

DHARMAPALA V: MAHAKALA (THE BLACK ONE)

MARCUS ALESSI BITTENCOURT

FOR 37-KEY PIANICA
AND LIVE ELECTRONICS
(DHARMAPALA CIRCUIT)



2010

Pianica range:
(37 keys)

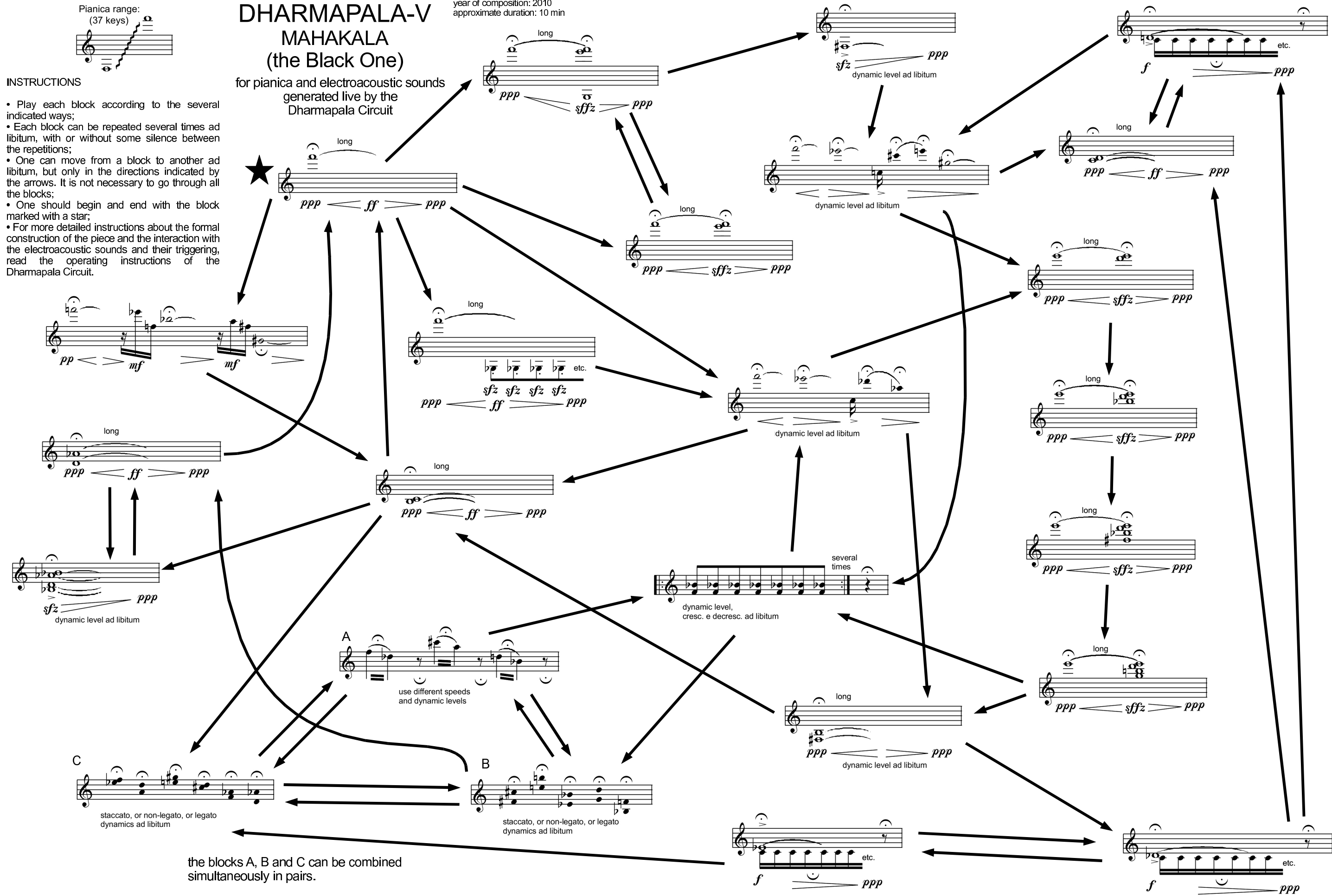
DHARMAPALA-V MAHAKALA (the Black One)

year of composition: 2010
approximate duration: 10 min

INSTRUCTIONS

- Play each block according to the several indicated ways;
- Each block can be repeated several times ad libitum, with or without some silence between the repetitions;
- One can move from a block to another ad libitum, but only in the directions indicated by the arrows. It is not necessary to go through all the blocks;
- One should begin and end with the block marked with a star;
- For more detailed instructions about the formal construction of the piece and the interaction with the electroacoustic sounds and their triggering, read the operating instructions of the Dharmapala Circuit.

for pianica and electroacoustic sounds
generated live by the
Dharmapala Circuit



the blocks A, B and C can be combined
simultaneously in pairs.

OPERATING INSTRUCTIONS OF THE DHARMAPALA CIRCUIT

COMPUTATIONAL REQUIREMENTS:

- Linux system with kernel \geq 2.6.27.21-170.2.56 <<http://www.kernel.org>>.
- Pure Data version \geq pd-0.39.3-1 <<http://puredata.info>>.
- Jack audio connection kit <<http://jackaudio.org>>.

INSTALLING THE CIRCUIT:

Unpack the file *DharmapalaCircuit.tgz* (you can use the command `tar -xvzf DharmapalaCircuit.tgz`) and then copy the resulting *Dharmapala* folder to any place in your computer of your liking. This folder contains all the elements needed for the running of the Dharmapala Circuit software, except for Pure Data itself. The Circuit was designed to be run inside Pure Data version pd-0.39.3-1, compiled for the 2.6.27.21-170.2.56 Linux kernel. The Circuit will most likely work with other previous or later PD or kernel versions, but this has not been tested. The pdf files with the schematic-scores containing the specific instructions for each of the eight Dharmapala pieces are enclosed in the *scores* sub-folder.

IMPORTANT: Two LADSPA plugins need to be installed in your system: *flanger_1191.so* and *cmt.so*, which must be placed in */usr/lib/ladspa*. In case you don't have these in your system, copy the available two files from the *libs* sub-folder to that place. This can be done from a terminal (from inside the *Dharmapala* folder) by issuing the following commands:

```
cp ./libs/flanger_1191.so /usr/lib/ladspa/flanger_1191.so
cp ./libs/cmt.so /usr/lib/ladspa/cmt.so
```

INSTRUCTIONS FOR THE PERFORMANCE OF THE PIECES:

- Connect the audio hardware (microphones and loudspeakers) according to the stereo setup of your preference and according to the audio-interface/soundcard of the computer. The video monitor must always be visible to the musician.
- To start the software, go inside the folder *Dharmapala* using a terminal (shell) and issue the command *RunDharmapala*. This command will load all necessary libraries and abstractions and it will start up the Pure Data patch of the Dharmapala Circuit.

- Preparation:
 1. Route the audio in and the audio out between pd and the soundcard via jack. The Dharmapala Circuit receives two mono audio channels, but it uses only one at a given time. Thus, it is possible to have two different inputs connected to the system at once: the toggle button marked "channel" in the graphical interface of the Circuit serves as an audio input-channel selector.
 2. Start the Pure Data Audio On;
 3. The "MonitorOn" toggle in the graphical interface serves to allow the direct monitoring of the input sound during a pre-concert set up. During the performance of the piece, the "monitor" must always be off.
 4. If the sound envelope of the instrument used is too percussive, it may be pertinent to switch on the Limiter. For this, use the "LimiterOn" toggle of the graphical interface.
 5. Set the input volumes, the limiting (if needed), and raise the Master volume to appropriate levels. Always regulate the output using the strongest and most aggressive sounds produced by the Dharmapala Circuit, so that these fill completely the concert hall in the most expressive and impacting way, but without being painful nor damaging to the ears.
 6. Turn the QWERTY keyboard monitoring using the "KeyboardOn" toggle of the graphical interface.

- Performance:
 1. Reset and start the stopwatch typing [0] then [=].
 2. Silently begin the piece by typing [n].
 3. Feed the Circuit according to the instructions and with the sounds and musical structures prescribed in the schematic-score of the respective Dharmapala piece to be played, among the eight ones proposed.
 4. Monitor the temporal dimensions of the piece with the stopwatch. An average duration of about 10 minutes is suggested. Considering the way in which the Dharmapala Circuit works, the musical form to be tried out is a structure that starts calmly, pianissimo and quasi-niente, then develops through several stages of activity, depending on the discretion, fluidity and ingenuity of the musician, and finally extinguishes itself slowly and calmly back to a pianissimo quasi-niente.
 5. If the piece enters uncontrollably in a feedback loop that does not resolve itself (this can happen if the Circuit is fed with certain types of very loud sounds for too long), one can place the patch in "PANIC" mode by typing [del] (observe the reaction of the "PANIC" toggle of the graphical interface). After the feedback loop resolves itself, make the patch exit the Panic mode by typing again [del]. Do remember that everything sonorous that happens during performance will become an integral part of that specific live version of the piece.
 6. To end, wait for a conveniently silent moment and type [z]. There will be a small delicate fade out and the piece will shut itself off automatically. The musician is to be considered dismissed only after the "START STOP on/off" toggle box of the graphical interface places itself automatically in the off position.

SUMMARY OF THE KEYBOARD COMMANDS

- [=] starts the stopwatch
- [-] pauses the stopwatch
- [0] resets the stopwatch

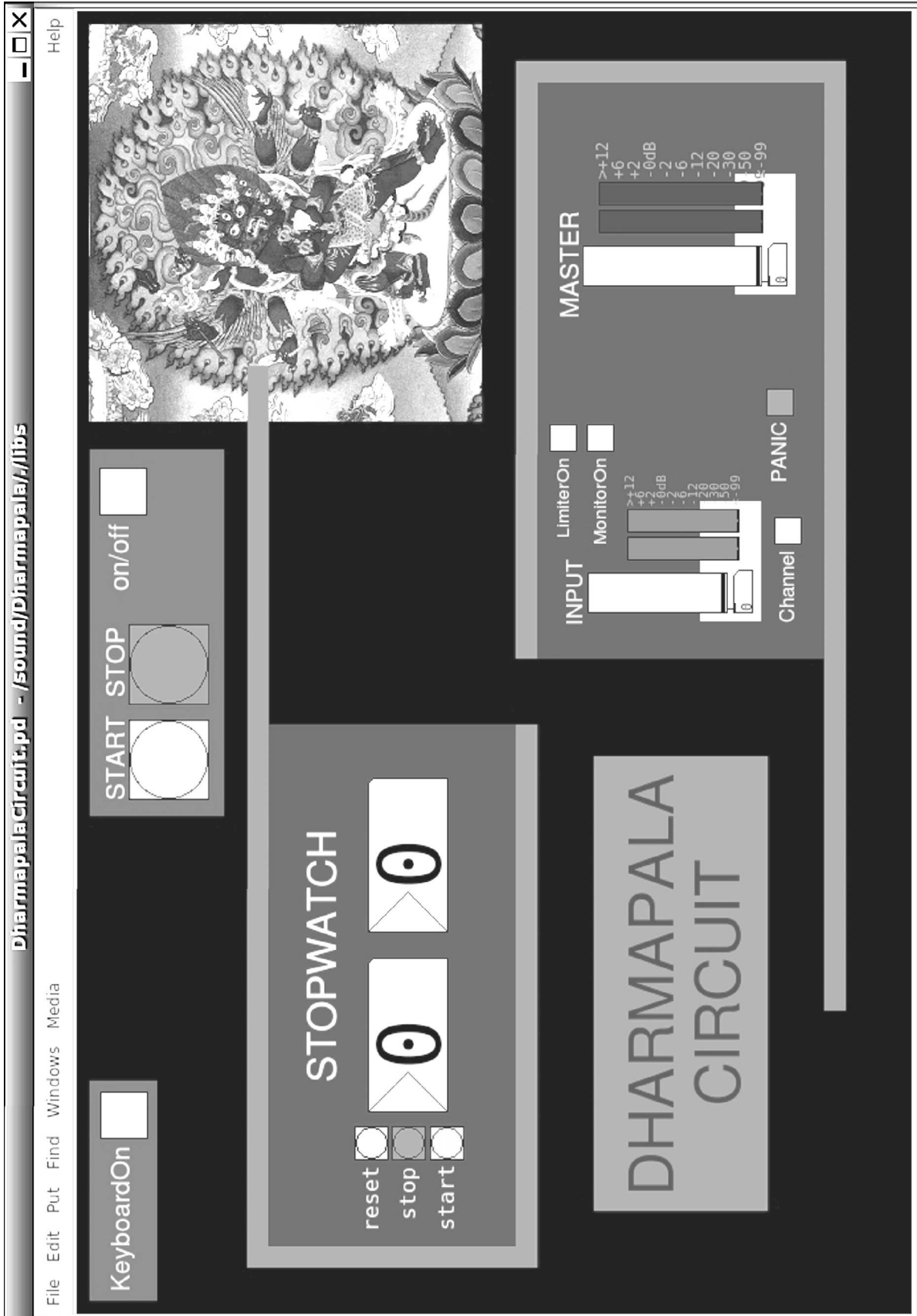
- [3] increases the Input volume
- [e] decreases the Input volume

- [1] increases the Output volume
- [q] decreases the Output volume

- [n] starts the audio processing of the Dharmapala Circuit.
- [z] gently stops the audio processing of the Circuit.

- [del] enters or exits the "PANIC" mode

GRAPHICAL INTERFACE OF THE DHARMAPALA CIRCUIT



LISTING OF THE DHARMAPALA PIECES

- Dharmapala I: YAMANTAKA (the Conqueror of Death), for berimbau (2008);
Dharmapala II: PALDEN LHAMO (the Goddess), for electronic oscillator (2008);
Dharmapala III: VAISRAVANA (the God of Wealth), for kalimba (2010);
Dharmapala IV: TSHANGS PA (White Brahma), for wine goblets (2010);
Dharmapala V: MAHAKALA (the Black One), for pianica (2010);
Dharmapala VI: HAYAGRIVA (Horse-Necked);
Dharmapala VII: BEGTSE (the God of War);
Dharmapala VIII: YAMA (the God of Death);

The Dharmapala Circuit: an electroacoustic environment for sound exploration

Marcus Alessi Bittencourt

ABSTRACT

I present here an analysis of the construction and process of composition of the Dharmapala Circuit, a closed improvisational and exploratory electroacoustic sound environment, implemented with the computer software Pure Data [10]. This Circuit is responsible for the creation in real time of the Dharmapala collection of eight musical works for a solo instrumentalist and real-time electroacoustic sounds, all produced from the live interaction of a musician with the Dharmapala Circuit. We will present here the inspiration and concept for the work as a whole – the Dharmapala collection – followed by explanations on the internal construction of the Circuit, its implementation in Pure Data, and remarks and instructions on the live performance of the piece.

1. INTRODUCTION

In my work as a composer, I have always been concerned with the design of sound and musical objects as well as of instruments of music in a Schaefferian sense [1]. I also have a habit of regarding these musical objects of mine as something like sound characters, which sonorously behave in very specific ways, unfolding in time their inner characteristics. When several of these characters are put together, their own properties and their very interaction serve important structural roles in the compositional logic of my pieces, actually to the point of them being the very source of it. Usually, I tend to work those ideas in the context of very specific sequences of musical fabric, notated with the utmost precision in a score. Nonetheless, I sometimes feel the urge of dismissing the constraints of working with a fixed text and I go after preparing something more relaxed, more plastic, usually in the context of my own explorations as an improviser. Here I point out that the concept of improvisation does entail a thorough knowledge of models, of basic procedures which serve as guides to the improviser in the process of concocting a composition live, in real time. The elements of the musical work here presented function within this context of a non-fixated text, but never failing to set a precise field of operations for the musician, with precise rules of conduct and consequences for the player's actions. These features guide and stimulate the performer to interact creatively with his own musical utterance. In this semi-improvisational context, after entering the Circuit every little thing played by the musician can't be taken back by him and has a musical consequence which escapes his immediate control. All the musician can do is interact with it, learn its aural logic, use it for his own expressive benefit, hopefully guiding it to a meaningful development. The creation of such arena of musical exploration is precisely the inspiration behind this musical work.

2. BACKGROUND OF THE WORK

2.1 On its Musical Concept

The Dharmapala Circuit can be considered an exploratory improvisational environment in a way very much indebted to Pauline Oliveros' work with "Deep Listening" [4] and her seminal electronic improvisational works from the 60s like "*I of IV*" and "*Bye Bye Butterfly*". Conceived as an automatic electroacoustic machine, the Circuit pursued a design that aimed at endowing the output sounds with a recognizable unity of mood and pathos, depending on the type of sounds fed into its input channels by the live musician. Led and stimulated by the live musician, the machine is called to output sounds that seem to behave in very specific and inter-related ways, thus creating the opportunity for the development of a sense of form and direction to the piece. To accomplish this, the Dharmapala Circuit was thought out as a system of interconnected sound chambers resembling a sort of a digestive system, where the incoming sound substances would peregrinate through several stages, undergoing chemical transformations of all sorts, being distilled into their primary elements or combined into bigger molecules, traveling from one chamber to the next. Of course (and most thankfully), this digestion metaphor was never intended to be taken all the way to its unfortunate logical conclusion. The Dharmapala work as a whole was thought out as a collection of several independent pieces, not necessarily to be played all in sequence at the same event. In each independent piece, the musician feeds the Circuit with the sounds of one single instrument or voice according to the purposefully frugal structural schemes of musical motives proposed in the music score of each piece, and the Circuit will magnify the qualities of this instrument, transmuting it into something else, hopefully fierce and impressive, with lots of opportunity for musical nuances.

2.2 On the Name Dharmapala

Dharmapala, "defender of the righteous path" in sanskrit, denotes a member of a group of wrathful Buddhist deities depicted in the iconography as powerful beings with multiple heads, arms and legs, crowned with skulls and parading fanged teeth with their vicious mouths wide open. They are usually shown girdled with chopped-off heads, amidst columns of fire and trampling over their prostrated defenseless enemies. Not exactly evil, their function is to destroy the passions of the mind and protect the Dharma, the righteous path [3]. There are eight Dharmapalas: Yama (The God of Death), Mahakala (The Great Black One), Yamantaka (The Conqueror of Death), Vaisravana (the God of Wealth), Hayagriva (The Horse-necked one), Palden Lhamo (The Goddess), Tshangs Pa (White Brahma) and Begtse (The God of War). All are considered wrathful manifestations of Bodhisattvas: enlightened beings that out of compassion refrain from entering Nirvana to undertake the mission of saving others.

The composition was named after these wrathful deities due to the finalized machine's ability to build with ease not only very menacing, ear-grinding sonorities, but soft, delicate, meditative-like sounds as well, all this in a very plastic way and, if the musician is apt, with drama and panache.

3. DISSECTION OF THE CIRCUIT

3.1 Foreword

I will now dismantle part by part the rather huge labyrinth which became, little by little, the Dharmapala Circuit. True to the concepts enumerated previously, it is composed of five stages, or rather audio chambers, all connected in a very specific and special manner. As a visual aid to the dissection, I included schematics of the several stages. Throughout them, the expression $i\text{-rnd}(x,y)$ means a randomly chosen integer number between x and y , and the expression $f\text{-rnd}(x,y)$ means a randomly chosen floating-point number between x and y . A thick line-arrow denotes a single channel of audio, a medium-thick double line denotes a pair of channels in a stereo setup, and a thin line-arrow indicates data or action streams. Some of the algorithms feature a starting action point, which is marked with a star.

3.2 The Moonshiner Stage

The first audio chamber I devised was thought out as a kind of sound distillery, hence the name "Moonshiner". Although it receives audio (in this case, directly from the `adc~`), it is only used as subject for spectral analysis by an FFT listening unit, and the sound it produces is entirely synthesized by oscillators. The overall sound result of this stage is an ever-changing, rhythmically pulsating web of timbre colors, all derived from the incoming sounds. These colors pile up and linger for a good while, due to a sometimes violent feedback loop, and slowly undergo a process of color replacement by the new incoming timbres. The core of this stage is an automaton which takes snapshots of the pitch spectrum of the current incoming audio and sends over the data to the oscillator banks in the form of a list of the amplitudes and frequencies of the eight strongest partials. It performs this task rhythmically according to a duration scale. Here we use a rather Stockhausen-esque scale of durations [9] based on a harmonic-series of a 50 msec fundamental and its seven first harmonics. Upon choosing one duration figure, the automaton has 66% of probability of keeping taking snapshots at that duration figure rate, and 33% of probability of picking another figure in the rhythmic scale for the spectrum sampling task. The synthesis is accomplished by two banks of eight oscillators each (one for every partial in the FFT data), each bank producing one of the channels of the stereophonic field. For the sake of a "shinning", ever-changing aura-like sound effect, each oscillator has its amplitude independently varied through a swelling machine that continuously adjusts its volume during a time fragment chosen randomly between .05 and 1 second to an amplitude value chosen between -100 and 0 dB. The audio produced goes still through a limiter, to boost some soft sounds inside the timbres and square off at -6 dB some of the loud waveforms, giving a rougher distorted sonority [5] [7], then goes through a reverb unity, set to a large reflective room, and finally leaves the Moonshiner stage. Before going to the limiter, the audio is also sent through a delay line of 1 second in a feedback loop

returning to the FFT listening unit. This will growl back at the performer if he is not attentive, but that is the actual spirit of the thing: after all, this is a musical portrait of Wrathful Deities. Nonetheless, it is still possible that a sound inserted a little too forcibly into the system may generate on its own a massive and never-ending wave of feedback. For this situation, a "Panic" mode was added to the Circuit which, whenever switched on, greatly attenuates the feedback loop of this stage, allowing the massive feedback to dissipate by itself. Anyway, the added limiters do take care of most of the possible distortions, making them more colorful and gritty than painful.

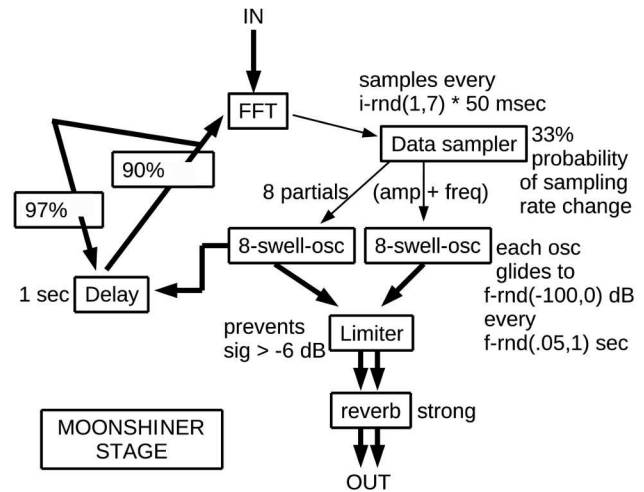


Figure 1. Schematic of the Moonshiner stage

3.3 The Ring Modulator Stage

I couldn't let the Ring modulation effect [5] [7], a most favorite token in my bag of tricks, out of the Dharmapala Circuit. This is also the only stage that allows incoming sound from the `adc~` to somewhat pass directly to the `dac~`, although in a garbled, ring-modulated way. The special feature here is that the frequency of the RM modulator is chosen based on spectral data extracted via FFT from the very incoming sound itself, which will also act as the RM carrier waveform. This, at least in principle, ensures that we will have mostly quasi-harmonic resulting timbres for the ring-modulated sounds [7] and this in a real-time adaptive way, as the incoming sound changes. Another idea I pursued was to have the outgoing sound coated with a nice moving inter-related lilting melodic pattern of timbres, as if the sound spectrum whistled and danced through its own partials. To accomplish this, the FFT data is sampled by a rhythmic automaton similar to the one of the Moonshiner stage, but working with a duration scale based on a fundamental figure of 100 msec (this puts this audio chamber working on a tempo half the speed of the Moonshiner stage one). Instead of sending a list of partials every snapshot, the automaton sends only one of the partial frequencies, randomly chosen among the eight in the data. In order to avoid some unfortunate frequency values and to yet throw in some graininess and a slight increase of inharmonicity to the result, the frequency is validated for use only if it stays between 5 and 5000 Hz and it is transposed two octaves down.

effect on the pitched contents of the incoming memory flux, creating a denser combination of harmonies sharing a natural, just-intonation minor mood (for this concept, see [2] and [6]), used in a rather arpeggiated setting. Upon definition of a grain, the slicer enters a loop mode where it keeps continuously throwing dice and performing, according to the odds, one of the following actions: it can immediately play the current grain (63% chance), it can wait silently a time between .5 and 3 seconds (25% chance), or it can define a brand new grain and play it (12% chance). This sound design clearly yields results indebted to the old-school *sillon fermé* technique [8], but with the insertion of variable, asymmetrical silent gaps in between. Every iteration of a grain will be independently given a stereo panning position and a gain level, ranging between .25 and .75 pan and -20 and 0 dB. Before reaching the exit of this audio stage, the combined sounds from the two parallel slicers undergo a mild flanging effect coloring process and receive a thick layer of reverb.

3.5 The Atomizer II Stage

As one could have guessed by its name, the Atomizer II stage shares lots of features and functionality with its sibling, the Atomizer I, but with some crucial differences. The first one is that the audio buffers here have sizes ranging between 10 and 20 seconds, making the available continuous flux of memory be of a medium-term quality rather than a short-term one. This stage, like its brother, also works with two parallel sushi-chefs, here called "choppers" to distinguish them from their "slicer" counterparts. Instead of a grain, the chopper manufactures what is here called a loop: an ordered and looping string of 1 to 3 grains, each grain consisting of a fragment of size 1.3 to 3.75 seconds taken from anywhere inside the current read-only buffer. This makes the Atomizer II work with quite bigger fragments of sound than the Atomizer I. Each chosen grain is set to play always forward and with a playing speed chosen by a just-intonation minor procedure similar to the one used for the Atomizer I. If there we had results of a rather arpeggiating character, here we have a more scalar end result, working with the 5th, 6th, 7th, 8th, 9th, 11th, 12th and 13th subharmonics of a series where the original pitch level figures as its eighth subharmonic. The just-intonation pitches produced here are more foreign to our equal-tempered scale, with the possible transposition settings being +8.14, +4.98, +2.3, 0, -2.04, -3.86, -5.5, -7.02 and -8.4 semitones, approximately. As one can see, here the pitch range magnification of the grains is considerably smaller than before and in a stepwise fashion. The dice-throwing loop mode of the "chopper" also has different actions and probabilities, namely: it can immediately play the next grain in the loop queue, circling along to the next item in the list (57% chance), it can wait silently a time between .5 and 3 seconds (29% chance), or it can define a brand new loop of grains and play its first grain (14% chance). The resulting mix from the slicer is then sent to an automated stereo panning and amplitude sweller which glides suddenly to a randomly chosen panning value between .25 and .75 and an amplitude value between -20 and 0 dB every time interval of .3 to 2 seconds. Before reaching the exit of this audio stage, the combined sounds from the two parallel choppers go through a delay line of 450 msec with 60% of high-pass (6.5 KHz) filtered feedback, then one of the stereo channels is dephased 100 msec from the other, to create a more spacious stereo image, and the result undergoes some medium

size reverberation. Another important difference between the Atomizers is that while number I works with the synthesised blots of sound color output by the Moonshinner stage, number II receives audio directly from the adc~, completely unprocessed. Thus, here is the closest we can get in Dharmapala to hearing the original adc~ input sounds in an unprocessed manner.

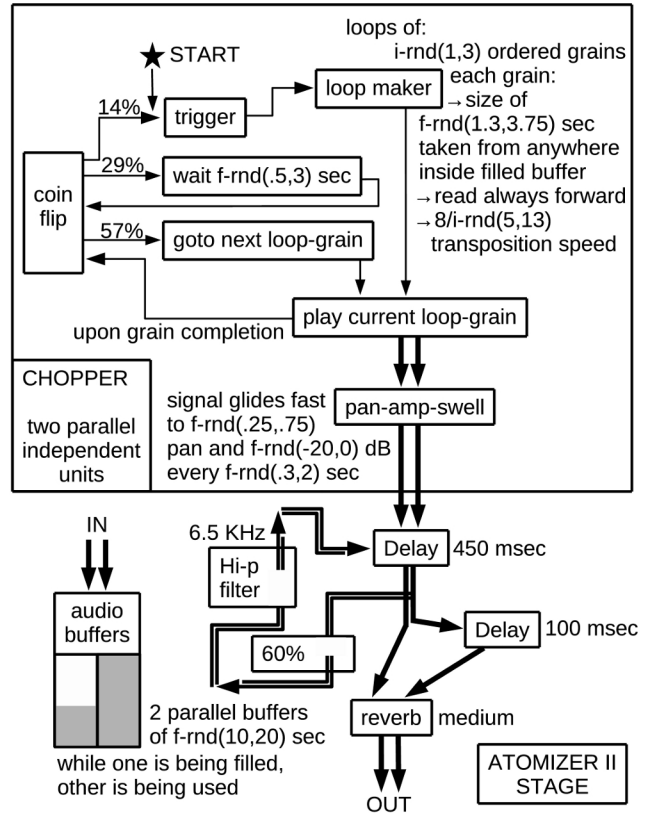


Figure 4. Schematic of the Atomizer II stage

3.6 The Swell Orchestra Stage

The function of this quite simple stage is to create, every time interval between 10 to 30 seconds, a single synthesized, hazy, crescendo-diminuendo style sound object event lasting from 5 to 15 seconds. This sound object represents a medium to long-term timbre memory of the collective past of other main Dharmapala stages and will have its pitch spectrum constructed from the data of a single FFT snapshot containing the amplitudes and frequencies of the eight strongest partials, taken somewhere between 10 to 30 seconds ago in the past of the input of this stage. The synthesis is accomplished by two banks of eight oscillators each, all identical in structure to the ones used in the Moonshinner stage. Each bank will produce one of the channels of the stereophonic field, and each oscillator has its amplitude independently varied through a swelling machine that, during the course of .05 to 1 second, adjusts continuously its volume to an amplitude between -100 and 0 dB. The audio produced by the banks of oscillators goes through a limiter at -6 dB, which serves to boost some soft sounds and square off some of the loud ones, and then goes to a potentiometer which is the actual responsible for manufacturing the sound object. Always closed when idle,

the potentiometer serves to shape the envelope of the object during the course of its chosen duration to the form of a steady crescendo followed by a steady diminuendo of equal size. The last stop for the output signal is to receive a very thick layer of reverb.

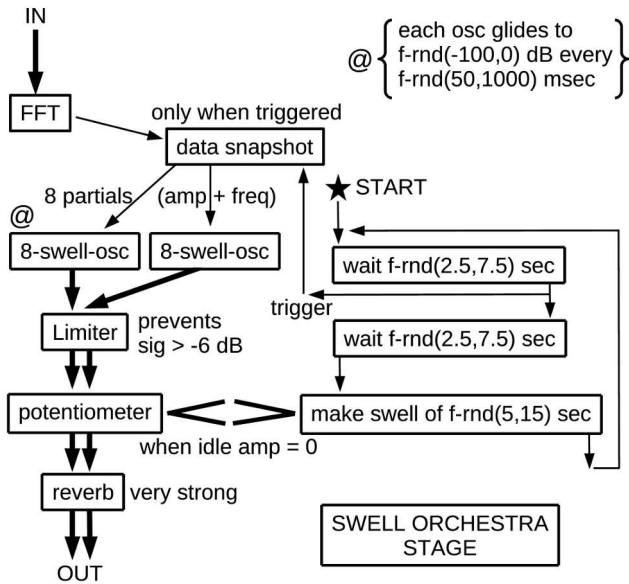


Figure 5. Schematic of the Swell Orchestra stage

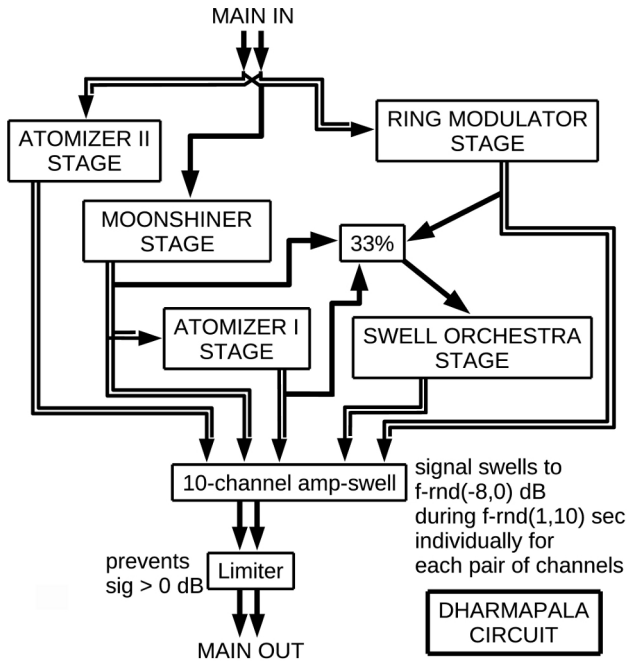


Figure 6. Assemblage of the Dharmapala circuit

3.7 Assemblage of all Stages

The incoming `adc~` input is distributed directly only to the Moonshiner, Atomizer II, and Ring Modulator stages. The Atomizer I stage receives its input from the synthesized sounds output by the Moonshiner stage and the Swell Orchestra stage receives its input from the equally combined output from the Moonshiner, Atomizer I and Ring Modulator stages. The stereo outputs of all five stages are routed to a 10-channel automatic amplitude swelling machine that keeps adjusting individually the volume of each incoming stereophonic pair in a continuous manner to an amplitude value chosen between -8 and 0 dB, during the course of time fragments between 1 and 10 seconds. After this automatic variable mixing stage, and right before being fed to the `dac~`, the signal is yet again hard limited at 0 dB, as a precautionary measure to prevent occasional overflowing.

4. THE PURE DATA IMPLEMENTATION

4.1 General Description

The Dharmapala Circuit consists of a single pd patch containing literally hundreds of sub-patches and abstractions of varied complexity levels. It is a huge maze whose construction required a good deal of trial-and-error sessions, crafting each audio stage individually, testing it with simple control sounds, correcting it when it plainly didn't work or didn't perform aurally as expected, adapting it, improving it until it performed adequately, safely for live performance and according to the musical concepts intended both collectively for the piece and singly for each stage. The version of Pure Data used to compose Dharmapala was the one distributed by CCRMA [11] for the Fedora 10 Linux, `pd-0.39.3-1`. The patch makes use of some external libraries, mainly the ZOOexternals, a collection of experimental objects programmed by myself from 2000 to 2009, and the LADSPA plugin~ object from the flatspace library. The LADSPA [12] plugins used are Steve Harris' `swh` plugin flanger (named "Flanger"), and LADSPA's default `hpf` plugin (named "Simple High Pass Filter"). Regarding the ZOOexternals, it is extensively used throughout the patches. The main objects used are `X_limiter~`, a simple hard limiter, `X_Lbuffer` and `X_Lbufferplayer~`, a pair of objects consisting of an audio buffer for recording directly to the computer RAM and a player that can access fragments of the buffer contents nonlinearly, with a fade-in, fade-out applied, backwards or forward and in any speed transposition, `freeverbit_st~`, a pd implementation of the known freeverb reverb algorithm, `int_between` and `float_between`, objects that pick random numbers from a given range as integers or floating-point numbers, respectively, `Zlist`, a storage device for pd lists, plus objects to operate these lists (`Zlist_size`, `Zlist_element`, `Zlist_shuffle`, `Zlist_append`, `Zlist_sublist`), `fork`, a data stream forking device after the `jMax` fork object, and `Zgate`, a variable multiple outlet routing device. Faithful to a common construction practice of mine, the Dharmapala patch has a colorful main interface that hides all the complexity of its sub-patches, presenting crucial information in a simple way to the performer and providing all the controls and switches necessary for the live musician to operate the whole patch. I have to confess that, for a person interested in studying these patches, their readability is really problematic, requiring a mammoth effort from the reader, mostly due to the non-breaking patch-chords in pd (such patch-chord folding ability is the only Max/

MSP feature I really envy). Nonetheless, once assembled, the whole patch amazingly does work as intended (or so I believe at this moment), and it has been safely producing some "amusing" live music in concerts.

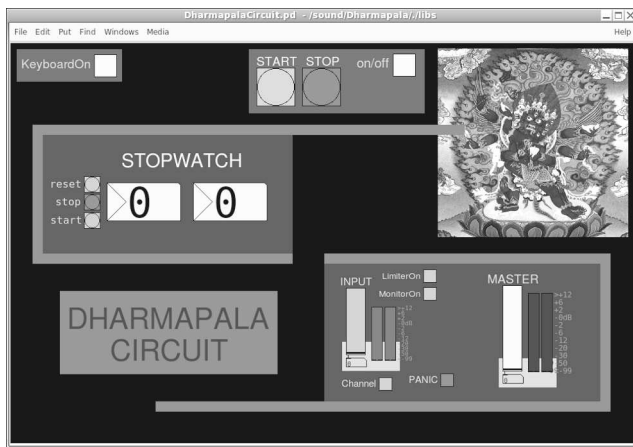


Figure 7. Interface screen for the Dharmapala Circuit

4.2 The Dharmapala Interface

As mentioned earlier, the main colorful pd patch of the Dharmapala Circuit serves as interface between the performer and the automated audio engine. The interface contains switches to turn the audio engine on or off, a stopwatch to help the musician pace himself, VU meters and sliders to control audio input and output. Some commands can be triggered by plain touching the keys of the computer keyboard (with, of course, no "enter" required), and for that we have a toggle box to switch on or off the keyboard listener. The input has a monitor control, which allows the input to be heard directly in the output, useful only as a pre-concert regulation device. The input can be pre-processed through a fierce limiter, which first hard limits the input signal at -20 dB, then amplifies it at +20 dB. This is very useful, if not mandatory, if we are to deal with very percussive incoming sounds, like a Brazilian berimbau for example, for the transients of the percussive attacks can generate garbage FFT data and produce uninspiring shrieks in some of the sound synthesizing audio stages of the composition. The main keyboard keys used for fast access control are: "n", to start the audio engine, "z", to signal it to stop, "0", to reset the stopwatch, "=", to start the stopwatch, "-", to stop it. The performer, in emergency situations, can switch on or off the Circuit patch to the "Panic Mode" (see 3.2) typing "del", and raise or lower the input and output volumes with the keys "l" and "q" for the master volume, and "3" and "e" for the input volume. For safety of operation, the keyboard listener patch waits idle 300 msec after any key has been pressed.

5. THE PERFORMANCE OF THE PIECE

The musician should elect an instrument to play, out of a list of eight possibilities (I have not yet compiled a complete listing, but the number eight refers ideally to the eight Dharmapalas). As we will see later, my first two concert-proven instrument suggestions are the berimbau and a vintage analog oscillator. Very importantly, one has to figure out a way of sending the

sound of the instrument to the computer without feedback from the live electronics. For this, contact microphones come to mind, and this is what I use for the berimbau. To play the piece, basically, after the performer sets his input audio levels and regulates the loudness/softness response of the output (no frying people's ears, please), all he has to do to play the piece is to turn the audio engine on by pressing the "n" key. The performer has to remember that the more he feeds the machine with sounds, the more excited it will get, the more complex its sound output will be. The musician has to listen and react to the sounds produced, conducting the flow of musical activity to interesting places. With the way Dharmapala works, the suggested obvious musical form to be tried is a structure that starts calmly, pianissimo and quasi-niente, evolves through various stages of activity, at the improviser's discretion, guidance and ingenuity, and finally dies out slowly and calmly back to a pianissimo, quasi-niente. The provided stopwatch serves to help the musician keep track of the overall dimensions of the performance. When done, the performer should press the "z" key, which will automatically initiate a gentle and slow fade out (to prevent the musician to inadvertently start new sound activities) and, upon silence, the audio engine will be automatically turned off. That's it.

6. FINAL REMARKS

The lack of a score for the Dharmapala Circuit makes these explanations the only readable form of tracking down for myself and for others what I have intended this composition to be. Regarding my experience performing this piece, its first live concert trials presented two takes on the main concept. In the first movement (Dharmapala I: Yamantaka), the instrument used is the Brazilian berimbau, captured with a contact mike and played in two ways: beaten with its usual stick and stone and played with a violin bow. In the second take (Dharmapala II: Palden Lhamo), we feed the machine with the sounds of a vintage analog oscillator, played live by the musician through the operation of its dials, buttons and switches. The former is a vigorous piece, virile and intense, the later is delicate, subdued, but not without its energetic moments. I consider patcher programs like Pure Data to be the most efficient way nowadays to build a project like this one. With a profound commitment to the open-source community, I elected Pure Data as one of my daily workhorses. I particularly appreciate the way it first opens to us: a blank canvas just waiting to be filled with ideas. It is also extremely reliable and of very safe operation in live contexts. Its handling does require some good patience and ingenuity from us though, but this is usually a most pleasant affair.

7. REFERENCES AND NOTES

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- [11] Planet CCRMA at home. Center for Computer Research in Music and Acoustics, Stanford University. <<http://ccrma.stanford.edu/planetccrma/software>>
- [12] LADSPA: Linux Audio Developer's Simple Plugin API. <<http://www.ladspa.org>>