and remote controlled sound using hand-held technology has resulted in a new kind of interactive performance genre in which microtonal instruments are easy to play, quick to learn and readily accessible to large numbers of people [6]. Musical interaction involves using sound sources that are physically relocatable and wireless communication that allows moving sound sources to be controlled using hand-held devices.

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Two new works that representative this genre are *Mandala 3* and *Mandala 4* performed at NIME in Paris in June 2006. In performance Bluetooth-enabled mobile phones attached to a cord are swung in a circular fashion to produce Doppler shift. Phones are used either as a flying sound source or as wireless hand-held controller to alter the behaviour of other sound sources.

Figure 1 Mobile phone is swung to produce Doppler shift

Figure 2 Moving sound sources controlled by hand-held phone

2. BLUETOOTH PERFORMANCE NETWORK

2.1 Piconet – *Mandala 3*
A bluetooth piconet is created when a master device is connected to one or more slave devices, each operated by a player. Each slave device (6230) communicates with the master (7610) whenever one of the players presses a button on the handset. The master then relays messages received to other slaves in the network. This scenario was first developed for *Mandala 3*.

Figure 3 Echo server piconet

2.2 Ad Hoc Connection – *Mandala 4*

An ad hoc connection is created when one device connects to another device. Point-to-point connection can occur between any pair of phones (6230) with either being master or slave. The master connects to a slave phone, transmits control information then disconnects. Only one device may be connected at any time. This scenario was first developed for *Mandala4.*

Figure 4 Ad hoc network

2.3 Bluetooth Initialization

Bluetooth devices are initialized at the start of each performance. This initiates a bluetooth discovery sequence to detect Bluetooth-enabled phones and identify phones required for the performance. Initialization is also necessary to synchronize each client phone.

In *Mandala 3*, initialization is done by the server (7610). The server is the first application to be launched. Initialization synchronizes the clocks that drive each of the three slave phones.

In *Mandala 4* initialization is done by phone A (6230), which synchronizes the start of sequences on phone A, B, C and D. This helps players anticipate cues that allow them to interact with one another.

Figure 5 Bluetooth initialisation sequence

3. JAVA IMPLEMENTATION

We encountered several anomalies in both MIDI and Bluetooth implementation of the 6230 phones. By describing these we hope to highlight the benefit of adopting standards that will extend the user base for phones in future.

3.1 Pseudo Note Envelope

On the Nokia 6230, note envelopes must be formed by using MIDI in a non-standard way. A pseudo note envelope is formed by sending a single note ON, followed by a stream of MIDI Controller Change and MIDI Pitch Wheel messages.

It was necessary do this on the Nokia 6230, because a continuous stream of more than 30 MIDI Note ON - Note OFF messages caused the 6230 to crash. The problem only occurred when code was executed on the phone but did not occur during emulation using Eclipse. However the Nokia 6230 had no such problem playing a MIDI file even if the file contained hundreds of MIDI Note-ON – MIDI Note-OFF messages.

MIDI Controller Change Messages (Controller No. 7) were used to create amplitude envelopes that artificially turn notes on and off. MIDI Pitch Bend was used in a similar fashion to define pitch. The Nokia 6230 proved to have remarkable tuning resolution. Even with pitch bend spanning a range of four octaves, the 6230 phone has a tuning resolution of less than 0.3 of one cent.

3.2 Bluetooth Multicast

On the Nokia 6230, Bluetooth messages can only be sent from one phone to another on a single channel and cannot be broadcast from a single phone. This limitation was overcome by using a separate mobile phone (7610) as a dedicated server. In performance, this is not used as a mobile sound source and is not visible to the audience. During initialization, the 7610 identifies the Bluetooth UUID of slaves taking part in the performance and prevents unwelcome contribution from uninvited participants.

In future network implementations we will use a dedicated mobile server with a Bluetooth configuration similar to the Nokia 7610. This will give more robust interaction between one player and another as well as allowing any player to transmit to every player in a single bluetooth operation. Implementation of the mobile server in future will best be done using a phone that can multicast rather connect, transmit and disconnect to a single phone.

4. CONCLUSION

For many people irrespective of their cultural background, the mobile phone has increasingly become an important part of the technological landscape. Yet this technology has largely been used as a means of delivery mono-cultural media content to a world of passive consumers. The widespread availability of this technology allows it to impose a single system of tuning that evolved as western musical instrument makers gradually adopted a standardized system of tuning. By appropriating mobile phone technology as a medium for interactive musical performance interface we hope to allow communities of non-expert performers to experience the richness and diversity of microtonal music.

5. ACKNOWLEDGMENTS

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6. REFERENCES

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