Assistive Synchronised Music Improvisation

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Abstract. The second stage of a project to develop a tool for assistive musical improvisation is described. Building on the findings from preliminary participatory workshops with a group of adult learners with mobility issues, a pattern based musical-model is defined. Employing a synchronised pattern-based approach to music generation a prototype 'instrument' has been realised that brings together key assistive and musical features that were identified as desirable. Using an example combination of joystick and force-sensor controls, the system offers the performer a combination of rule and skill-based performance behaviours to maintain both a sense of ownership and control.

Keywords: Accessibility, disability, music, improvisation, technology

1 Introduction

Group-based activities can greatly increase an individual's sense of social inclusion and music-making through improvisation can enhance this further through additional self-expression on the part of the participant. Community Music practitioners will often work with groups of individuals who can benefit from such collective music happenings but who are, for one reason or another, faced with barriers to participation. There may be physical reasons why it is difficult for an individual to engage with playing a traditional instrument, or cognitive challenges that might make the process of comprehending common music conventions difficult (key, meter, harmony etc.). Factors such as the cost of taking music lessons or purchasing an instrument can affect an individual's choices as can the ability to master and retain the technical information to produce satisfactory musical outcomes. Community Music workshops will tend to focus on using methods and instruments that help alleviate some of these challenges and barriers.

There is no one philosophy here, but improvisation can be key in overcoming these barriers as everyone can have something to contribute. Stevens [1] describes techniques for encouraging and enabling improvised music for mixed abilities and Moser and McKay [2] address similar themes whilst also taking into account other factors including how to setup the environment, warming-up and using technology. Improvised game-play can be used as a vehicle for introducing people to music making, indeed Stevens' Sustain, Click and One-Two are all examples of game-like exercises and in this same way Lewis [3] and Nankivell [4] suggest similar musical games including Hocket, Add-On, Name Game and Six Chords. Of these, Add-On is an approach that is particularly rewarding as it follows a familiar musical structuring system that is both easy to comprehend and commonplace in many musical styles. A short repeating pattern or 'groove' is established by one player while the rest of the group simply listen. After a short while, one of the remaining group members adds a layer to this initial idea and the process is repeated until, layer-by-layer, a complete musical texture is achieved; this might be quite complex rhythmically, harmonically and melodically by its conclusion. Key here is the notion of very simple musical offerings gradually coming together to create bigger and more complex outcomes; the individual becoming part of the group regardless of ability.

It was this same layering game of Add-On that Challis and Smith [5] used to explore the potential for assistive technology in enabling users with mobility issues to take part in community music workshops. A series of three workshops was employed to allow the researchers to engage with the group as observer participants. Initially this involved joining in with the group in typical musical activities followed by two technology-assisted workshops to enable a more varied repertoire to emerge.

2 Findings of the Tools for Improvisation Project

The findings of these workshops are deliberately condensed here and can be further supported by other work by Challis [6-8] in this same area of assistive music technology. It should be noted that the individuals who contributed to the workshops had differing mobility issues rather than sensory or cognitive challenges. With this in mind, the group had relatively fixed ideas of the type of musical interaction they enjoyed but had challenges in working with conventional instruments; In particular, two members of the group had specific issues with dexterity such that individual finger movement was observed to be noticeably difficult.

Synchronisation: The ability to have musical phrases synchronized in time was immediately identified as being important; without this the group would quickly lose the beat and the layering process would become confused. It was acknowledged that this was quite significantly influenced by the make-up of the group, most of whom had head-related traumas that, amongst other challenges, presented mobility issues. The level of effort and articulation and effort required to repeatedly carry out, for example, percussive exercises was obviously demanding in terms of maintaining rhythmic cohesion. A simple MIDI-clock system was used to test this theory with very positive results.

Skill/rule-based behaviours: Earlier work in this same area [5] had already suggested that Malloch et al's model for Performance Behaviours [9] had considerable relevance within the field of assistive music technology but that additional consideration needed to be given in terms of understanding the key labels of skill, rule and model. Where skill would ordinarily suggest that the performer is responsible for the entire lifespan of each note, the same may not be true for someone with clear physical barriers. As such, employing rule-based behaviours for the latter performer may be considered to involve more skill than for someone with no physical barriers. With this in mind, it was seen that aiming to introduce performance behaviours that lie somewhere between skill and rule would be advantageous; being able to further adapt these actions around the individual's needs could enhance this further.

Pattern Generation: Observation and participant feedback clearly showed that the group were most comfortable working with repeating rhythmic and harmonic patterns to build up layers. This was particularly true where the performer had substantial control over the generation of the patterns. It was also shown that synchronisation of the patterns was of considerable help to the group though it should also be acknowledged that, if the performer missed the beat when triggering a pattern, the musical events would be generated in time with the rest of the group whilst remaining off-beat. This helped maintain a skill-based element to the flow and control of the music. It was also clear that, though abstract approaches to improvisation are frequently employed in a community music setting, the group were keen to work with mainstream song-like structures employing chord progressions and meter-led percussion beats.

Ownership: As suggested by Healey [10], a sense of ownership remains significant to the participant who is perhaps using assistive means. Pressing a switch to release a pre-arranged and quite comprehensive stream of music may not be as meaningful as, for example, pressing a switch again and again to control the way in which the notes flow. Some level of control and skill is introduced into the process.

Ease of use: In simple terms, participants appreciated control devices that are intuitive to use, perhaps offering bigger musical outcomes than are suggested by the user's input so long as the previously identified sense of ownership is not eroded. There is a fine balance of relationships here as ownership is in part affected by the notion of skill-based performance behaviours which may well dictate the extent to which an interaction can be regarded as being easy or not.

3 Musical Design

The first stage of the Tools for Improvisation project concluded that this collection of features could be brought together within a system that employs a grid-like system for controlling the triggering and control of musical patterns. This was based on the success of using a similar interface in the workshop with very positive results. In principle, one or more grid-controllers could be used in conjunction with an additional input mechanism to enable expressive control. This would enable the performer to trigger and manipulate sound expressively whilst also still requiring some level of skill. This would be particularly true if small melodic units could be navigated and triggered to create more complete patterns and progressions. Using small scale testing of different approaches, the musical scope for such a system has been more clearly defined, leading in turn to a working prototype. Before discussing the design of the interface to the system it is first important to understand the rationale behind the musical model that it enables.

3.1 Musical patterns

Modern music makes much use of repeated phrases to create layers. Indeed, the term loop is now very much established within the vocabulary of music composition and analysis; a contemporary take on the more traditional notion of the ostinato. Certain components of popular music can be deconstructed into repetitive loop like phrases. Take a drum beat for example, a complete drum part might be broken down into a series of short phrases which are repeated for substantial passages, perhaps punctuated by slight adaptations or fills to underline the structure. The basic starting pattern itself may be further broken down into constituent repeating parts for individual drums: a pattern of high-hats, a rhythmic backbone from the kick, a back-beat from the snare and so on. Given a starting palette of complementary patterns, a player might pick and choose individual beats to join together, building longer bars and phrases by moving between much smaller musical units. This is the basic concept that is used behind the musical model of the improvisation tool; the performer has access to a virtual array of nine such patterns that can be combined to create either rhythmic or harmonic patterns.

3.2 Creating rhythmic patterns

For the rhythmic palette, a player can access beat-long fragments that focus on key drum voices. A pattern might be, for example, mainly focused on the kick-drum such that if played repeatedly, this emphasis of the rhythm would remain firmly with this particular drum; it would ‘feel’ like a kick-drum rhythm. Contrasting patterns might focus on other drums and percussion instruments (snare or toms for example) and again, repeated play of these would have similar results, creating a rhythm that is focused purely on the single drum. However, if the player chooses to move between patterns, the overall feel can be made to oscillate between two or more drum-focused patterns (see Figures 1 and 2). Using this approach, a familiar drum beat can be deconstructed into its constituent beat-long patterns, these become part of the palette which is then filled with a number of variation patterns. The performer can reconstruct the original beat but can also build variations and adaptations by choosing alternate phrases. This is contrast to current commercial technologies (e.g. Kaossilator) where the system essentially enables the performer to join together bars into phrases rather than beats into bars.

Fig. 1. Example patterns on a kick and snare drum.

Fig. 2. Simple beat based joining of patterns in Figure 1.

This can be achieved by simply timing when to move from one pattern to another though, as will be described in Section 4, additional parameters can be altered to further increase the variety of the patterns and fills that can be created. Importantly, a performer should be able to move from one pattern to another between beats if needs be. This way, a larger phrase might be constructed using whole and part-beats (see Figure 3).

Fig. 3. A more complex phrase, built with the same patterns as Figure 1 but moving from pattern to pattern within the beat.

3.3 Creating melodic and harmonic patterns

In a similar fashion to building rhythmic patterns, melodic ideas can be built from palettes of pitch-based units. These can be based on single pitches, with repeating rhythms, and also from groups of pitches that share a diatonic relationship, again with repeating rhythms. The player can build musical ideas based on repeated single pitches or bring together a sequence of units to create an arpeggiated pattern, where the notes are taken up and down chord voicings. Again, the extent to which additional variety and expression can be introduced is governed by the interface design and the limits and needs of the user. Though there are technologies that enable these arpeggiated approaches, they typically involve the input of a base chord shape by way of a conventional keyboard; the approach being explored here, removes this requirement as diatonically related chords are mapped out within the grid.

3.4 Instrument Design and Implementation

For the purposes of the prototype design, the grid-size has been limited to three by three such that the initial palette will offer nine rhythmic or harmonic patterns for the user to improvise with. There are various ways in which a grid like this might be conceived and accessed, including a physical grid of switches or pressure pads, a touchpad, a virtual grid based on the movement of sensors such as accelerometers and gyroscopes, or through the use of a joystick; the following interface is just one example of how this can be achieved. The switches and pads will offer additional visual cues and feedback as to where and how to interact as the grid will be apparent within the device. The joystick approach will require some additional skill to control though there is some feedback in the position of the joystick lever itself; similar is true of the touch-pad where the position of the finger is the cue. The virtual approaches may introduce more uncertainty and required skill without additional feedback.

The purpose of the prototype has been to demonstrate that the musical model can work rather than to demonstrate the appropriateness of any specific interaction method. For this initial version, two methods have been explored, a grid of force-sensitive pads (Figure 4) and a combination of stay-put and centring joysticks (Figure 5). Depending on the mode of play (rhythm or pitch), pressing one of the pads will begin the pattern associated with that specific grid position. Maintaining pressure will allow that pattern to cycle round to create a repeating phrase whilst changing pressure will increase and decrease the volume. Patterns can be joined together by moving from pad to pad to access the different phrases and silence can be achieved by simply not pressing a pad. MIDI clock messages are available such that other devices can be synchronised to the main tempo though individual events are not delayed in any way to quantise around the beat. So, if a player triggers a pattern on a beat it will be in tempo, if the same pattern is triggered slightly behind the beat, it will also be in tempo but always behind the beat until retriggered. This meets the requirement of needing skill to remain in beat whilst triggering and moving between individual patterns.

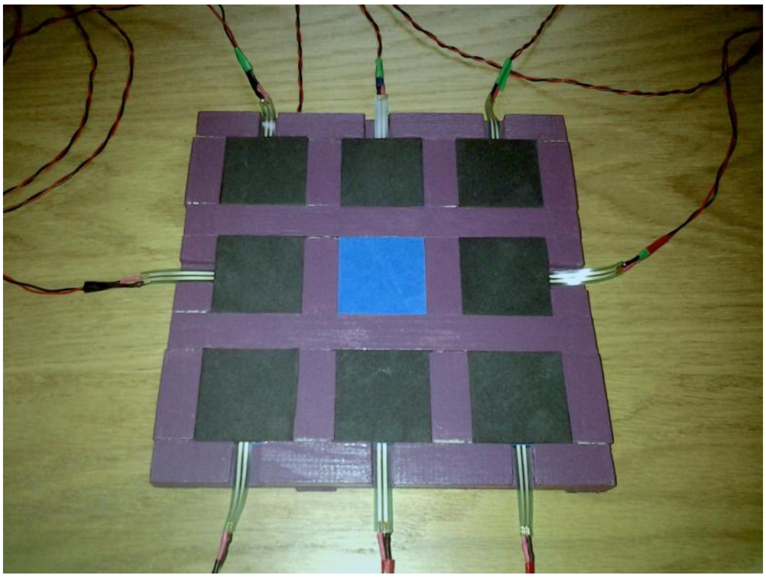

Fig. 4. Interface: force-sensor component.

Although quite complex patterns can be achieved by using the pads alone, addi tional variation can be introduced by using a joystick. This, again, offers nine positions that correspond to a three by three grid (centre, up, up-right, right, down-right, down, down-right, left, up-left). When playback is rhythm-based, the joystick allows different combinations of drums, cymbals and percussion to be included within the main patterns being triggered by the pads. For example, one position might offer a basic drum-snare combination, whilst another will use similar rhythms but with an added hi-hat pattern or perhaps hand-percussion or possibly both. There is an element of learning-through-play involved with the performer finding his or her way around the patterns and permutations on offer and this very much suits the intended application of the controller within improvised music.

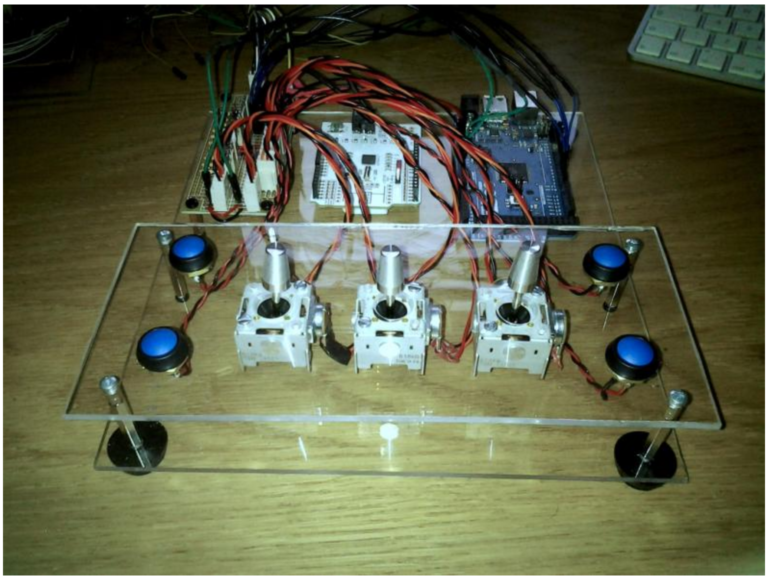

Fig. 5. Interface: stay-put and centring joysticks.

When the controller is being used for pitch-based playback, the joystick dictates the root note for the current musical pattern. This allows simple patterns to be moved diatonically from one harmonic position to another, following a chord progression for example. The pitch-based patterns are organized such that vertical or arpeggiated phrases can be achieved alongside more horizontal phrases. Though the system has been initially built using the combination of a grid of force-sensitive pads and a joystick, both offer a 'grid'-based frame of reference. With this in mind, it is wholly possible that a similar interaction may be achieved using two joysticks alone, or two sets of pads and preliminary experiments with two joysticks suggests that this could be particularly effective although the expressive element can be lacking. It should be noted that the joysticks being used within the system are relatively small (3cm x 3cm) as the cost of larger stay-put joysticks has proven to be prohibitively expensive at this stage; initial indications are that larger joysticks will clearly benefit some of the users from the original workshops. It is also acknowledged that a compositional element could be introduced into the system such that patterns could be created and stored by the performer; currently the prototype is only working with a limited set of pre-programmed example patterns.

4 Conclusion

The second stage of the Improvising Tools Project has concluded with the development of a working prototype for enabling group based improvisation. Using an example combination of force-sensitive pads and joysticks, performers are able to trigger and move between a palette of rhythmic or pitch-based patterns to create longer and potentially quite complex phrases. The system employs a balance of skill-based and rule-based performance behaviours to maintain a sense of control and ownership on the part of the improviser. MIDI clock messages are available such that the system can act as a master unit whereby other devices can be synchronized and kept in relative tempo.

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