MidiGrid: Past, Present and Future

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ABSTRACT

MidiGrid is a computer-based musical instrument, primarily controlled with the computer mouse, which allows live performance of MIDI-based musical material by mapping 2-dimensional position onto musical events. Since its invention in 1987, it has gained a small, but enthusiastic, band of users, and has become the primary instrument for several people with physical disabilities. This paper reviews its development, uses and user interface issues, and highlights the work currently in progress for its transformation into MediaGrid.

Keywords

Live performance, Computer-based musical instruments, Human Computer Interaction for Music.

1. INTRODUCTION

The MidiGrid project was an experiment to investigate the design of a new computer-based interface to electronic tone generators. It was started at the University of York UK in 1987, and has been developed in stages since then [1][2][3]. MidiGrid has been used by a wide range of people (composers, schoolchildren, and special needs teachers and their clients) and its use has raised several important issues relating to the design of interactive musical systems. A summary of its key features is now given, followed by a discussion of the issues that arise from its use.

2. THE MIDIGRID CONCEPT

Many computer programs with mouse control exist to allow musical information to be stored and edited on a computer, rather like a musical word processor. These programs are often called (sequencers, editors) as they enable people to build up sequences of music, track by track, usually in non-real time.

In contrast MidiGrid allows users to trigger musical material freely in real-time using the computer's mouse. As shown below, the screen shows a grid of boxes, each of which contains a nugget of music that is triggered as the mouse cursor moves over it.

Hand gestures are thus converted, via the mouse, into notes, chords and musical sequences.

The range of movement can be customised so that more or less of the user's physical action can move the mouse cursor around the grid. The grid can be set up in advance to consist of any number of boxes containing any musical material (including that played in from a keyboard).
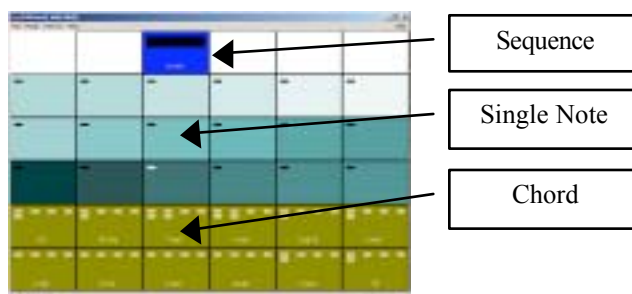

Figure 1. Main MidiGrid performance screen (PC version) showing sequences, single notes, and chords.

The grid can be shaded to separate different areas of notes, for example (in figure 1, above) some areas consists of melodic notes whilst others contain chords (denoted by more than one dot in a grid box.

In fact, the grid can be arranged to allow an assortment of instrumental sounds to be present on the screen. Thus the user can freely explore several timbres by moving the mouse to different areas of the screen. Anything that is played on the grid can be recorded and placed into a box of its own as a sequence. Further recordings can be made which involve sequences, and thus complex layers of musical material can be rapidly constructed.

2.1 Customizing the grid for performance

The grid is of a user-definable size and shows the musical contents of each box by simple graphical representations of notes and sequences. Thus the layout of the cells can be customized for each player, performance or musical use. The grid pattern shown in Figure 2 contains many shaded areas, each containing sound elements on different timbres.

The player sweeps a cursor (using the computer mouse) around the screen and notes are triggered when the mouse buttons are pressed. Consequently identical gestures produce identical musical results, but these gestures have to be learnt and rehearsed by the player.
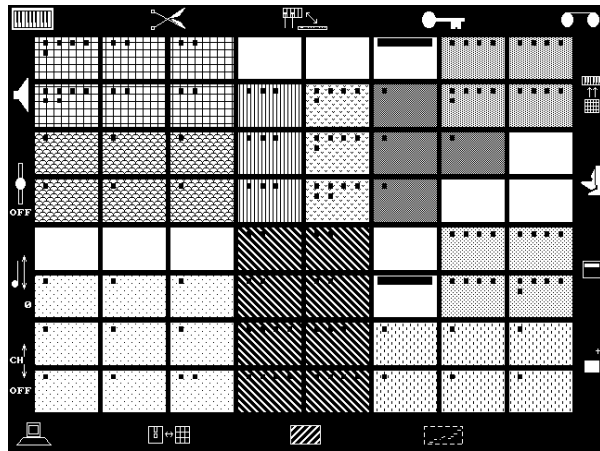
Figure 2. Grid pattern showing a variety of shaded areas (Atari version), each containing a different timbre.

The system uses the MIDI protocol for controlling notes on an external synthesiser or sampler. Versions of the software since 1990 have allowed a variety of MIDI continuous controllers to be sent in response to mouse movement. The effect of this is to permit much more subtle forms of musical control using gestures to bend the pitch, sweep the panning position and swell the volume, using the same gestural input to choose and control the notes.

2.2 External Control

Other MIDI instruments (e.g. electronic keyboards, drums or wind controllers) can be used to trigger the musical material in the boxes, so - for instance - notes on a keyboard can be used to activate several pre-recorded sequences of music. This feature allows MidiGrid to be 'remote-controlled' by any other MIDI-compatible device. This has yielded some of its most interesting uses over the years, as it moves the player away from the computer terminal and allows them to concentrate on a physical performance interface. One of the more popular configurations has become known as 'Carpet-Grid'[5].

MidiCreator [6][7] is a device which converts the various signals from electronic sensors into MIDI. Based on a music technology student's project, it was subsequently developed by the York Electronics Centre, the commercial arm of York University's Electronics Department. Assorted sensors are available which sense Pressure, Distance, Proximity, Direction etc. These are plugged into the front of the unit, which can be programmed to send out MIDI messages corresponding to notes or chords. Thus movement is converted to music.

When a grid of pressure sensors is placed on the floor a 'carpet-grid' is formed. Each pad can trigger a note on a specified instrumental sound. When these notes are routed through the abovementioned MidiGrid software, entire musical sequences can be triggered from different areas of the floor. This forms a fascinating 'floor-based' instrument which people of moderate movement can explore. In some cases people have driven their electric wheelchairs over it to achieve the same effect.

2.3 MidiGrid version history

MidiGrid's original and most fully developed platform was the Atari ST. During the 1990s a series of ports were made to the PC platform and the most stable of these is available for a trial download from www.midigrid.com. This version does not have the comprehensive real-time controller implementation or piano-roll editing of the Atari version, but embodies most of the main grid-cell features for live performance of MIDI material.

2.4 Context: Computers in Live Performance

Since the introduction of digital computing technology to the art of music in the late 1950s, there have been several strands of research which use the computer as a performance instrument. The most common thread is the addition of a specifically designed control interface. Axel Mulder [16] and Joe Paradiso [17] each describe the various forms that these devices tend to take – mostly in emulation of existing acoustic gestural models, such as wind interfaces, keyboards, guitars or conducting devices. They also note the less familiar concept of the using the computer's native interfaces (specifically the mouse and the keyboard) as live performance tools.

A number of systems have been developed over the last fifteen years for using the computer mouse as a means of triggering and controlling real-time sonic material. MidiGrid is one such system, so is Music Mouse[4] (see section 2.4 below). Other systems which use similar paradigms include Fleximusic [18] (allows keys to trigger sound and MIDI files), and MousMuso [19] (mouse is used to strum virtual melodies and harmonies). More recent systems use the concept of pre-packaging musical material into a form ready to be triggered in live performance, but using a specially designed physical interface. A particular example to note is the BlockJam project [20] which uses a graspable block-structured interface to allow several users to trigger audio samples and algorithms in real-time, with graphical and tactile feedback.

2.5 Music Mouse

Comparisons have occasionally been made between MidiGrid and Laurie Spiegel's Music Mouse [4]. This is hardly surprising since both pieces of software were developed (in different continents!) at about the same time, and both allow the user to move the mouse to make real-time musical improvisations.

However, the programs and the concepts are quite different, and I have discussed this with Laurie some years ago and more recently during the production of this paper. Music Mouse uses a level of 'intelligence' to provide an interactive environment within which users can improvise using different mouse gestures.

In contrast MidiGrid provides no interpretive intelligence; the boxes (and the musical material contained within) are simply triggered when the cursor passes over them or the mouse is clicked on them. So, MusicMouse 'joins in' your improvisation, whereas MidiGrid simply reproduces the stored musical material on demand. You probably have to work harder with MidiGrid to create a coherent sounding polyphony.

Despite these differences, Music Mouse and MIDI Grid do share something that has turned out to be far less common among music programs than might have been expected by either of their authors when these programs were first created. A core value of both is the satisfying immediacy of sound responding directly to human movement and touch that has been central to most successful human interfaces to musical sound for millennia. Both programs place the computer in the role traditionally given to musical instruments, rather than seeing the computer as a tool for storage and editing of materials to be played subsequently via some other instrument[26].

3. USES OF MIDIGRID

MidiGrid has been used by a variety of people from many walks of life. Whilst it has been used for triggering sequences and notes in live electroacoustic performances, it seems to have found its niche with people who benefit from the pre-storage of musical material – yet under live performance control. Many of these users have been people with physical disability as the mouse movement and grid layout can be customized to suit individual gestural capacity.

3.1 Music Therapy

Music Therapy is an increasingly popular form of clinical practice which engages client and therapist in dynamic interaction without necessary recourse to words, by involving the power and universality of music. Gary Ansdell, in the book "Music for Life"[22], describes the main function of Music Therapy as being for the therapist to hear, respond and answer, while the client experiences being heard, being responded to and being answered. *"The aim of Creative Music Therapy is to benefit people by giving them access to a creative music relationship within a sustained and dependable therapeutic context"*[22].

Many of the branches of Music Therapy make use of improvisation sessions involving both clients and therapist. It is therefore important that the client has access to a device which enables real-time musical interaction. Traditional acoustic musical instruments are customarily used, but cause problems when clients have restricted movement or weak muscles. This is where the use of electronic-powered music technology devices becomes important. Surprisingly little work has been done to provide technology in such an improvisational context for therapy, but Phil Ellis has been working with the direct use sound for such purposes for a number of years[23][24]. Fitzwilliam describes some of the potential of electronic technology, along with several practical reasons why technology has not been as popular with music therapists[25]. Most of these relate to the overt technicality (wires, menus, programming, setting up) that seem to be required by many electronic instruments, in contrast to the simplicity and directness of an acoustic instrument.

In Music Therapy, MidiGrid has been used [7][8][9][10] to allow free improvisation on a palette of sounds. The sounds have been pre-chosen by the therapist to constrain the musical material to a particular genre, tonality or timbre set. This has allowed access for people with limited movement to trigger self-consistent performance material. One of the outcomes is that where several acoustic instruments are used in the same piece aswell, MidiGrid can be effectively 'pre-tuned' so that, for example, it is in the same tonality as the chime bars. This enables groups of musicians to play together.

MidiGrid was built into the mobile Music Therapy van, devised by Mary & Raymond Abbotson [11] and used as part of the North Yorkshire Music Therapy centre's service in the UK over a number of years.

Outside of clinical Music Therapy, MidiGrid has been used on a number of occasions to allow people with limited movement to access musical material in an immediate way.

Figure 3 shows a grid pattern that consists of a web of individual notes which form scales (when played up and down) and arpeggios (when played across).
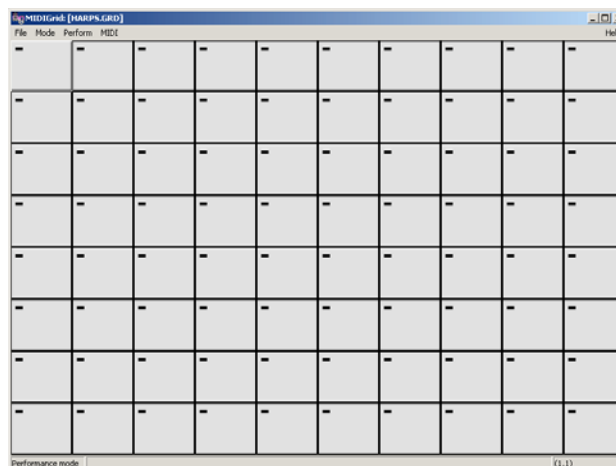

Figure 3. Grid pattern containing harp notes arranged in arpeggios and scales.

A harp-like sound is used, and flurries of notes can be easily generated by gentle mouse movements. In a series of tests in the children's centre at York District hospital, a 2 year old blind girl with severe learning impairment moved the mouse rapidly and even began talking to it. Therapists noted that this was her longest recorded concentration span without one of her regular seizures.

In a concert by the Drake Music Project [21] several people with movement difficulties each played a MidiGrid as part of a live performance with conventional (professional) musicians at London's Millennium Dome. For some people, MidiGrid has become their primary instrument, the tool that has enabled them to contribute to the musical world.

4. INTERACTION ISSUES RAISED

Several issues have emerged from personal experimentation with MidiGrid and from watching others performing with it. These issues have implications for the design of computer instruments and of new forms of interactive human computer interfaces in general [12].

4.1 Learning an instrument

Players of musical instruments have always required considerable dedication and commitment to hard work and rehearsal in order to learn how to play well. During the difficult times, particularly at the start of this process, it is the inspiration of watching an accomplished musician perform on the instrument that provides the motivation for continuing to practice for long periods of time.

Therefore we should assume that if a computer interface demands more than a surface level of operation, users should be expected to spend long periods of time learning the dynamics of how to 'drive' it. Many computing interfaces are, however, based on the assumption that users do not need to learn it, since they navigate the menu system and interpret accordingly each time they want to access a certain function.

4.2 Configurable Instruments

MidiGrid can be customised by the user to produce individual grid patterns of different size and complexity, containing whatever layout of performance material is required. This flexibility of configuration has been responsible for MidiGrid's successful use in schools and for various Music Therapy situations. Teachers and therapists can devise, restrict or expand the musical material that is available

to the end-user. In doing so they form customised musical environments where the tonality, instrumentation and physical layout of the notes (and thus the type of hand gestures used to play them) are defined for a particular music/client combination.

However, there is a danger that players will never learn to control the instrument beyond a surface level of exploration because the 'goalposts are constantly being moved'. Players of traditional acoustic instruments undergo a good deal of configuration themselves in the process of learning to control their instrument! Generally, if we allow system interfaces to be continually reconfigured, we are perhaps in danger of removing any reason for human operators to work hard at learning to control the system interactively. We should perhaps set up an instrument for a particular situation and then always use that configuration with that particular situation. After all a cymbal or a drum does not change its character from one session to the next.

4.3 Necessity of graphics for musical instrument control

One aspect of a developing control intimacy shown by a traditional instrumentalist is a decreasing reliance on visual cues.

"Novice users of MidiGrid frequently request that material be annotated so that they may remember the location of material within the grid. This is analogous to the labeling of a piano keyboard with the letter names of the notes on the stave. Observation of competent pianists will quickly reveal that they do not even look at their fingers, let alone any annotation which may be associated with the keys". [3]

As users develop their musical performance ability on a particular instrument, they rely increasingly on tactile, audio and kinaesthetic feedback, and less on graphical information. Therapists cannot be expected to constantly stare at a computer screen in order to operate the program without breaking the concentration and eye contact that is so vital for effective musical communication. However, there is also a general lesson here for the designers of human-computer interfaces in high-performance systems; graphics are a useful way of presenting information (especially to beginners) but are not necessarily the primary channel which humans use when they are fully accustomed to the system.

4.4 'Performance Mode'

When users are performing with MidiGrid there is no 'dialogue' between user and computer, instead the computer responds instantly to the user's hand movements. The computer does not set the agenda or dictate the conversation or insist the users select from a set of predefined options, but instead provides an environment for creative exploration. This is very close to the concept of 'flow', coined by Mihaly Csikszentmihalyi [27], where users experience a continuous stream of enjoyable and creative activity for its own sake.

This mode of operation is very different to the conventional means of communication with a computer. Traditionally the software is there to gather data, and often does so by dominating the interaction. Even in those situations where the user is fully in charge of the interaction, it usually takes place at a certain level of language ability (for example, the need to read, interpret and take action on hierarchically arranged menus).

5. THE FUTURE OF MIDIGRID

It is a strange feeling to have produced an experimental instrument, moved on to other things, then to regularly hear about the 'new life' that the instrument has in other people's hands. So recently, once again, we have returned to the design table, and are reconsidering how MidiGrid should evolve in the 21st century. Two major new projects are planned, and are currently in their early stages.

5.1 MidiGrid on a PDA

Work is underway to produce a portable version of MidiGrid that will run on a Portable Digital Assistant (PDA). The ready availability of a touch-sensitive screen in a portable device would enable a miniature version of MidiGrid to be used on the move, and very easily in concert situations. We are currently experimenting with various devices and operating systems, and at the time of writing have a simple grid which responds to the touch-screen. An artist's impression of the final product can be seen below in Figure 4.
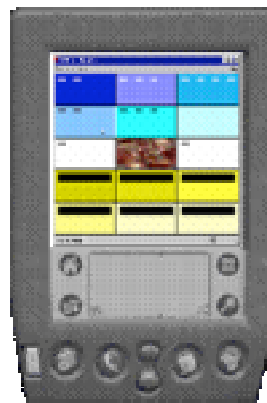

Figure 4. Artist's impression of MidiGrid on a PDA

5.2 MediaGrid

There is a natural progression for MidiGrid to be developed into a device capable of allowing live performance of pre-stored multiple media material [13]. The speed of today's PCs makes this perfectly feasible. What is interesting is to speculate on its uses. Imagine a touch-screen (or a mouse-control) on which there is a grid. As the grid is touched images appear on a screen, or soundfiles play, or movie snippets begin. Other boxes control the evolution or transformation of the material.

Though this project is in its infancy, we are excited by the possibilities of having a simple two-dimensional mapping of finger/hand position to animation clips, graphics, sounds, and the original MIDI-based notes, controllers and sequences.

MidiGrid continues to be used and developed, and has prompted a good deal of discussion and research into the role of mapping for live performance control [14][15].

6. REFERENCES

[1] "MIDIGRID - A new musical performance and composition system", A Hunt and PR Kirk Proceedings of the Institute of Acoustics 1988

[2] "MIDIGRID - An innovative computer-based performance and composition system", A Hunt & PR Kirk Proc. International Computer Music Conference 1990 pp127

[3] "MidiGrid - A computer-based Musical Instrument", Andy Hunt & Ross Kirk, Journal of the Institute of Musical Instrument Technology, Vol. 1 June 1994 pp 3-13

[4] Laurie Spiegel's "Music Mouse" software: http://retiary.org/ls/programs.html

[5] "The Role of Gesture in Environmental Control", Ross Kirk , Andy Hunt, Mark Hildred and Adrian Verity, Proc. EuroMicro Conference 2000, vol II, pp 377-381, Maastricht, September 2000.

[6] MidiCreator website: www.midicreator.com

[7] "Computer Music in the service of Music Therapy: The MIDIGRID and MIDICREATOR systems", M & R. Abbotson, PR Kirk, AD Hunt, A Cleaton, Medical Engineering Physics, Vol. 16, May 1994, pp. 253.

[8] "Enabling Musical Performance in Therapy: The MIDIGRID and MIDICREATOR systems", M & R. Abbotson, PR Kirk, AD Hunt, A Cleaton Proc. 11th International Congress World Federation of Occupational Therapists, April 1994.

[9] "Technology in the service of Music Therapy", M & R. Abbotson, PR Kirk & AD Hunt, World Congress of Music Therapy. July 1993

[10] "Music Therapy and Electronic Technology", Andy Hunt, Ross Kirk, Mary Abbotson and Raymond Abbotson, Proc. EuroMicro Conference 2000, vol II, pp 362-367, Maastricht, September 2000.

[11] "MIDIGRID - in the Mobile Music Therapy Unit", PR Kirk, AD Hunt, M & R Abbotson World Congress of Music Therapy, April 1991

[12] "Radical user interfaces for real-time control", Andy Hunt & Ross Kirk, Proc. EuroMicro Conference 1999, vol II, pp 6-12, Milan, September 1999.

[13] "Graphical Performance Interfaces for Computer Music Systems", Ross Kirk, Andy Hunt. EuroGraphics HCI conference April 1993 pp. 103

[14] Radical User Interfaces for real-time musical control, Thesis by Andy Hunt, University of York, 2000. Available on-line: http://www-users.york.ac.uk/~elec18/download/adh_thesis/

[15] "The importance of parameter mapping in electronic instrument design", Hunt, A.D., Paradis, M. & Wanderley, M., Proc. Conf. New Instruments for Musical Expression, Dublin, May 2002.

[16] "Virtual Musical Instruments: Accessing the Sound Synthesis Universe as a Performer", Axel Mulder. Available on-line at: www.cs.sfu.ca/~amulder/personal/vmi/BSCM1.rev.html

[17] "Electronic music interfaces: new ways to play", Joe Paradiso, IEEE Spectrum Magazine, Vol. 34, No. 12, Dec. 1997, pp. 18-30. Available on-line at: http://www.spectrum.ieee.org/select/1297/muse.html

[18] Fleximusic: http://www.fleximusic.com

[19] MousMuso: http://www.busker.net/mousmuso/mm1.html

[20] BlockJam: http://www.csl.sony.co.jp/IL/projects/blockjam/index.html

[21] Drake Music Project: www.drakemusicproject.com/

[22] Ansdell, G. "Music for Life – Aspects of Creative Music Therapy with adult clients", London 1995, ISBN 1-853-02299-3.

[23] Ellis, P. & Dowsett, R. (1987) MicroElectronics in Special Education British Journal of Music Education 4 (1), 17-23.

[24] Ellis, P. (1997) 'The Music of Sound: a new approach for children with severe and profound and multiple learning difficulties' (British Journal of Music Education, vol.14, no.2) 4.

[25] Fitzwilliam, A. (1988) An Assessment of the Benefits of Micro Technology in Music Therapy Journal of British Music Therapy 2 (1), 24-3.

[26] Laurie Spiegel, personal correspondence with the author.

[27] Csikszentmihalyi, M., "Beyond Boredom and Anxiety: Experiencing Flow in Work and Play (1975; reprint, Jossey Bass Wiley; 2000 ISBN: 0787951404).