DESIGNING INTERFACES FOR COLLABORATIVE MUSIC COMPOSITION

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Abstract

Advancements in technology, ranging from the decreasing cost of PCs and availability of broadband technology through to the spread of mobile computing technology, open up interesting possibilities in collaborative music composition. To-date technology approaches in this field have yet to fully explore all of the possibilities that new technology offers.

We believe, that for any advancements to be made in the area of collaborative composition, progress must first be made in the area of notation, for as Bamberger points out "Music notation is a complicated and non-intuitive representation of musical information and for many it is the point at which interest in learning music ceases"[1]. Some successful attempts to overcome the limitations of notation have been based upon informal GUIs and Papert's idea of a microworld[2]. These systems give the user a chance to build and explore musical concepts in a more intuitive way than with formal notation. Examples of these are Hyperscore[3], Impromptu[4] and DrumSteps[5].

This paper focuses on the tradeoffs in educational functionality that must be made in order to meet the technical challenges presented by deploying software of this kind in different domains. This paper looks at how to tailor one of these composition microworlds, DrumSteps, for use on various platforms that are suitable for collaboration. The paper will outline the design of a version for use with handheld computers. Following which the paper will outline the design of two versions of the software that are suitable for deployment over the internet to be used in asynchronous collaboration environments. In each case we will discuss the trade offs in educational functionality that had to be made to facilitate the new technology.

Keywords:

music education, collaborative learning, interactive learning environments, interface design

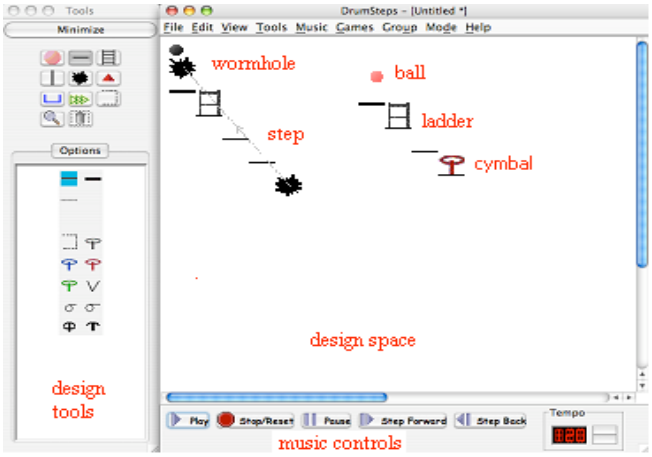
COLLABORATIVE MUSIC COMPOSITION

As far back as 1970 the League of Automatic Music Composers realised the potential of ICT to facilitate group composition when they used computers to aid composition on a local network[6]. However since then there has not been as great a volume of work in collaborative composition as there has been in other educational areas, like the sciences. One reason for this is the reliance on musical notation. The current environments that tailor for composition require the student to have a solid grasp of musical notation before they can take part in the collaborative process. As Bamberger states "*notation is a complicated and non-intuitive representation of musical information and for many it is the point at which interest in music learning ceases*"[1]. But until recently this has been the only available way to compose music. Researchers such as Reese (Netcomm)[7], Cosenza, & MacLeod (the Vermont Midi Project)[8], Hickey (Micnet)[9] and Burk (TransMidi)[10], all make use of formal notation packages such as finale or cubase to compose music collaboratively. Composition in these environments is only open to those with the required skills with notation. This creates an unfortunate barrier to participation for novice learners. They also use a limited model of collaboration, namely file exchange via email or an internet drop box.

However there has been some successful research into how to overcome the notation barrier and open up composition to novice learners. These projects have been based upon informal GUI approaches and Papert's idea of a microworld. Tools such as Hyperscore[3], Impromptu[4] and DrumSteps[5] enable learners to build and explore musical concepts in a more intuitive way. Hyperscore enables users to compose by drawing lines. These lines are associated with simple motifs and the lines can be adjusted to cause different musical effects to the particular motif. With Impromptu users compose music using small blocks of music or "chunks", while

DrumSteps enables users to compose and play back sophisticated percussive scores using a metaphor of dropping balls down sets of steps. We argue that these tools could be used as the bases for a collaboration environment that would benefit even novice learners.

One of the tools listed, DrumSteps, is the result of our previous work on music composition.



The different elements are labeled on the left. The balls embody one of 36 different percussive sounds or timbres.
By hitting play the balls fall down the steps and make the appropriate sound when they hit a step, steps can be seen as the basic unit of the beat.
Ladders subdivide the beat further.
The Wormholes enable users to loop sections, when a ball enters one wormhole it will remerge from its partner wormhole.
On the left is the design tools area, currently showing is the different cymbals and whistles that can be placed on a step. These will then be triggered as the ball rolls past or falls on them.
For a more detailed description refer to DrumSteps - A Constructionist Approach to Music Learning[5]

Figure 1 DrumSteps

By constructing these sets of steps children can compose original works of percussion without the use of either an instrument or standard notation. The step structure itself embodies an intuitive notation system that is based on the simple world knowledge that the ball will fall down the set of steps. This enables all levels of learners to engage in a constructivist exploration of music composition. The software separates editing and listening to encourage procedural thinking and a reflective process. It facilitates all the necessary elements of percussion; pulse, tempo, timbre, texture, syncopation and accent. DrumSteps has proved very successful. It is freely available for download and has been used in Ireland, the UK and Singapore, in a variety of classroom settings and outside school workshops.

Collaboration

Collaboration has proved very beneficial to learning in other areas but as we have said earlier it is less developed in the field of music composition. We have argued that this is because of the barrier that notation can present to novice learners. We want to investigate the potential of a tool such as DrumSteps, which requires no knowledge of notation, to facilitate collaborative music composition. We built upon three existing models of collaboration; shared workspace, file exchange and knowledge building communities.

Our initial investigation of collaboration was Networked DrumSteps[11]. It is based on a shared workspace paradigm and enables two or more users to share the design space and work together on a composition in real time. It provides a text chat facility for communication. This approach has proved modestly successful. Our research has shown that "*Networked DrumSteps provided for positive interdependence among students, as well as scaffolding behaviour that promotes the learning and success of each member.*"[11]

Collaboration through file exchange enables users in different locations to access one another's work. Typically it is achieved using email or an internet drop box, as with the existing collaborative music composition environments. We decided to explore a slightly different route. Handhelds could provide a more personal face-to-face method of exchanging file using the devices infrared technology. However first we had to develop the software so that it runs on a PDA.

"Knowledge building communities" provide a pedagogical model that has been successful in other areas, like the sciences[13]. They encourage children to participate as active members of a community that is discovering its own knowledge. The process used is similar to that of a research community where participants present their ideas and the community reviews and refines them or uses the ideas as a starting point for new ideas. These communities are typically deployed through a web browser and users present their ideas using text and

graphics. In order to present musical ideas within these communities the browser need to be able to display and enable editing of this new type of information.

To further examine our ideas on collaborative composition we needed to first redevelop the application for these two domains without losing too much of the educational design that enriches the application. This paper looks at the design tradeoffs that had to be made in order to develop DrumSteps on these domains.

DEVELOPING DRUMSTEPS FOR THE HANDHELD

There has been much activity to harness the potential of handheld PCs to aid learning. Researchers have looked to make use of the device's mobility and communication features to create interesting group collaboration environments. Apart from pedagogical issues one also has to overcome the handhelds specific limitations when design useful learning applications. These machines have a much smaller screen and are of a lower specification than a PC.

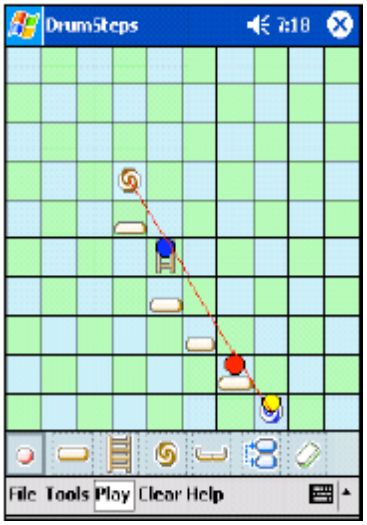


Figure 2 PDA Interface

We created an application that was as similar to DrumSteps as the device permitted. We had to sacrifice the amount of design space available due to the small screen size but the area available would still facilitate pieces consisting of 2-3 small parts and the touch screen proved a very intuitive way of placing the steps. Our interface included all the necessary elements balls, steps, ladders wormholes and trapdoors. We were also able to successfully share pieces between two handhelds using the infrared technology.

However we ran into considerable problems with the devices lack of ability to generate audio dynamically. The Handhelds currently available come with very basic soundcards that do not support the playback of midi data. As a result the processing of the sound needed to be done in software. As the devices themselves are of limited specification this proved too strenuous a task. What we have achieved is a tool that consists of just four different timbres to be used with the balls and lacks support for elements such as triggers, syncopation and accents. There are also less variation in the choice of ladders and only three variations on tempo. All of these problems are related to the lack of sound generation options on the device.

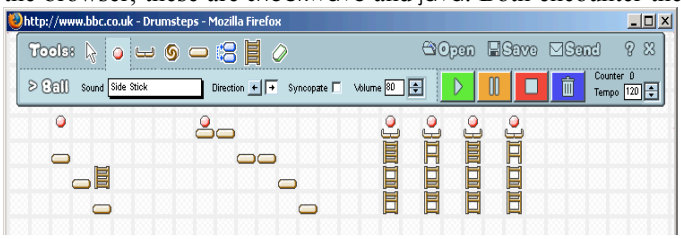
In this case, the educational tradeoffs have been great. Students who used the application enjoyed the interface and were successful in sharing composition. But as it currently stands the technology is probably not ready to facilitate this type of software. The key element that is missing is a means to create audio dynamically. This may well be added as the technology continues to develop.

DEVELOPING DRUMSTEPS FOR THE INTERNET

Asynchronous collaboration has been used in many fields of education and there are various models of collaboration that we could follow. With the existing software it would be possible to facilitate the type of file exchange based collaboration seen in other collaborative composition environments. Instead we have chosen a knowledge building community model as outlined earlier. This necessitates that DrumSteps be accessible within a web browser.

Redesigning PC applications for use in a browser presents us with a number of challenges. There is less screen space available within the browser window, the application will be downloaded each time so it needs to be smaller to minimise download times and applications on the internet are restrained by certain security restrictions that prevent them from saving files and other activities that could prove harmful. To meet these challenges necessitates a trade off in some of the applications existing educational functionality.

We have looked at two different technologies that would enable us to embed an application of this type within the browser; these are shockwave and java. Both encounter the same three problems outlined. The workspace or "design space" is of primary importance to a microworld such as DrumSteps. It is important to give the users ample physical space to enable them to express themselves fully. The interface from Fig. 1 has been redesigned to maximise the available design space but still grant easy access to al of the main interface elements. Fig. 3 shows the two slightly different interfaces, across the top of each has been added a single tool area, which combines all the interface elements of the original interface into a much smaller space. This redesign has greatly reduced the amount of screen space that we have lost. It was also possible to include a scrollable area with the java version thus offering as much space as was desired. This was possible due to the more sophisticated programming environment that java provides over shockwave.



The lack of screen space and the need to create smaller sized applications has also required us to trade of other educational features of the DrumSteps software. We have removed all of the non-core functionality such as the collections feature, the favourites feature and the additional games. These features add extra support and functionality to the application but removing them does not prevent the user from working with DrumSteps. Additionally for the shockwave version we also had to remove the various editing features such as copy, paste and undo support. Both applications are now of an appropriate size and load in a timely manner. The shockwave version loads the faster of the two.

We have overcome the small screen size and we have removed some extra features that were designed to enhance the educational value of the application. There still remains one problem to overcome. In order for the software to be useful it is important that the children can save their compositions and reflect on them at a later date. However for security reasons applications deployed over the web are not permitted to save to the local hard disk.

To overcome this we have used two slightly different approaches. The shockwave environment permits saving of small amounts of data on the local hard disk, however it only permits text files and only within the software's folder structure. This enabled us to permit the user to save five pieces on their computer.

Java provides no such facility but it does have a richer programming environment, which enables us to save files to the host server rather than the local machine. This ability will also be required when using the tool as part of a knowledge building community. If we create our own protocol for sharing files then the firewall software found in most learning institutions would need to be reconfigured to allow this communication complete. Instead we have chosen to use the HTTP protocol to share our files with the music composition forum. This is the same protocol that is already in use for standard web access. As a result it does not suffer from the same firewall problems. We can simulate a file upload from a normal web site by wrapping our file in a RFC1867 message. Our server is configured to deal with this type of HTTP message and save the file for the user.

The completed applications have had to drop some of the educational functionality and there has been some redesign work in order to meet the technical limitations of deploying applications on the internet. But they still enable novice learners to compose original works of percussion and contain all of the elements that have made DrumSteps a successful microworld. It can now be incorporated in to a wider collaboration environment to facilitate asynchronous collaboration.

The shockwave version has been included as part of the BBC education website[12] and it enables simple file exchange collaboration via email. It has been the focus of multiple nationwide composition competitions. With the winning pieces being played by the BBC Manchester orchestra. The java applet version has been included within a large knowledge building community environment and has been rolled out on the new village network for the Intel computer clubhouses. This environment provides users with the tools to save their musical ideas for others to review and refine. The system also provides a graphical visualisation of the derivations of a piece over time.

CONCLUSION

When developing software, like DrumSteps, for use with different technologies it is important not to lose sight of the original educational benefits of the software. Different technology will naturally require different approaches to how the software functions but this should not be at the expense of the educational value of the software.

In the case of DrumSteps, the handheld version of the software had sacrificed too much functionality to make it a worthwhile educational tool. As handheld computers improve it will hopefully become possible to improve the music processing abilities of DrumSteps on the PDA. It should also be possible to combine the handheld version and the asynchronous version so that users of the handheld device could participate in the knowledge building community.

On the other hand the version developed for the internet retains the key educational features and we now hope to investigate its potential to facilitate collaborative learning. It has been used as the corner stone of a new knowledge building community and has been rolled out on the new village network for the Intel computer clubhouses. Here users of the many clubhouses worldwide have access to the applet version of DrumSteps. We will perform an evaluation study concentrating on how the asynchronous features were used when the project has taken off.

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