'Composability': widening participation in music making for people with disabilities via music software and controller solutions

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ABSTRACT

This paper discusses ways of enabling visually impaired and physically disabled people to compose and perform music.

The usage and adaptation of existing software-based composition systems are described, in the context of education work undertaken by the Drake Music Project - a charity which aims to facilitate disabled people in making music via technology. Some of the problems faced are discussed, and a custom system presented which aims to resolve some of these difficulties.

KEYWORDS

Music, Physical Disability, Visual Impairment, Composition, Education, Software, MIDI, Adaptive Technology.

INTRODUCTION

Disabled people who want to make music may need to be assisted in various ways by a computer-based system to compose, perform or improvise. Computer software can enable a disabled person to enter and manipulate musical material which may then be played. In addition, systems may enable even a severely disabled person to perform live by triggering or selecting pre-prepared material, or other processing of the performer's control input.

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Another of the problems faced by disabled people wanting to make music is their inexperience in playing a musical instrument. This can often mean that such people lack an intuitive 'feel' for musical shapes and structures (e.g. of pitch, harmony and rhythm) which is typically built up over a period of playing an instrument.

BACKGROUND - CURRENT USAGE OF EXISTING SYSTEMS BY THE DRAKE MUSIC PROJECT

The Drake Music Project (DMP) is a charity - established in 1988 - whose main ethos is to facilitate music-making for physically disabled people through the use of music technology (Smith 94). It runs regular music workshops UK-wide for disabled people, along with residencies, touring workshops (often culminating in performance), taster days, and educational in-service training. Its activities also encompass research, development and assessment of systems to facilitate disabled access to music making.

During DMP workshops the tutors not only teach music through group and individual sessions, but spend time determining the appropriate equipment and hardware interfacing for each person to use most effectively.

The emphasis is on utilising easily available 'off the shelf' products wherever possible. MIDI controllers are in regular use during workshops: these include keyboards (with standard or miniature size keys), percussion pads, spatial position detectors (eg. 'Sound Beam', 'Midi Gesture'), and movement to MIDI converters (eg. 'Midi Creator') utilising various switches, sensors and transducers.

As well as triggering individual sounds (from synthesisers or samplers), a MIDI controller can be used (with appropriate software such as 'MidiGrid' or 'Max') to initiate, select or step through pre-prepared chords or sequences of notes. The MidiGrid software also allows computer mice, trackerballs, and joysticks to be used as performance controllers. DMP is also developing software to facilitate group performance in a flexible way (Anderson 94).

Group and individual performance work is supported well by such systems, but another important emphasis for DMP is on facilitating composition by individuals. The interest in creating and playing back music can potentially provide a high degree of motivation for perseverance in learning to use a composition / sequencing software system.

However, currently available standard systems are usually not an effective solution for severely physically disabled people. A number of often interrelated factors can reduce motivation and interest in using systems independently. Factors can include: (a) the complexity of use of the system or its visual presentation; (b) a lack of reading skills; (c) insufficient size and clarity of the screen; (d) lack of continuous one-to-one teacher guidance due to the size of a group; (e) difficulties in operating the system without full mouse/track ball control.

Thus, in many cases, a severely disabled (eg. single switch-using) musician is able to learn the skills necessary to compose music, but *not* how to use a composition system except through example - a tutor has to operate the software in response to the musician's decisions.

One of the aims of DMP is to provide musicians who want to work independently at a professional standard with the necessary skills to do so. The quality of the music produced by DMP clients at present warrants the aim of facilitating

complete independent control of the composition environment by people with any degree of disability.

Two approaches have been taken by DMP to improve disabled access to composition systems: (i) adapting, extending or combining existing software and hardware, and (ii) creating bespoke solutions. Both approaches have their good and bad aspects, and are examined in the following two sections.

ADAPTATIONS OF STANDARD SYSTEMS FOR IMPROVED DISABLED ACCESS

Some of the kinds of adaptation designed to aid physically disabled and visually impaired users are here briefly discussed, in the context of hardware and software currently used for musical purposes.

(i) Adaptations oriented towards users with physical disabilities

Most, if not all, of today's professional standard music software is now WIMP-based. Many systems also provide a number of 'keyboard shortcuts', and some even allow various functions to be controlled via external MIDI messages. However, many functions (typically operations within dialog boxes, or selecting blocks of notes) still require some use of the mouse.

A variety of hardware and overlay software is available to facilitate or assist in mouse (as well as keyboard) usage of such systems.

• Switch-controlled menu-driven overlays to emulate mouse or key press actions. These attempt to allow a user to emulate mouse pointer movement, mouse button presses (eg. click, hold, double click) or console key presses by using one or more switches via a menu system. An example for the Macintosh is 'Ke:nx'.

• External switches replacing mouse buttons. Many users have difficulty in pressing or holding a button on mouse or trackball while moving it, or keeping the cursor in the desired screen location. Other users have difficulty in 'dragging' with the mouse, ie. moving it while holding down a mouse button position at the same time. External switches can replace the 'on board' mouse buttons, and may be able to be locked down. This can be very effective for such users: for example, the simple facility to be able to lock down the mouse button may enable someone to fully utilise a trackball using their foot.

• Keyboard aids. Other common aids allow the user to hold down console keys, allowing combinations of keys to be 'pressed' with only a single finger or, for example, a head pointer. Other aids can prevent a held key from repeating (so multiple presses will be ignored). Examples are the 'Slow keys' and 'Sticky keys' features of the Macintosh 'Easy Access' system software.

• Macros. Various utilities allow a user to record 'macros' - each is a sequence of actions which can then be initiated with a *single* action. Such facilities are often used in conjunction with other adaptations.

• Switch emulation of mouse operation. External hardware can allows a joystick or switches to emulate mouse movements (eg. the 'MouseStick'). Key presses on the console can also emulate moving the mouse pointer in different directions or holding the buttons down. An example is the 'Mouse keys' feature of the Macintosh 'Easy Access' software.

Such adaptations can be very useful but, when used with WIMP-based music systems, are not an ideal solution for a variety of reasons.

Many systems present the user with a vast choice of actions. There is a large 2-dimensional control space within which to move the mouse pointer (even if using the above aids), with many icons and displays which present a small target area. When over an icon, the user may then have to press one or more mouse buttons, and hold or drag. This may have the effect of scrolling through many values or options, or present a pop-up menu or a dialog box containing further fields, sliders and buttons. Thus, a single operation can involve numerous disparate user actions.

There is often no indication of how to approach a task. While a beginner is learning to use a system, there is often a lack of feedback, encouragement, and quick 'default' results - everything has to be done correctly before the desired outcome is achieved (eg. some music is heard).

(ii) Adaptations oriented towards users with visual impairments

Many hardware and software add-ons are available to help people with partial or total visual impairments to use standard software. Some typical examples are briefly presented:

• Screen readers.

Such systems typically consist of overlay software linked to an external hardware-based speech synthesiser. Many speak *text* as written on screen as the user navigates a cursor around it, and are therefore less useful with more graphically-based software. An example is the 'HAL V1.02 + Apollo II' system which works effectively with DOS-based music sequencer software such as Voyetra systems 'Sequencer Plus' or Twelve Tone Systems 'Cakewalk'. The 'Atlas' (environment) file for 'Cakewalk' is the first music-based environment file included with HAL as standard. The inclusion of a default Atlas file in version 1.02 makes it easier to write environment files for other DOS-based sequencers. Research at University College, Bretton Hall has shown that the 'Cakewalk' and Voyetra sequencers are the most widely used by visually impaired people.

There are many language-based composition systems which can be successfully used with such text editor-based screen readers systems (eg. 'Symbolic Composer' and 'Formula'). However, their presentation as a programming language necessarily implies a degree of complexity, and a long learning curve which makes them less approachable by the majority.

Some screen reading systems can work effectively with text within a graphical environment, able to read text or numbers presented within a graphical display. An example is 'outSPOKEN' for the Macintosh (which incidentally does not require external hardware, performing the speech synthesis in software). However, outSPOKEN does not recognise standard music notation or graphical icons, so is not a complete solution for most music composition systems.

Another example is Aldridge Technologies 'Metaphor' for the Atari computer - still a major platform for music software in Europe. Metaphor can also translate a graphical environment into spoken text, and has been successfully used with the Cubase composition/sequencing system.

It has a number of users in the United Kingdom; the attraction for most visually impaired people is not only the power of the music application and screen reader themselves, but the opportunity to be using a system which is at the cutting edge of music technology, like their sighted colleagues.

Other substantial research and development is under way for systems providing access to GUIs in non-music applications, so the availability and quality of this kind of adaptation is likely to improve in time.

• Screen magnifiers

These software overlays enlarge the bit-mapped display, enabling people with partial visual impairment to effectively use any software. The user only sees part of the original screen at any one time, and can navigate the enlarged view around the screen.

Examples are 'LUNAR' for PC/Windows, and 'CloseView' and 'inLARGE' for the Macintosh. These systems work effectively with music software packages, although problems can arise: at high degrees of magnification, the proportional screen area on view can be so small that the user can have difficulty in navigating around the screen. In addition as the software simply replaces each pixel by a block of the same colour pixels, the enlarged display can become extremely jagged and difficult to interpret.

Screen readers and screen magnification systems for MS Windows, such as 'Windows Bridge' and 'JAWS' have been used with some degree of success with music applications. However, an example of a difficulty experienced when using these programs with 'Cakewalk Professional' for Windows v.3.0 has been orientation. Movement around the program is in a manner similar to a spreadsheet, using a cursor which appears as a highlighted box that surrounds the 'cell' that the composer is working in (the track numbers are vertical, and the parameters are horizontal). To date, no Windows speech package will recognise this element.

A CUSTOM SOFTWARE COMPOSITION SYSTEM FOR DISABLED USERS

Having examined a few of the adaptations which attempt, with varying degrees of success, to provide disabled access to standard software, we now present a bespoke solution - a custom software system for music composition and education called 'E-Scape'. Its structure and operation as well as the user interface have been designed from the outset to facilitate unaided use by people with a wide range of disabilities and experience. 'E-Scape' is a development of an earlier composition application (Anderson 90, 93c) now incorporating a number of interfacing and operational innovations to approach a solution to some of the problems with the adaptation solutions discussed above (Anderson 93a).

E-Scape can operate under single or multiple switch control, and allows the user to choose musical elements such as timbre, note position, pitch and duration for different tracks of music. Material can also be copied and moved, or loaded in from a library. A user can thus build up and finely edit a multi-tracked musical piece.

Every operation in E-Scape - without exception - can be effected via menu selections. Menus can be controlled by mouse as normal, by the console keyboard, by one, two or more switches, or by external MIDI messages.

The system is, however, completely window-based with graphical score displays; a mouse user can operate it completely normally as a WIMP environment. At the other extreme, a single switch user is able to exert the same control, albeit more laboriously. If the user presses a switch (eg. a console key, an external switch, or some MIDI message), a top level menu appropriate for the active window pane will pop up. If in 'single switch' mode, this menu then scrolls down its options by itself, and the same switch can be pressed to select the desired option. In 'multiple switch' mode, each further switch press scrolls down one item; a second switch can then select the desired item. If the user can use more switches, these can facilitate more flexible operation, eg. a switch can scroll the menu up, or scroll down several items at once (useful for long menus of filenames, for example).

We will now consider three aspects of the interfacing and operational innovations provided within E-Scape, and their effect on its usability by disabled people.

(i) Control - provision of flexible physical interfacing for system control by user

A user can employ any available interface to control the system, allowing him/her to interact physically with the system in a variety of ways, using a wide range of movement types and extents. Control can be totally effected by a single switch, or use several switches, a mouse, a joystick, the computer keyboard, sounds, or any MIDI messages, or any combination of these. Movement can be detected via an appropriate sensor and analysed, so for example, a change of motion by the user can act as a switch.

The way the interface is used is customisable by the user. For example, a notional 'switch press' could be effected by any or all of the following actions:

• hitting an area of the computer keyboard;

• hitting a zone of notes on a MIDI keyboard, or one or more drumpads;

• a reversal of movement within a distance to MIDI converter;

• moving a MIDI keyboard's pitch bend lever to the left;

• pressing a mouse button.

Users can thus tailor the interface themselves to their own particular needs, which may alter as their physical capabilities change.

(ii) Guidance - provision of pathways through compositional tasks.

Composition using standard systems requires a user to perform many complex tasks which manipulate musical data, typically involving repetition of actions and decision-making at each stage. E-Scape presents such compositional tasks as coherent 'Activities' - each is a structured set of pathways through the maze of possible actions which the system presents.

Users can then undertake compositional processes by choosing an appropriate Activity, at a high or low level. The Activity presents the user with choices about what musical operations to carry out (eg. entering or processing material, choosing sounds etc.

An example of a higher-level Activity might be "write a pop song"; an example of a lower-level Activity might be "create a transposition of the previous phrase". The Activity would then lead the user through a series of questions and choices which build up into a series of actions, often incorporating the auditioning of material generated as a result of a decision at a previous stage. Within an Activity, the user may step through component actions in order, or select different paths (branches, repetitions, jumps, etc.) through the activity.

For any user, the undertaking of compositional operations within a restricted range of options can be helpful. However, the user may still exercise creative freedom, and make musical evaluations, decisions and choices within the Activity. Activities are not restrictive - a user can freely modify them as required - but the structuring of activities is deliberately

undergone as part of the discipline of composing within a framework.

(iii) Economy of effort - reduction in the number of actions required to carry out an operation

Physically disabled composers often have a restricted communication bandwidth - each control action can take a long time and consume much effort, and it is easy to accidentally select an undesired option. This system is ideal for such users, as a large number of actions can be selected and carried out by stepping through actions and menus using only a few control inputs - minimally with only a single switch. Disabled composers are thus able to try out and control complex or repetitious processes quickly and easily. They can be provided with (or construct their own) activities which require little user input apart from the crucial compositional decisions. If a user's motor skills improve with practise, activities can be expanded to require more control inputs(with the resulting increase in navigational flexibility). As users' compositional experience increases, they can adapt or replace activities to allow for more choices and expertise.

The provision of an immediate musical result, with instant automatic audio feedback at each stage, is also highly motivating in the early stages of the learning process. Many severely disabled people want to make a lot of sound and noise using a real-time controller if they possibly can, as often this is the first time they have had the opportunity to do so. The fact that the user can produce some musical results before they have started to learn to compose fulfils that need for immediate feedback. Lack of results, when a lot of effort is required, is one of the reasons why many people get put off using existing software.

Current E-Scape features which support visually impaired users

At the existing stage of development, E-Scape has several features which facilitate use by visually impaired users, through its flexible operation, and presentation of information and feedback to the user:

(i) Operation and orientation

• All interaction with the system may be via non-mouse input.

Options can either be selected by a keypress, or via a switch controlled series of menus. The text-based nature of most of the E-Scape control system (although the score display is graphical) means that speech output can be a valid option.

Visually impaired users could utilise the switch-controlled aspect of the program, but E-Scape also allows the use of the console keyboard, which makes orientation just as easy for the visually impaired user.

• Menu items can have sonic or vocal feedback.

It is possible to use the in-built facility within E-Scape to assign speech samples to menu items but - for a user who is more familiar with it - the use of 'outSPOKEN' does not interfere with the keyboard control of E-Scape (as outSPOKEN is operated using the numeric keypad).

• Automatic auditioning of sounds when chosen.

One of the advantages of E-Scape for the visually impaired user for whom screen magnification is not a viable option is the fact that it is not really necessary to see the screen at all if speech output is present. The score display is not of essence to the musical result, as it can be played, and notes or groups of notes auditioned at any time. Every musical operation is automatically auditioned. For example, when selecting sounds, chords or clipboard selections from a menu, each menu item plays itself automatically.

(ii) Score and menu display

Various choices offered to the user regarding the visual presentation of score displays and menus enable the system to be finely tuned for a partially sighted user. For example:

• Scores are displayed as graphic bars ('piano roll' style) on a horizontal time-line; the colour and height of the bars are alterable by the user.

• The colour and width of the play and step entry cursors (vertical lines on the score display) can be altered (up to several cm wide if desired).

• The colour of pop up menus can be altered by the user; different colours can be selected for the menu title and each of its items.

• The text size for menus and alert boxes can be selected by the user; at the highest practicable size (about 80 point text) a single menu item fills the screen. If this is still not large enough, the user can switch on a screen magnifier and further magnify the text.

(iii) MIDI considerations

E-Scape is designed to obviate the need for a user to operate or look at the sound devices in use; once a device has been set up, it can be left alone. E-Scape is aware of the state of connected device at all times (as long as it is not disconnected or fiddled with!), and can control each device as necessary. The user is completely shielded from the MIDI protocol and device terminology: for example, the user does *not* need to know about such things as MIDI channels, patch numbers, bank changes, program change maps, pitch bend sensitivity, controller numbers, system exclusive strings etc.

This helps to alleviate another problem facing visually impaired users, namely the common usage of LCD panels on MIDI keyboards and modules. Many LCD panels are quite small, and in the main the colour contrast is not high enough to make it a viable way of accessing information for the partially sighted, and not at all for people with total visual impairment. There are some exceptions: for example, some devices employ fluorescent displays which can be used by some partially sighted people.

There has been research into making the LCD accessible at the Kentucky Dept. for the Blind (Thompson 93) with some success, for example with the Yamaha QY10 workstation. The Kentucky Dept. distribute information free of charge about the necessary adaptations that need to be made to the circuitry to enable speech output, but as of yet this cannot provide an 'off-the-shelf' solution.

COMPARISON OF A TASK PERFORMED ON CUSTOM AND STANDARD COMPOSITION SYSTEMS

The 'Cubase' sequencing package is a representative industry standard application widely used by DMP, and is powerful enough for most mainstream musical applications. However, the operation of the system is not viable for the majority of severely disabled people.

To illustrate some of the reasons for this, and the reduction in complexity which can be offered to the user by a custom system, we now present a comparison of the actions a user needs to undertake to perform a task on standard and custom systems.

For illustrative purposes, a simple example task might be to enter a sequential row of notes with different pitches and durations.

In Cubase the user has two choices (if we neglect the option of performing and recording material in real time); both can be problematic for disabled users:

- If not using a MIDI keyboard, the user can 'draw' in notes with the mouse on the graphic score display. To do this a 'pencil' tool is first selected by clicking and dragging on a grid of tool icons.

The mouse cursor is then placed at the desired pitch (vertical position) and time (horizontal position) for the new note. The button is then held down while dragging to the right until the note is displayed with the desired duration (length).

- If using a MIDI keyboard, the user must first press a small 'foot' icon with the mouse to go into 'step entry' mode. A numerical 'step position' display then appears which shows where an entered note will be placed. To specify the note duration the user must choose a 'quantise' value from a pop-up grid of numbers. To do this, the user has to click with the mouse on a small label called 'quantise', hold the button down, move the mouse over the grid, then release. Numbers relate to note fractions, eg. 8 will give a duration of an eighth note. Alternatively, numeric key presses can directly set the duration.

The user can then press a key on the MIDI keyboard, and a note is entered with this pitch and the duration of the 'quantise' value. The step position will then increment according to a 'snap' value, ready to input the next note. This 'snap' value has to be selected in a similar way to the 'quantise' value. To change the note duration while entering the row of notes, the user must change both these values.

Cubase may also be used together with many of the adaptations discussed above, which can help the situation to some extent. However, many problems remain. Adaptations which enable a switch user to emulate mouse and keyboard operation can at least make usage physically *possible*, but operating Cubase requires such a large number of precise mouse movements and holding and dragging operations that usage in these circumstances is highly laborious and can

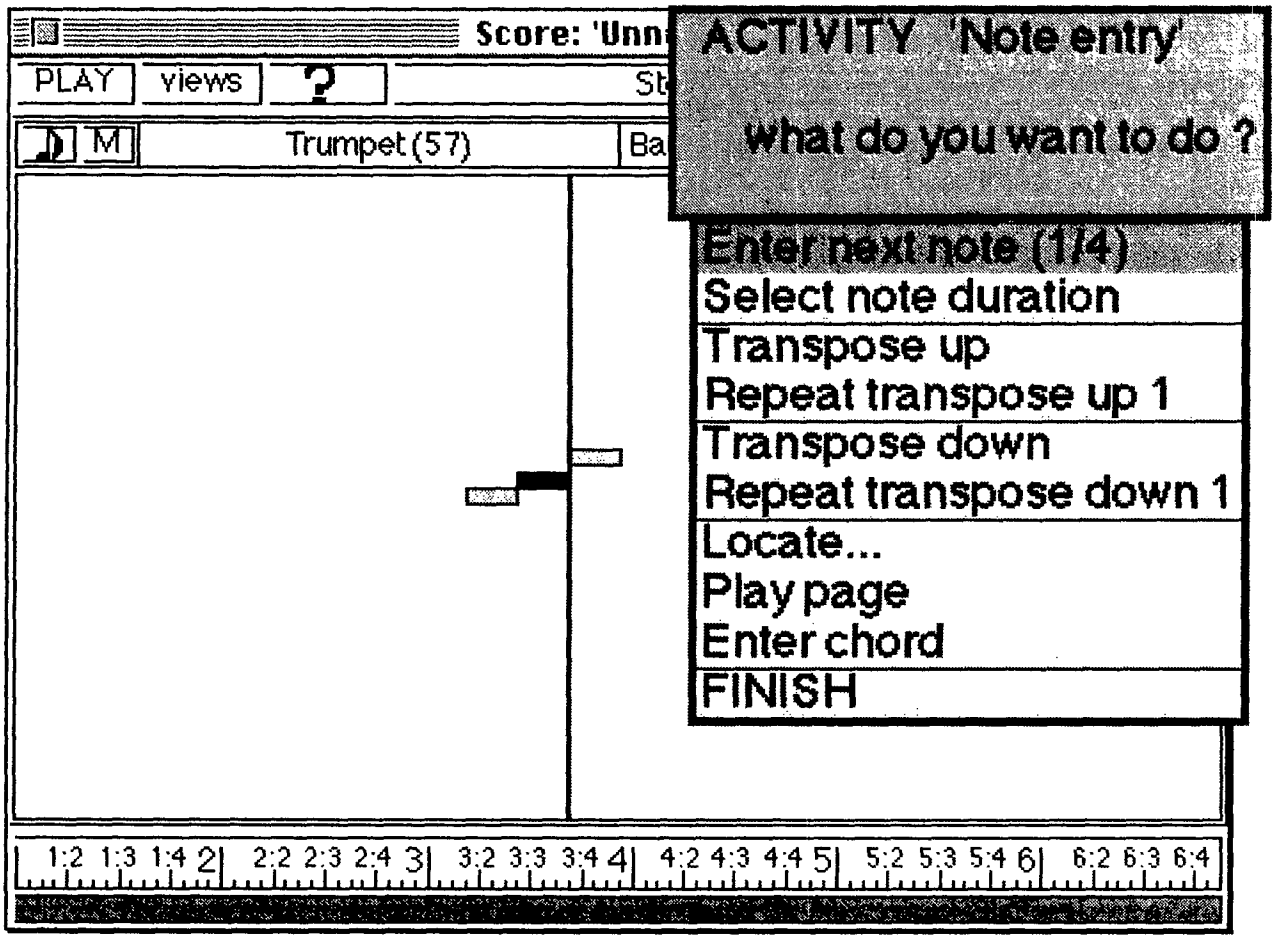

Fig. 1 The 'Note Entry' Activity menu in E-Scape

be confusing - eg. forgetting when one has left a mouse button locked down can lead to difficulties.

Macros can help to simply certain operations, but not all Cubase functions have keyboard shortcuts. Mouse movements can also be incorporated into macros, but screen locations recorded in the

macro are not context sensitive in most cases - eg. which window is open, where it is, or the current state of the edit screen (zoom amount, time location etc.).

In E-Scape, there are again two methods of undertaking the example task:

- If not using a MIDI keyboard, the user first selects the 'Enter notes' option from the main menu (operated by switch as described above). This then presents a menu of choices for an Activity called 'Note Entry'. In this menu, the options relevant to the task are 'Enter next note' and 'Select note duration' (although options for transposition and location are also available). Fig. 1 above shows a single track of a score displayed in E-Scape, with this menu in use.

To enter the next note the user simply selects the 'Enter next note' option which places a new note (with the currently displayed duration) at the current step position. The step entry cursor by default then moves to the end of the newly-entered note, which is just what is needed in this task (to have gaps or overlaps, the user would select the 'Locate...' option which allows the cursor to be stepped backwards or forwards).

To select a different duration, the user simply selects the 'Select note duration' option from the same menu. This then presents a further menu of durations (optionally shown in ms, note fractions or beat values). The pitch can either be selected in a similar way in advance, or the note entered at the current pitch, then transposed afterwards as described below.

- If using a MIDI keyboard, an E-Scape user can select the 'MIDI step entry ON' option from the main menu. The duration can again be selected from a pop up menu, from numerical key presses (as for Cubase) or from MIDI messages, such as pressing program change buttons on the keyboard.

The latter is useful for users who can press notes and buttons on a MIDI keyboard, but may not have the *reach* to be able to also turn and use the computer console. This is an example of the utility of facilitating total control solely from external MIDI messages, or solely from the console, as well as other combinations.

To change the *pitch* of entered notes, again the systems' operation contrasts greatly:

In Cubase, several methods can be used:

- Press the delete key to rub out a note, then re-enter another one of different pitch (as described above);

- Manipulate the note on the graphic display screen, by locating the mouse cursor on it, then holding the button and dragging vertically. This is difficult to do while maintaining the same horizontal position (ie. time position). Some other standard sequencer systems do provide ways of dragging in one dimension only (eg. by holding down a control key at the same time, or dragging a note with the mouse pointer at a particular location *within* the note icon).

- Move the mouse over a display panel which shows the pitch, (as well as other parameters) of the current note. The mouse must be located quite precisely in the upper half of the pitch display then clicked to transpose up (or in the lower half to transpose down). On a platform with a two button mouse, the left or right buttons can be pressed to transpose up or down. Again, the required precision of placement, then maintaining this position while pressing buttons, is problematic for most users.

In E-Scape, the user has two ways of transposing a note (in addition to mouse manipulation in the manner of Cubase).

- Select the 'transpose up' or 'transpose down' option from the menu. This then pops up a menu of possible transposition amounts, labelled in semitones as well as named musical intervals. Each option is auditioned (the transposed note played) when selected.

- Select the 'Repeat transpose up' (or '..down') option from the menu. A repeating cycle then occurs: the selected note is transposed by one semi-tone, then auditioned (ie. played in context with any notes surrounding it). The user need do nothing except listen, then press a switch when the desired pitch is attained. If the user was working within the 'Note Entry' Activity, this menu then automatically pops up again.

As can be seen from these examples, E-Scape requires far fewer operations to achieve the same task, and related actions involved in performing a particular task are presented together. In addition, tasks are initiated by intelligible menu options such as 'Select note duration'. All this helps a user to focus on *musical* rather than operational issues, and evaluation so far with novice users bears this out.

ONGOING SYSTEM DEVELOPMENT AND ASSESSMENT

E-Scape is undergoing continuing development, which will allow it to be tailored effectively to real-world needs, and expand in its range of usefulness. Several aspects of this development can be considered:

(i) User evaluation

Informal evaluation of the E-Scape system in use by students in DMP workshops has been undertaken during the latter half of 1995. Observations so far indicate that E-Scape is successful in allowing people even with severe physical and/or cognitive difficulties to approach the task of unaided music making, for the first time in many cases. User reaction has generally been extremely enthusiastic. The fact that non-readers who have had no previous experience of composition have been able to use the system has been very encouraging. A video of the system in action will be shown at the conference.

In early 1996, clinical trial groups are being set up by DMP in Ireland to carry out a more formal assessment programme. This feedback will result in continuing refinement, redesign and expansion of the E-Scape user interface, and the musical Activities provided.

(ii) The 'Access to Music through Technology' Project

Research is being carried out at University College Bretton Hall as part of the 'Access to Music through Technology' project to evaluate the usage of E-Scape by visually impaired users, as the system is developed.

Features already planned by the first author for next system release include:

- each system action providing context dependent information (eg. the basic action 'select next note' could not only announce this via a speech synthesiser, but also play the note, and/or announce various parameter values of the note);

- further customisation of the visual presentation, eg. altering window background colours, border sizes and colours etc.;

- menu items able to be user selectable icons;

- the provision of a moving 'zoomed in view'. This could be better than the screen enlarger adaptations above, as the image would not be jagged, and the area which is enlarged would be context sensitive, ie. be the area of current user focus.

Such features will be evaluated with visually impaired users, and feedback and ideas provided for the further enhancements and

features required to facilitate *complete* control and use of the system by people with any degree of visual impairment.

(iii) E-Scape for the more advanced musician

Additional features for complex sound construction and control (beyond the scope of this paper - see Anderson 92, 93b) are present within E-Scape. These aspects are becoming of interest to the more advanced disabled musician, as well as in mainstream higher education. E-Scape thus has the potential as a compositional tool for high-level music making and sound creation. Scores created in E-Scape can be transferred to other software (either in real-time or via standardised MSF files), for example to be further edited or printed out in music notation.

Users who wish to enter professional music working environments will naturally want to use the current 'industry standard' system if at all possible, so it is important for previous work to be transferable between systems. Indeed, one of the aims of the DMP is to provide training pathways to enable people to progress into the mainstream world of music.

(iv) Additional areas of utility for the system

When fully developed, E-Scape will be able facilitate a wider variety of usages than originally envisaged.

- In special or general education, students can work through a set of prepared didactic Activities, within which they can be allowed an appropriate degree of creative freedom, making musical decisions and choices. A student can be guided through a compositional process, progressing to activities which demand more decisions, or which use the methodologies of a particular composer.

Music educators will be able to construct sets of activities which guide a student through a selected compositional process. Students can thus learn by observing and participating in an active process. Activities can be more or less prescriptive, allowing varying degrees of user control and choice.

Students can start with 'beginners' activities where there is little user choice required. Activities with no choice at any stage could also allow a student to merely step through the process, observing the effect of each action.

As students gain more experience and confidence, they can gradually progress to successive activities which allow them to exercise more control - having to make more compositional decisions, and having more freedom to navigate between actions within the activity.

At a more advanced stage, a composition student may wish to investigate or use the methodologies of a particular composer under study. Suitably designed activities could allow a student to compose within the framework of a particular compositional methodology while allowing partial or full decision making. Students could also customise their own environment as they progress; altering existing activities or constructing new ones.

- Music experience and enjoyment for people with learning difficulties could be provided; people can enjoy creating music, within a 'safe' environment, with an appropriately restricted set of options and choices to make.

Activities can be designed which allow a user to make musical decisions at a high level, with activities able to proceed with little further user interaction. For example, a user could select a melody from a library, choose the kind of accompaniment style or change the tempo and key etc. All decisions produce some kind of musical output, and hence maintain motivation and interest. Users can progress to more interactive activities as their skill and confidence grow.

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