Daisyphone: Support for Remote Music Collaboration

N. Bryan-Kinns
IMC Group,
Dept. of Computer Science,
Queen Mary, University of London,
Mile End, London, E1 4NS. UK.
nickbk@dcs.qmul.ac.uk

P. G. T. Healey
IMC Group,
Dept. of Computer Science,
Queen Mary, University of London,
Mile End, London, E1 4NS. UK.

ABSTRACT
We have seen many new and exciting developments in new interfaces for musical expression. In this paper we present the design of an interface for remote group music improvisation and composition – Daisyphone. The approach relies on players creating and editing short shared loops of music which are semi-synchronously updated. The interface emphasizes the looping nature of the music and is designed to be engaging and deployable on a wide range of interaction devices. Observations of the use of the tool with different levels of persistence of contribution are reported and discussed. Future developments centre around ways to string loops together into larger pieces (composition) and investigating suitable rates of decay to encourage more group improvisation.

Keywords
Music, collaboration, improvisation, composition.

1. INTRODUCTION
In this paper we are interested in support for a basic form of human creativity – group music improvisation [12]. Typically people still improvise music together by playing individual instruments in the same space. Examining the literature on new music devices (see, for example, [7]) it is clear that there is a growing body of work in new instruments such as the HyperBow [15] – a development of the conventional violin bow – and more unconventional instruments such as the control of music using Ultrasound imaging [13], or 'painting' as a musical metaphor [9]. However, developments which are explicitly concerned with how to support the creation and performance of music as a group (*e.g.* COOL [6], as opposed to individual composition support such as Audiopad [11]) are less common, especially when the group is not physically co-present (*e.g.* see Blaine and Fels survey of the area [1]). Such support is exemplified by systems which support group composition through sharing of music files *e.g.* FMOL [7] where a novel individual music controller is complemented by file sharing and on-line repositories. Supporting group music improvisation whilst players are remotely located is a difficult design challenge not least because the inherent network delays would make synchronous interaction very costly and technically complex. Typically these challenges are overcome by relying on improvisation with short loops of music which are semi-synchronously co-ordinated through some networking infrastructure – *e.g.* WebDrum [4] and MetaTone [8]. It is this less explored area that this paper focuses on – how to support people playing music together when they are not in the same space, and have limited network resources.

2. DESIGN
The instrument reported in this paper is part of ongoing research into mutual engagement in collaboration [2, 3, 10] and is referred to as Daisyphone reflecting its aesthetic and musical features. The primary design aim for Daisyphone is to provide a remote group music experience on a range of interaction devices and as such Daisyphone is built using Java 1.4.1 and uses default MIDI instruments.

2.1 Supporting Interaction
Daisyphone's interface is made up of four main elements illustrated in figure 1. First is the representation of the **musical loop** itself which takes up most of the screen real estate. Players click on the circles to set and unset notes which are played as the rotating grey arm passes over them as discussed later. Second is the modal **control** of the player's instrument and volume in the centre of the Daisyphone. Third is the **session selector** in the top left hand corner of the Daisyphone. Fourth is the continual **annotation** which takes place over the whole interface – when the player clicks using whatever interaction device they have, a graphical annotation is produced.

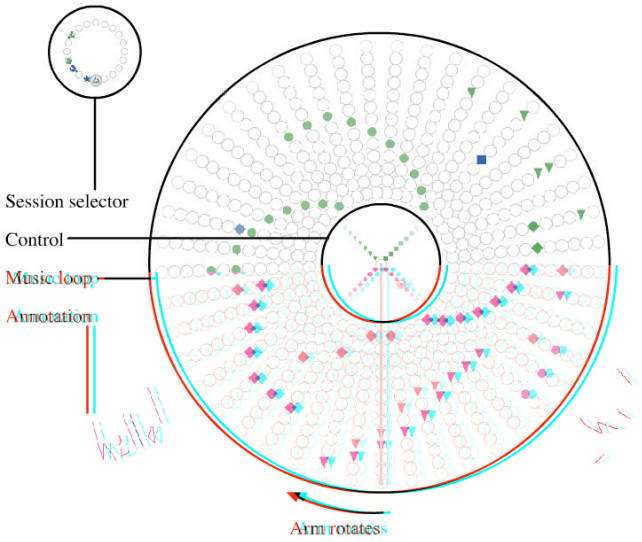

Figure 1: The Daisyphone user interface

2.1.1 Musical loop and modal control
The musical loop consists of 45 beats represented by spokes radiating from the centre of the Daisyphone. 45 notes were chosen in order to produce a symmetrical pattern of spokes around the Daisyphone whilst ensuring that notes were not too small to interact with. The notes on each spoke cover an octave

of MIDI notes in different instruments represented by different shapes. Notes range from MIDI 80 in the centre to MIDI note 68 at the outer edge. We decided to rely on default MIDI instruments so that Daisyphone could be used on a range of devices including tablet PCs, PDAs, mobile phones, home computers, *etc.* Whilst technology is developing to support richer sound production (*e.g.* Vector sound production for mobile devices) it is still proprietary and requires players to install plug-ins.

The player selects their current instrument and volume for composition from the central 4 spokes (modal control). Currently the default MIDI instruments of piano (circle), bell (square), glockenspiel (diamond), and percussion (triangle) are selectable. The volume of notes is indicated by the saturation of color – the more saturated, the louder the note is.

The visual design emphasizes the looping nature of the music created. When observing novice players using other interfaces for creating short loops based on a linear, horizontal timeline, we noted that the loops tended not to 'join up'. That is, they created a sequence of notes in which there was a noticeable break when the loop restarted. We hope that the circular representation will reduce this phenomenon.

We decided not to provide notes on a scale such as pentatonic which would have made it easier for novices to construct tuneful compositions. This was because we wanted to provide some challenge for people who had, or developed, musical skills.

2.1.2 Session selector

Currently 20 sessions are supported – these are selected using the session selector illustrated in figure 1. Each circle in the session selector contains a tiny representation of the content of that session. Furthermore, the content of the circle flashes when activity occurs in that session with the hue of the contributing player.

2.1.3 Annotation

Annotation in Daisyphone is continual and shared. Whenever a player presses with their interaction device (*e.g.* mouse, or pen) a mark is made and shared with others. Unlike notes, annotations are persistent which provides some history of action – when notes are set and then unset the small annotations created from setting and unsetting the notes remain. Figure 3 illustrates the use of persistence to illustrate the location of notes which have been deleted in the composition process. Note that in a typical 10 minute composition so many notes are added and deleted that the sequences become lost in a mess of annotations – some more effective design needs to be developed in this area.

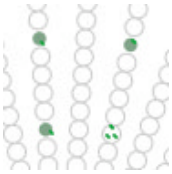

Figure 3: Persistence of annotation

2.2 Supporting Collaboration

Daisyphone uses a client-server configuration similar to that used by WebDrum [4]. Messages are sent from clients to the server and then, if appropriate, messages are broadcast to other clients. This provides semi-synchronous collaboration with low-bandwidth requirements.

In a previous study of the use of WebDrum we identified several features of human interaction which we believe are important to make the logistics of collaboration efficient and free-flowing [2]. The Daisyphone user interface is designed to visually support these features which are:

- **Identity** – knowing who is contributing what. In Daisyphone each player is assigned a unique hue which provides a form of identity.
- **Mutual awareness** of actions – knowing who is doing what. Each contribution by each player is shared with all other players through the server, the color of the contribution gives an indication of authorship, and the session selector provides some indication of what is going on in other sessions.
- **Mutual modifiability** – being able to modify each other's contributions. There is no edit control in Daisyphone so each player can edit any one else's notes simply by clicking on them.
- **Localization** – being able to easily reference parts of the joint product. The graphical annotation provides an intuitive localization mechanism *e.g.* circling interesting sequences of notes and writing comments next to them.

2.2.1 Client-server protocol

A proprietary text based protocol is used to support communication between clients and the server *via* TCP/IP sockets (illustrated in figure 4) – we are investigating migrating the protocol to more open protocols such as OpenSound Control [14] to make Daisyphone more generally usable and possibly co-ordinate it with other musical devices. Three categories of message are supported in the proprietary protocol: Notes (set, unset); Annotations; Session control.

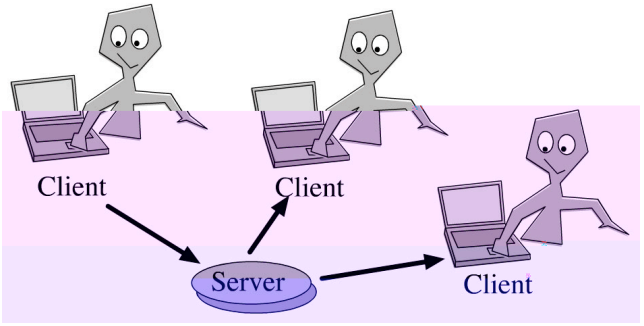

Figure 4: The Daisyphone client-server infrastructure

The server keeps a copy of all messages for future analysis and to support the persistence of sessions.

3. STUDY OF USE

Previous studies [2, 3] have identified several design issues with Daisyphone and its support for group creativity. In this paper we explore the nature of persistence in contributions. In pervious versions of Daisyphone all contributions were persistent. In order to investigate the effect of persistence of musical contribution, a new version of Daisyphone in which notes slowly disappear was developed (referred to as the decay version). Only the notes are transient, therefore the graphical annotation created when the notes are contributed remain providing some visual cues to the contributions. The rate of

decay of the notes is critical to the design – too quick and coherent sharing of music will not occur given the semi-synchronous nature of the infrastructure; too slow and the musical space will continue to became overcrowded. For the studies here, decay is created by halving the volume of notes every time the arm passes over them. This typically gives 3 plays of a loud note before it disappears which appears to be sufficient for co-ordination

3.1 Format

Ten post graduate students were set a piece of coursework in which they were asked to use both the persistent and decay versions of Daisyphone to remotely create music together over three weeks, perform their piece of music for the rest of the group, and analyze and report on the interaction that took place in Daisyphone in both versions. The students grouped themselves into 3 groups and had a wide range of musical ability. None had ever used a tool like Daisyphone before.

Logs of all actions in Daisyphone were stored for later re-play and analysis.

4. PATTERNS OF USE

This section outlines the patterns of use and behavior that took place in the study with the persistent and decay versions of Daisyphone. Initial analysis of logs are presented here – detailed analysis is currently being undertaken. An average of 8 sessions with the persistent version and 3 sessions with the decay version were recorded for each group. Each session lasted on average 16 minutes for the persistent version and 12 minutes for the decay version.

4.1 Patterns of Use with Persistent Version

As with ongoing analysis of the use of Daisyphone, in both versions the participants tended to spend the first parts of their sessions exploring Daisyphone on their own. Typically in the shared environment this meant working in a particular quadrant of the loop of music. Once participants were able to understand Daisyphone's interface they then moved on to working in other areas to develop longer tunes or contribute to other participants' work.

Interestingly, an informal role assignment developed when using the persistent version with participants tending to stick to one instrument. Moreover, a 'leader' tended to emerge during the sessions. This person typically constructed the main melody which was then supplemented by others in the group. Daisyphone has no explicit mechanisms or guidance for how to divide the collaborative effort, so we believe that we are starting to see here some emerging behavior which could give us insight into how to develop more engaging collaborations in the future. We suggest that role assignment emerges naturally and does not need to be explicitly built in to the interface *i.e.* in this case there was no need for ownership control of instruments as participants negotiated it themselves.

In pervious studies we noted that participants tend to write their name on Daisyphone. Given the ongoing nature of Daisyphone public trials, and the informal nature of other trials, we suggested that this name writing was a form of stating ownership - saying 'This is mine'. From post study discussion it became clear that participants were using their names as presence and authorship indicators – saying 'This is me'. We suggest that the emergent and conventionalized behavior of writing one's name on entry to a session indicates that the messy nature of the interface additionally supports the informal evolution of expressions of identity. To this end we do not believe that the introduction of explicit identity into the interface is necessary or worthwhile. Interface features such as pictures, textual names, *etc.* add an unnecessary layer of interaction (setup, login, and so on) which we seek to avoid in the development of informal, *ad-hoc*, serendipitous interfaces.

Participants reported being fairly relaxed about deleting other participants notes and making modifications to their contributions. This is in contrast to previous studies and ongoing public use where reluctance to edit others' contributions is evident. We suggest that this is due to the nature of the exercise set ('you must create a piece of music together for performance later') and the social situation (they all knew each other quite well and had possibly worked together before).

4.2 Patterns of Use with Decay Version

The use of Daisyphone with decaying contributions was not as engaging as anticipated. Participants complained that they could not keep up with the required contributions and that sessions tended to become unstructured and uncoordinated. Experience with Daisyphone as a musical instrument was a key factor in engagement with the decay version – the more experience participants had, the easier they found the decay version to handle.

When looking back over the logs of the interactions it is clear that in the version with decay participants tended to make musical 'gestures' rather than placing individual notes as they had on the persistent version. This is illustrated by the amount of annotation in figure 6 which reflects the creation of music through gesture rather than placing of notes as in figure 5. These gestures tended to be quickly drawn lines which could easily be replicated to keep the tune going. Perhaps providing an even more fluid form of interaction where gestures are interpreted around the Daisyphone would provide easier ways to create musical motifs in real time. It was also clear that the decay version required more focus on the music, and much less discussion of pieces, with participants having to keep musical motifs in their head in order to keep a tune going. In some ways this makes the decay version more akin to conventional group musical improvisation where typically the music and gestures provide for communication between participants as opposed to speech (text in Daisyphone).

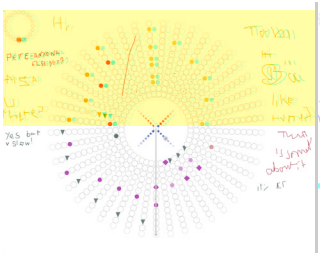

Figure 5: Persistence

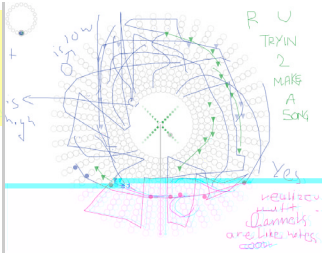

Figure 6: Decay

Persistence of annotation which provides some history of contributions did not prove as useful as anticipated as the proliferation of contributions meant that there were a lot of indications of old notes as illustrated by the mess of graphical lines in figure 6. Perhaps the sequence of contributions also needs to be indicated in some way.

Also, interestingly there was anecdotally more convergence of tunes between participants with the decay version *i.e.* they started to make similar tunes within a group more quickly than they did with the persistent version. This indicates that decay may encourage quicker convergence of musical patterns after a period of experimentation.

In terms of organization, participants found that with the decay of notes the division of labor was more egalitarian. That is, there was no longer the typical emergent leader of the piece, instead participants contributed what they could, with the tendency to converge quickly on a musical theme (if one could quickly be established).

Finally, from analyzing the logs it is clear that participants contributed notes more frequently with the decay version (*e.g.* one group made approximately twice as many contributions per minute with decay *versus* persistence). This is clearly because of the amount of contributions that are needed to keep a tune going when the notes disappear.

4.3 Implication of Decay for Design

The key implication with respect to the decay of contributions is that contributions should only start disappearing once people have learnt how to usefully make them. We had expected the converse to be true – that when contributions decay it would be easier to learn the effects of the interaction through experimentation. So, we suggest that in order for creative experiences to become more engaging people's contributions should become more transient as they become more experienced, whilst support for the logistics of collaboration remain constant *e.g.* mutual awareness of actions should not change. We can usefully relate this to Csikszentmihalyi's analysis of flow and its relation to skills and challenges [5]. In the case of Daisyphone we believe that with persistence people became bored of the interaction as the challenge was no longer sufficient for their skills, whereas with decay participants were initially anxious, but some did increase their skills enough to experience flow. We suggest that as people become more skilled with the interface the rate of decay should gradually increase so that the challenge is sufficient for a flow experience. Doing so would provide people with an experience of music in which their initial low skills are supported by persistence of contribution, so not being too anxiety provoking, whilst boredom is abated by increasing the challenge (decay). Moreover, we suggest that by keeping the collaboration support constant the participants will become more engaged with each other as well as the product at hand. We would expect to see more convergence of music, and hopefully more reliance on others' contributions in the joint production. Furthermore, we believe that the decay of contributions by skilled users could be usefully employed to engender mutual engagement in other group creative tools such as brainstorming, problem solving, and so on.

5. CONCLUSION

This paper presents observations on the use of a group music improvisation tool in two versions: one where musical contributions persist, and one where they decay. We suggest that allowing variable amounts of decay in an interface will allow the challenge of an interface to change to reflect the skills of participants and so hopefully more flow experiences will occur. Moreover, it will support increased engagement between people as indicated by more convergence and borrowing of other people's ideas. These are useful features for other creative applications.

Additionally, we feel that the 'messy' nature of Daisyphone provides a useful interaction metaphor which informally supports many aspects of the logistics of collaboration including identity, awareness, history, localization, and the development of communicative conventions. We argue that the introduction of explicit support for these features of group interaction is unnecessary and instead suggest that more messy support will encourage people to intuitively develop their own conventions.

6. ACKNOWLEDGEMENTS

Supported by Queen Mary, University of London and EPSRC grant GR/S81414/01. Thanks to all those who have taken part.

Daisyphone is currently hosted at: gouda.dcs.qmul.ac.uk

7. REFERENCES

[1] Blaine, T., and Fels, S. Contexts of Collaborative Musical Experiences. *In Proceedings of NIME-03,* 129-134, 2003.

[2] Bryan-Kinns, N., Healey, P., Thirlwell, M., and Leach, J. Designing for Group Creativity. *In Supplementary Proceedings of HCI International 2003* (Crete, 2003).

[3] Bryan-Kinns, N., and Healey, P. Daisyphone: The Design and Impact of a Novel Environment for Remote Group Music Improvisation. *Proceedings of DIS 2004.*

[4] Burk, P. Jammin' on the Web - a new Client/Server Architecture for Multi-User Musical Performance. *Presented at ICMC 2000.*

[5] Csikszentmihalyi, M. *Flow: The Psychology of Optimal Experience.* Harper Collins. 1991.

[6] Hankins, T., Merrill, D., and Robert, J. Circular Optical Object Locator. *In Proceedings Of NIME 02*, 2002.

[7] Jordà, S. (2001). Improvising with Computers: A Personal Survey (1989-2001). *In Proceedings of 2001 Int'l Computer Music Conference. La Habana.*

[8] Leach, J. *MetaTone: Shared Environment for musical collaboration*. MSc IT Thesis, Queen Mary, University of London. 2001.

[9] Levin, G. *Painterly Interfaces for Audiovisual Performance*. MSc. Thesis, MIT, USA. 1994.

[10] Marks, P. Will Jamming be the New Texting? *New Scientist, 180, 2418* (25 Oct 2003), 25.

[11] Patten, J., Recht, B., & Ishii, H. Audiopad: A Tag-Based Interface for Musical Performance. *In Proceedings of NIME 2002.*

[12] Sawyer, R. K. *Group Creativity: Music, Theater, Collaboration*. Lawrence Erlbaum Ass. 2003.

[13] Vogt, F., McCaig, G., Adnan Ali, M., Fels, S. Tongue 'n' Groove: An Ultrasound based Music Controller. *In Proceedings of NIME-02*, 24-26, 2002

[14] Wright, M., & Freed, A. Open SoundControl: A New Protocol for Communicating with Sound Synthesizers. *Presented at ICMC 97.* 1997.

[15] Young, D. The Hyperbow Controller: Real-Time Dynamics Measurement of Violin Performance. *In Proceedings of the 2002 Conference on New Instruments for Musical Expression (NIME-02)*, Dublin, Ireland, May 24-26, 2002.