The Samchillian Tip Tip Tip Cheeepeeeee: A Relativistic Keyboard Instrument

Leon Gruenbaum
96 St. Mark's Place #2
New York, NY 10009
646-286-0893
leon@samchillian.com

ABSTRACT

Almost all traditional musical instruments have a one-to-one correspondence between a given fingering and the pitch that sounds for that fingering. The Samchillian Tip Tip Tip Cheeepeeeee does not - it is a keyboard MIDI controller that is based on intervals rather than fixed pitches. That is, a given keypress will sound a pitch a number of steps away from the last note sounded (within the key signature and scale selected) according to the 'delta' value assigned to that key. The advantages of such a system are convenience, speed, and the ability to play difficult, unusual and/or unintended passages extemporaneously.

Keywords

samchillian, keyboard, MIDI controller, relative, interval, microtonal, computer keyboard, pitch, musical instrument

1.INTRODUCTION

Modern improvising musicians often play very rapid soloistic lines that seem concerned primarily with the rhythm and the shape of the line. It was with such musicians in mind that I came up with the idea to create a keyboard wherein each key denoted not a fixed pitch, as is usual, but rather a relative change in pitch. That is, each key would denote whether the next pitch would be up or down from the previous note heard and how many steps away, in the current key and scale selected. The player could focus on the rhythm and general shape of what he/she wanted to hear and let the notes take care of themselves, essentially. In addition, many phrases that would otherwise be impossible to play on a conventional keyboard - or at the minimum require weeks or months of practice - could be performed extemporaneously, in any key. And any new approach to a melodic line necessarily yields strange and unusual music, which in and of itself can be of interest to adventurous musicians. I named this keyboard the Samchillian Tip Tip Tip Cheeepeeeee, or Samchillian for short.

I was also interested in creating something "manual" - i.e. with only one note sounding per keypress - to give a human feel to the playing. This would be in contrast to a lot of devices on the market that make it "easy" to play music because one button sets off a lot of automated music. The result is an an instrument that actually takes some effort to master but whose output I believe has a unique "personal" character to it. In the examples below I have implemented this concept using a computer keyboard, though plans are under way for a custom keyboard specially built for this purpose.

I have played some version of this keyboard for over a decade, recording and touring internationally. It has proved to be valuable in a number of varied musical settings, both in my own musical projects and with artists such as Vernon Reid ("thrash jazz") and James Blood Ulmer (blues).[1]

NIME07, June 7-9, 2007, New York, NY

2.THE SAMCHILLIAN SYSTEM

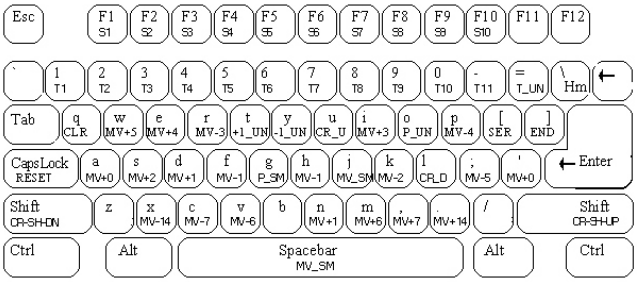
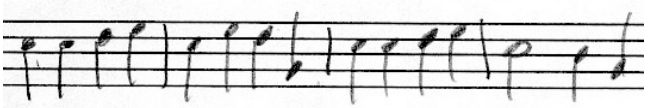


Figure 1. The codes on each key denote Samchillian functions.

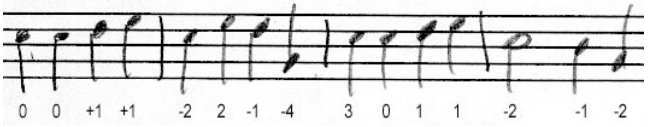
The most important functions are described below:

2.1Movement Keys (MV+*n*, MV-*n*)

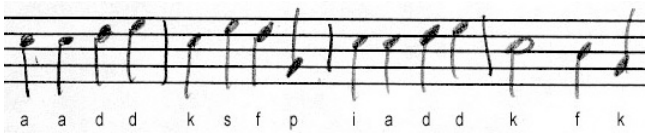
Here's an example of a melody, written in traditional music notation. All examples below are in treble clef:



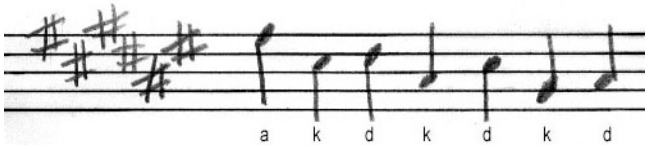
To play this on Samchillian, you must first analyze the differences in pitches from note to note.



And then find the letters of the keys matching those 'delta' values on the keyboard itself:



The example above is a very simple one using the "major" scale in C. Let's look at another example: starting on the note F# in F# pentatonic scale (the black keys on piano), "minus 2" alternating with "plus 1" might yield this sequence:



Such a system is surprisingly good at covering most melodies, especially when put in diatonic ("major") mode. Typical melodies go stepwise or with skips of a few notes at most. There may be jumps of more notes than that, but almost never above an octave. Therefore, in the default keyboard layout I have from plus or minus 1 to 7 steps (an octave in the diatonic scale mode), and also keys for plus or minus 14 steps (2 octaves).

2.2Scales (S*n*)

The default scales are both western (major or "diatonic", chromatic, pentatonic) and microtonal (10-note equal, 20-note equal, overtone series simulation, harmonic minor, "compressed"/"expanded" (see below), and 16-note equal).

The user can add his or her own scales. A scale is defined as an ordered set of relations to the root key. The scale need not even repeat at the octave. For example, the 'compressed' and 'expanded' scales sound like major scales except that the intervals between scale values are slightly compressed or expanded, and when the scale repeats at the 2 octave mark, the scale is one half step off, low or high respectively.

Note that there is no necessity of a "minor" scale - if one selects "major", then starting the scale on each of the seven notes yields each of the modes (including several types of minor scales).

Microtonality is achieved by means of sending pitch bend values prior to each MIDI note sent - this means that the receiving synthesizer need not be microtonal-capable.

2.3Key Signatures (T*n*)

Key signature changes are relative as well - as one presses each subsequent key of the transposition row, a greater number of flats are added to the existing key signature. (I.e., pressing the '1' key adds one flat, '2' two, etc.).

One immediate advantage to such a relativistic system is that to transpose a melodic phrase learned in one key signature, one needs only press a key signature key and can then play exactly the same sequence of keys in the new key.

2.4Reorient Feature

If the scale or key signature changes, the system immediately calculates where the last note fits in the new scale note set, and subsequent moves are smoothly related to the new "last" note. This is true even if the last note does not belong to the new set.

2.5Special Keys

- **P_UN** (Undo): returns the user to the previous pitch
- **MV_SM** (Same): repeats the last diatonic interval used
- **P_SM** (Same actual): repeats last actual pitch interval used
- **CR_U**, **CR_D** (Chrom): plays a chromatic step away (up or down), 'chromatic' as defined in the scale data
- **CR_SH_DN**, **CR_SH_UP** (Chrom Shift): Left and right shift keys do not sound pitches, but rather, while depressed, lower and raise every subsequent note by a chromatic step (as defined in the scale data). This is akin to the chromatic button on a harmonica.

There are also keys which are variations of the above - e.g., a key which returns the user to the previous note but one step higher or lower, etc..

2.6Serial Mode (SER, END)

One interesting feature is a serial mode (as is used in twelve tone music). There are two parts to this mode: recording, in which notes are sequenced and not allowed to repeat - this process continues until the END key is pressed, or the number of notes in the scale is reached; and playback, in which the recorded notes are played back manually - forwards, backwards, by 2's or 3's etc., according to which Samchillian keys are pressed. This becomes especially interesting when non-traditional scales are selected, such as the 20-note equal-tempered microtonal scale, and a cyclical pattern is played whose intervals sum to a number that is relatively prime to the number of notes in the scale. In such a case, by cyclically repeating two or three keys one can generate patterns that take literally hundreds of notes before they repeat.

2.7Harmony Configurations ("Chords") (Hm) and Monophony

The instrument tends to be used monophonically since there is no clear benefit to playing chords on it. As a monophonic instrument the Samchillian turns out to be extremely versatile - in addition to playing extremely fast, unusual solo lines, one also can play interesting repeating percussive patterns using the serial mode. And it is quite useful for playing bass lines, a role that is typically monophonic.

However, technically the unit is not monophonic - on a sustaining sound one can hold one or more keys while striking others and the first ones will continue to sound. And one can play chords by playing several keys rapidly, one after another, giving the perception of simultaneity, like strumming on a guitar.

And there is another way it is possible to play chords on this instrument - there are 4 preprogrammed harmony configurations through which the user can cycle by repeatedly pressing the Hm key, "\". One configuration, for example, will harmonize the lead note with notes both 2 and 4 steps below it, making a triad within the current scale. Playing Samchillian with one of the harmony configurations selected is analogous to playing a piano with the fingers of the hand fixed like a rake.

2.8Scoring

I have adapted the traditional five-line staff notation to Samchillian, where the middle line is "0", the space above it "+1", the line above that "+2", etc. Similarly, negative moves are positioned below the center line. (Examples on my website [2].) The truth is, however, that aside from notating practice exercises, I haven't found much use for written notation, as the instrument is intended for improvisation.

3.RELATED WORK

Nishimoto et al. [3] describe an improvisational jazz instrument ("RhyMe"), in which the keyboard shifts to play on the 'correct notes' for each pre-sequenced chord. While this is a step in the

right direction of freeing the player from the learning and cognitive load required to play over chord progressions, it is not as radical as Samchillian: within a given chord, a keypress still stands for a fixed function to the root, which I believe results in lines which are more conventional than Samchillian produces. RhyMe also lacks the reorienting feature, which allows for a smooth line to continue through chord changes in an intuitive way. Finally, it is not always possible or desirable for the player to pre-sequence the chord progression - even if the progression is fixed, the drummer (not a computer) may be deciding the tempo.

4.KEYBOARD IMPLEMENTATIONS

4.1Piano-Style Keyboard

The first version of this device utilized a standard piano-style keyboard as the input device, redefining each key's function through a translation table. (E.g., middle C was 'zero', C# was 'plus 1', B was 'minus 1', etc.)

4.2Computer Keyboard as Musical Instrument

However, I wanted to show that the old black-and-white layout was not the only option for modern keyboard playing. Also, as I was very concerned with speed, I rejected other gesture control options. Using sticks or palms or something other than fingers would slow the user down. Likewise for playing in air or on something like a flat membrane that doesn't bounce back, or moving something continuously like a mouse. Furthermore, with a computer keyboard, a maximal number of keys are easily reachable without moving the hand. Therefore, the decision was reached to use a computer keyboard as input instead, even though this meant losing touch sensitivity and other niceties. An ergonomic keyboard made by Kinesis® was chosen, as it was comfortable and aesthetically pleasing. The preferred performance style is to stand with the keyboard strapped around the waist, flat against the torso.

Figure 2: Inventor in performance, Newport Jazz Festival '02

4.3Keyboard Layout

In designing such a system, much thought was put into the layout of the keys. (That is, which keys should do what? Should the "plus 1" key be assigned to the letter 'f', etc.?) Although provision is made for the user to change the keyboard layout, I felt that it was important to design such a layout and stick with it, because once the user learned it, it would be difficult to change his/her habits. I wanted to place the most-used keys in the strongest fingers, and furthermore to optimally allow for alternation of the hands and fingers for ease in playing rapidly.

In the 1930's August Dvorak created a typewriter keyboard layout meant as a more efficient alternative to the standard QWERTY one, so I studied his reasoning and applied it to what is essentially a huge math problem. The AI program, "Prolog", was enlisted to aid in this. Obviously there are many good solutions to such a problem, but the final layout was deemed satisfactory because most of the patterns I wanted to play were reasonably easy to execute.[4]

4.4Turning any MIDI Controller into a Samchillian

Most recently I have added a feature to the software version which turns any MIDI controller into a Samchillian. This is to say that when the user plays notes from an external MIDI controller into the program, those notes are assigned 'samchillianistic' functions. E.g., one can assign "+2" to the controller's D# above middle C, etc.. One immediate advantage, such as I had in the very first implementation, is that the user has velocity sensitivity, aftertouch, and anything else that that particular MIDI controller has to offer.

There is also a mode wherein an external MIDI note is passed through as is, and subsequent Samchillian moves are relative to it.

5.SOUND

Since Samchillian lines are often quite rapid, triggering sounds with short attacks tends to work best. And setting the receiving sound to be monophonic is often advisable, as it "cleans up" the line. It is critical to take some time to develop rich, interesting sounds to trigger, as they "become" the instrument to the listener.

6.SAMCHILLIAN AS HARDWARE

This project began as software, moved to hardware and most recently exists again as software on a laptop. However, years ago, laptops were rarely used in live performance, and because there was no need for a full screen or a hard drive, etc., the decision was then made to run the software in a custom built hardware box with a PC-on-a-card as the processor. (See Figure 3.) This system featured: a pitch wheel knob; a foot pedal for "continuous control" (to control vibrato, wah filter, etc.); blinking lights to indicate when the keyboard was being played - the 3 lights represented the last 3 digits of the current MIDI note # expressed in binary; an 8-bit 11KHz sine wave that came out of an audio jack mounted on the box; and a display indicating the current note, key and scale.

7.HARDWARE VS. SOFTWARE: ADVANTAGES AND DISADVANTAGES

I am currently using an OS X laptop in performance. Laptops are plentiful and don't require users to lay out any additional money. And though it was not used for this project, the program Max/MSP makes programming for MIDI quick and easy.

However, there are some advantages to using a hardware unit. Since the application is the only one running on the system, there are no conflicts with other programs. Furthermore, upgrading or adding another program is impossible, and making any changes at all to a system can often interfere with proper functioning of a given piece of software. In addition, laptops on stage run the risk of falling and/or getting broken or stolen. And theoretically, in mass production a hardware version could be cheap to reproduce.

Figure 3: Samchillian Hardware

8.SOME UNINTENDED CONSEQUENCES WHICH TURNED OUT TO BE USEFUL

When I created the serial mode I intended that the user record a series of notes, and then once the serial buffer was filled with notes, start by playing them back in the order he or she recorded them. However, I once observed another player fill up the buffer, and then naively continue to play the same cycle of keys he had just played when he was in record mode. This produces a fascinating and complex pattern, with very little effort by the user. (The effect is reminiscent of a drawing game from many years ago, Spirograph ®.)

It also turns out to be interesting to start with a spiraling pattern of 3 or 4 repeating keys in one scale, and then change the underlying scale to hear the same 'harmonic contour' in a different context.

Another unintended consequence involves the peculiar way in which microtonality is achieved, which is by sending pitch bend commands prior to every note, as if there is a robot user very quickly and accurately moving the pitch bend wheel just before each note is struck. I discovered that if one holds a note in a microtonal scale, and then holds a second note, the pitch of the first note being held will be changed, since only one pitch bend value is allowed per channel. This is quite an unusual, "scary movie" type of effect, especially effective with a “pad” sound, such as strings.

9.FUTURE ENHANCEMENTS

Future enhancements include: an absolute (traditional) mode; a user-defined velocity value; pre-sequenced key signatures; more interesting graphical displays; an entirely mechanical, non-electric, sound-producing version; and a more ergonomic interface, custom-built with the niceties of any modern keyboard (velocity, aftertouch, etc.), as well as some new ones. [5]

10.CONCLUSION

Over the years I have been (pleasantly) surprised at some of the musical lines the device comes up with, and often I need to listen to a recording to fully appreciate what I have played. This due to the speed, and also to the unusual way that notes are generated.

Though I have been disappointed in my progress as a player - when I began I had hoped to fully replace the traditional keyboard as a solo instrument - I have come to appreciate that there are some uses at which Samchillian excels and others for which it makes more sense to use a traditional keyboard. The latter include: chordal keyboard playing; music that changes scale or key frequently, or doesn’t stay within a key, or is chromatic with large jumps. I had originally planned to allow the user to change the scales and keys with foot pedals but my experiments with this suggested it would be too demanding, especially while standing. Overall, my experience on Samchillian has been very interesting. As I am fond of saying, “the hard things are easy and the easy things are hard.”

And recently with the release of the OS X freeware version, a number of beta testers worldwide are beginning to perform and record with it, using their home keyboard as input. I look forward to hearing what new uses they find for it. I believe that someone starting early enough on the instrument would find it as natural to play as the piano.

11.REFERENCES

[1] **Leon Gruenbaum** - Math Camp “Away” (Agenda Del Mondo, 2006). L.E.G. Slurp “Foolifingo!” (Sergeant Dan’s Records, 1998) Discography featuring samchillian: **Vernon Reid’s Masque** - “Other True Self” (Favored Nations, 2006) , “Known Unknown” (Favored Nations, 2004), “Mistaken Identity” (Sony, 1996); **James Blood Ulmer’s Memphis Blood** - “Bad Blood In The City: The Piety St. Sessions” (Hyena, 2007), “No Escape from the Blues” (Hyena Records, 2003)

[2] http://samchillian.com/aboutsam.html (contains audio and video clips); http://samchillian.com/standalonepc.html (freeware); http://samchillian.com/thelicks.html (exercises)

[3] Nishimoto, K. et al. “Why Always Versatile...” (NIME-2003)

[4] Determination of optimal keyboard layout: http://samchillian.com/dvorakprolog.html.

[5] Eitan Shefer’s demonstration video: http://youtube.com/watch?v=DbOIBIwg_E4

ACKNOWLEDGMENTS

Thanks to Vernon Reid and Gideon D'Arcangelo for their interest and support over the years. Also to Joe Waltz for hardware and Dan Coates and Ray Haleblian for software.