Live Electronics, Standardization and Tradition.

Within the electronic music field, we can delineate the 'traditional instrument plus live electronic extension' segment. Both composers and players tend to have a critical attitude with regard to the idiosyncrasy of live electronic set-ups and their place in musical tradition. In this article, a method will be suggested for standardizing the use of live electronics and thus moving towards building a tradition. Standardization should be taken as the creation of a possibility to repeat or copy playing/performance circumstances (this includes the copying of the physical live electronic set-up) as to improve the level of instrumental skills. Building a tradition is to be seen as a way to avoid unnecessary and time-consuming re-invention (and not as a reactionary attitude that kills creativity) in order to enhance the quality of 'live electronic' composition and performance practice. Development of a repertoire is part of the equation[1].

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1. Electronics and the classical standard

Electronic means for musical purposes have not only become increasingly more diverse, but also cheaper and therefore more easily accessible. This gives the impression that musical possibilities are now endless, especially in the area of live electronics. The first performance of Boulez' *Répons* in the Donaueschingen Festival (October 10th, 1981) was a complex effort that needed special equipment and several computers running dedicated software. It is safe to say that a lot of the live electronic processing that was in an experimental stage then, can now easily be created on the laptop at home[2]. The term live electronics is used to denote electronic music performed in real-time in a concert situation with live performers creating or controlling their sounds and/or other ingredients by means of electronic devices[3]. Electro-acoustic music can be categorized as follows:

1. Electro-acoustic music on recorded media ('tape pieces').
2. Music for traditional instrument and recorded media.
3. Live electronic music that uses new, specially constructed devices to control and process.

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[1] It is obvious that the discussion on how to build a repertoire of recent pieces of music (of which the premiere is also quite often the derniere) could be started here straight away. It is beyond the scope of this article though.

[2] Several musical principles were explained by Boulez in the live radio broadcast immediately after the premiere, supported by examples played by the ensemble.

[3] A similar definition can be found in Peter Nelson and Stephen Montague (eds.), *New Instruments for the Performance of Electronic Music,* Harwood 1991, pp.85-86

4. Live electronic music that utilizes (a) traditional instrument(s) as the source for processing, triggering and controlling.

This categorization can be applied in a flexible way. There are examples that would fit more than one category [4]. A lot of my work as a performer and as a composer is part of the fourth category. In this article I limit myself to just this fourth category in an attempt to map out the possibilities we have today, hoping that it will result in a more efficient implementation, without claiming to come out with ultimate solutions. Luckily the world of electronic music is too diverse and moving too fast to be able to do that. Limiting oneself is necessary, simply because there are so many different devices, models, software and so on readily available, that it is impossible to know everything or have a full overview. The more knowledge one acquires of a selection that was made, the bigger the chance to come to musically acceptable results.
Whenever I commission pieces for flute and live electronics, I often experience a critical attitude towards the electronics that could be summarized as follows:

- A live electronic set-up is designed especially for only one piece and can only be used for that specific composition.
- A traditional instrument plus live electronic extension add up to a new instrument that asks for its own thorough approach in order to make it manageable in a professional way.
- Live electronics have no tradition, whereby one can refer to a few standardized instruments, preferably with a standard repertoire.

All these points of criticism typically are observations from composers with a 'classical' background, who depend on performances by other musicians and who do not want to write specifically for one player or one ensemble. I feel we need a different way of dealing with this criticism, since there are more angles from which live electronics can be looked at. The contemporary music world has seen an increase in the number of composer-performers, whose role is as important as the one of the 'classical composer'. Furthermore the wall between popular and classical music and their respective music practice has become considerably lower, as one result of which improvisation has become much more respected and important again.
In 1994 the English composer Trevor Wishart formulated his criticism as follows:

> 'In the neomanic cultural atmosphere of the late Twentieth Century, the temptation for anyone labeled "composer" is to build a new electronic extension for every piece, to establish credentials as an "original" artist. However, an instrument builder must demonstrate the viability and efficacy of any new instrument being presented, does it provide a satisfying balance of restrictions and flexibilities to allow a sophisticated performance practice to emerge? [...] For the performer he/she is performing on a new instrument, which is composed of the complex system acoustic-instrument-plus-electronic-network. Any new instrument takes time to master. Hence there is a danger that a piece for electronically processed acoustic instruments will fall short of our musical expectations because no matter how good the performer,

[4] E.g. Kaija Saariaho's *Six Japanese Gardens* (1993) in which the musical result stays very close to a composition for traditional instrument plus fixed media, although the percussion soloist starts the appropriate samples with a MIDI footswitch.

> his or her mastery of the new system is unlikely to match his or her mastery of the acoustic instrument alone with the centuries of performance practice form which it arises. [B]ecause success in this sphere depends on a marriage of good instrument design and evolving instrument practice, it takes time! From this perspective it might be best to establish a number of sophisticated electronic-extension-archetypes which performers could, in time, learn to master as a repertoire for these new instruments develops.' [5]

My response was to take the archetype of the live electronic extension as a starting point, but to put the weight on the technological and, more importantly, the musical functionality of all possible parts, as apposed to thinking in devices, models, brands or the construction of a totally new device. This refers mainly to the first point of criticism: try and avoid the creation of idiosyncratic instruments or set-ups that can only be used for one piece, by one composer or by one performer. It also takes into account that new devices, models or software are being produced in such a high tempo, that all description of their application is due to lag behind.

Although we can implement all the recent developments of computers and their software, which are used in my live electronic set-up as well, my approach to live electronics has hardly changed since I started to apply the archetype in 1998. As a result I can still play the pieces that were written for me from around 1998 until 2000 and they can still be performed and combined alongside more recent work, without ending up changing cables or even modules in my set-up during a concert (which I simply refuse to do because it is bound to create trouble considering the little time that can be reasonably allocated to such an action)[6]. I do feel that this meets Trevor Wishart's assertion that there is not enough standardization to make it possible to master the instrument. We also need to realize that the introduction of live electronics cannot be compared with, for example, the introduction of the electrical guitar. Although a revolutionary new instrument, which was developed ca. 1930 (a standard being created with the appearance of the Stratocaster in 1954) the mastering of it needs exactly the same process as any other traditional instrument, even though it is being used more often in a non-classical environment.[7] The diversity of possibilities to put together a live electronic extension is so big, that we need to consider another angle of looking at it than the one from the 'classical' composer, in order to be able to sensibly judge both performance practice as well as the founding of a tradition. In the meantime we can already speak of some tradition in relation to live electronics. Especially the communication via Internet that results in the exchange of software, patches and ideas has created a context that is very different to anything that occurred in the music world in the past. This counterweights the argument that there is no tradition. Furthermore, like Wishart says, building a tradition needs time and apparently a lot more than the time that passed since the presentation of 'the singing

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[5] Trevor Wishart, *Audible Design*, York 1994, pp. 7-8.

[6] From ca. 1998 until 2000 I was, for instance, involved in the development of a live electronic department at Oxford Brookes University (UK), related to which staff and students wrote pieces for me.

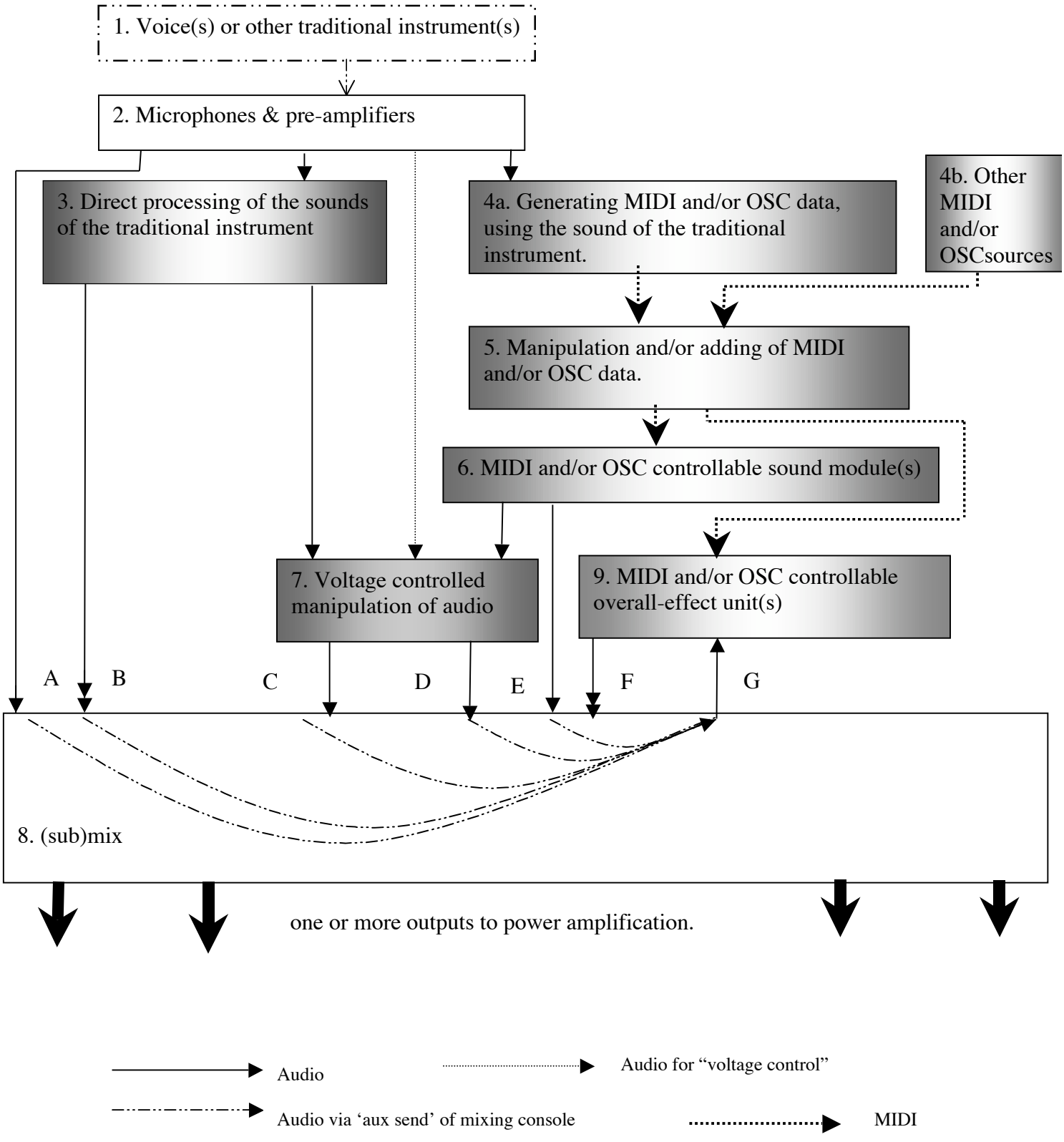
[7] A short description of the Stratocaster and its background can be found in Andy Mackay, *Electronic Music,* Minneapolis MN 1981. It is a book I regularly recommend, especially since the author successfully ignores the wall that still exists between western classical music and 'the rest of the planet'.

arc' by William Duddell in 1899, the introduction of MIDI[8] around 1983, or the increase of accessibility of more versatile computers and software since ca. 1995.

[8] MIDI (Musical Instruments Digital Interface) is a communication protocol that enables electronic musical instruments, computers and other equipment to communicate, control and synchronize with each other in real time.

2. **Archetype of a live electronic extension.**

<Figure 1>



Blocks 2 to 9 form the archetype of a live electronic extension. The grey shaded blocks can contain stand-alone modules, but (part of) their content can also be included in the software of possibly one and the same computer.

Figure 1 is a block diagram that describes the archetype I use. Block 1 comprises one or more traditional instruments and/or voices. Block 2 comprises the microphones and pre-amplifiers, forming the bridge between the actual sound of the instrument and the electronic processing of this sound (a more detailed discussion of this block can be found in chapter 7). In block 3 we find devices that can modify the direct input of the instrument with one or more effects. Block 4a contains devices that can generate MIDI information (such as a pitch-to-MIDI converter) or OSC[9] information. In block 4b more MIDI or OSC information can be added, for instance by means of a MIDI foot controller. The MIDI or OSC information that was generated can be modified, multiplied, delayed, etc. in block 5. These data can also trigger the sound modules in block 6 or the effects in block 9. Samplers and live-samplers, if used, are also part of block 6. New sound sources are added here. Quality and content can be a total opposite of the original sound of the traditional instrument (which is a significant difference with what happens in block 3). In block 7 the output of numbers 3 and 6 are routed through an old-fashioned voltage control. The control voltage is supplied by the traditional instrument, which establishes a strong one-to-one relationship with its own sound and the audio output of all sound sources. In block 8 a balanced sub-mix of all sound sources of the extension is created. This is a crucial element since a balance between the sound of the acoustic instrument on one side and the modified and added sounds on the other contributes to an audible relationship. On this spot it is also determined to which loudspeaker(s) a sound will be routed. Placement and movement of a sound in a concert space (location modulation) is one of the powerful tools of electro-acoustic music. In block 9 all sounds are given the same treatment (e.g. reverb), which can enhance their coherence in amalgamation and make their musical relationship clearer. The diagram makes the following basic assumptions:

- Looking exclusively at the functionality makes this concept independent of devices or software that, more often than not, are only available for a short period of time. Idiosyncrasy can be avoided, or at least be minimized, while there is no exclusion of innovative artist created instruments[10].
- Devices of any manufacturer can be used in the appropriate places in the archetype. Examples of different ways of filling out the archetype are given in figures 2 and 3 at the end of this article: figure 2 shows the equipment I used around 1996, figure 3 what I am using at the time of writing this article.
- Not all blocks need to be used or fully filled out; it is possible to select only a part of the functions.
- Not using a block, or changing its physical content does not change the archetype as such.
- More than one function can be executed by one and the same device (this counts particularly for the computer).

[9] OSC (Open Sound Control is a protocol for communication among computers, sound synthesizers, and other multimedia devices that is optimized for modern networking technology.

[10] Because of practical reasons I have in the past changed certain components of my extension(e.g. replacing a sample player by a live sampling program on the computer) without changing the musical content or functionality of the set-up. Even the particular quality of the sounds could be preserved.

Some examples: In block 2 only one, but also several microphones can be used. In block 3 we can put only a single effect pedal (e.g. a distortion, but also combine it with a pitch-shift performed by a computer that, at the same time, performs the MIDI manipulation of block 5; block 4a can be a stand-alone pitch-to-MIDI converter but the pitch-to-MIDI conversion can also be part of the computer software.

All sound sources are meeting in the sub-mix of block 8:

A: The natural sounds of the acoustic instrument. It is important to make sure that a reasonable portion of the unprocessed sound is part of the total sound output. The balance between the unamplified instrument and amplified sounds from the loudspeakers has to be taken into consideration too.
B: The modified sound of the traditional instrument but not routed through the voltage control. In case B and C are fed with the same effects, a useful balance between the two should be achieved (most likely it will not be necessary to use B).
C: The processed sound of the traditional instrument of which the loudness and colour are modified by the voltage-controlled amplification and filtering (a one-to-one connection with the activity of the traditional instrument).
D: The sound of the added (MIDI) sound modules of which loudness and filtering are influenced by the voltage control.
E: The direct sound of the added (MIDI) sound modules without voltage control. The balance between E and D can be compared with the one between B and C.
F: Sounds of A to E routed via G (a so-called auxiliary send) into an overall effect (e.g. an echo or a reverb) to suggest the amalgamation of all different sounds in one synthetic acoustic environment.
G: The aux. send (cf. F).

Whenever a live electronic extension is used, the most important element to take care of is the creation of audible relationships and a proper balance between the sound of the traditional instrument (this can be its actual sound in the performance space and/or the clean, unprocessed part of the amplification) and the different components of the live electronic extension. The aim is to eventually make the total function as one new instrument and approach the mastering of it as if it were a traditional instrument. The subtleness or quality of the archetype is, in first instance, not depending on the actual choice of devices, but on the manner in which its musical capacities are being used and controlled (part of the control possibilities are explained in figure 1, especially where the mix of sound sources is concerned. As a support I take three assumptions, mentioned by Trevor Wishart in the introduction of his 'audible design' for granted:

- Any sound whatsoever may be the starting material for a musical composition[11].
- The ways in which this sound may be transformed are limited only by the imagination of composer.
- Musical structure depends on establishing audible relationships amongst sound materials.

[11] A point John Cage already made in *Silence* (1968).

From my point of view the second assumption needs a small modification and the word composer should be replaced by musician(s), simply because I am convinced that the contributions of the composer, the sound technician and the performer are equally important in making a live electronic extension work efficiently[12].

[12] c.f. the remark about the fulfilling of different roles in chapter 5, p. 16.

3. Pitch and prejudice.

When traditional instruments or human voices produce so-called musical sounds, it immediately stimulates 'traditional listening', especially when it concerns listening without watching. It does not matter whether sounds are produced from fixed media (using, for instance, an iPod or CD player), as long as these sounds contain enough elements that we can define as readily recognizable, such as regular rhythms, repeated phrases and defined timbre. Pressing play and listening to, let us say, a Beethoven string quartet, a Bach oratorio, a song by Bono or panpipes playing a baidoúska (and getting to grips with the expected tension-release curve or familiar form) is in general not problematic for an average listener. Also when the performers are not visible, most listeners can easily imagine how the string quartet, the choir and soloists and orchestra, the pop singer plus band or the panpiper physically behave to produce their sounds. Everything seems acceptable as long as the sounding material corresponds with what the listener expects to get from a certain medium. In the case of just listening, not watching, it becomes quite a bit trickier if the listener is confronted with Bartok's 4th string quartet (4th movement), Bartolozzi's alternative sounds for woodwind, Beefheart's *Trout Mask Replica* or epic chant from the Balkans. Familiarity becomes even less when listening to electronic sounds by Edgar Varèse, John Cage or Trevor Wishart. Sounds need to be recognized or given a meaning before the step of listening to organization of sound or musical coherence can be taken. Imagining a physical aspect of sound production is no longer self-evident or even relevant. Within this context the combination traditional instruments plus live electronic extension is also problematic. First of all there is still a very limited listening tradition, which means that it is practically impossible to expect any recognition of content or coherence. Secondly the combination has the tendency that its sound production that is hybrid: is it a flute, it is a synthesizer or is it a duo of which each member plays one of these two instruments? Alienation or total incomprehensibility could be the result. The listener can be misled unintentionally which means it is crucial to ensure the production of enough audible relationships between the sound of the instrument and the electronic extension.

There are solutions however. To create audible relationships we can start with the assumption that listeners are able to recognize patterns. An example: when the traditional instrument produces sounds in its low register, distortion is applied and sounds of a vocal nature are being added. As soon as it moves to its higher register, the distortion disappears and the vocal sounds are being replaced by one that is fairly close to the instrument's. After enough repeats of this process (which does not mean that the result is necessarily repetitive or process music[13]) it can be developed or even replaced by another sound object which makes that deviation of what became recognizable as the musical process. The idea is to implement a method (the listener being taught on the way) in which not only the generators of the sound world and that sound world as such can be perceived and assessed but also makes that sound world self-explanatory. The meaning of the sound object within the context of the piece is more important than the object as such or the generator that produces it. Of course many more possible procedures could be given in addition to the example above.

[13] Often erroneously referred to as 'minimal music'.

A practical example: In 2001, I accompanied the Dutch-Catalan percussionist Josep Vicent in a performance that had to use Surrealism as its starting point. The concert took place in the gardens of Castell Gala Dali, a museum in the Spanish town Puból. In the direct surroundings, innumerable crickets made their intense noise. I opened the performance with the triggering of sampled cricket sounds, as a result of which most of the real crickets were falling silent and almost nothing but sampled crickets were left[14]. At first the audience did not realize that the cricket sounds were actually controlled by my playing. Only when I started to play "complex" lines and the crickets were singing along in a perfect unison it was becoming clear that the sound was produced by the live electronic extension and that my flute kept it going. Later in that same performance I presented an "orchestration" of a song by Francis Poulenc (that uses a text by Gala Dali's ex-husband, the surrealist poet Paul Elouard). A large choir of sampled mosquitos sang the piano part, whereas the flute played the vocal line, triggering the buzzing of a fly bouncing off a windowpane. At that point the audience had already gotten use to the sound of insects (the crickets) being connected to my flute playing. Only the perception of the sound content through listening was important here and not necessarily connected to my presence on stage or that of my live electronic extension.

Here we happen upon an important point of discussion concerning the use of samples and sample players (listed under block 6 of figure 1). The examples given here are tending towards using the MIDI sounds as sound effects, artificially reproducing sounds of nature or man-made sounds[15]. This direct reference to reality forms a huge contrast with the relative abstractness of the sound of a traditional instrument or synthetic or electronic sounds. It abstracts the creation of a self-explanatory audible relation within a musical context. It tends towards a theatrical effect. When live electronics are applied, there are two basic considerations:

1. The sound content of the electronics has to have an audible relation with the sound produced by the traditional instrument. If the sounds of the electronic extension could have been recorded on fixed media and played back with the traditional instrument playing over it, the use of live electronics is highly disputable.
2. The musical 'story telling' has to be able to stand on its own feet, also when the visual aspects of the performance are not present.

The fist consideration asks for a proper balance between the traditional instrument and the electronic sounds it triggers. The sound of the traditional instrument has to be a substantial part of the total sound (although not necessarily throughout an entire piece). Its role should not be reduced to being a controller, meaning it only keeps the electronic sound going. It is useful to carefully scrutinize the content of blocks 3 and 6 from figure 1. Block 3 processes the actual sound of the traditional instrument and is therefore completely dependent on what kind of sound is being fed. The audible relation will always stay clear, especially if a clear portion of the unprocessed sound is present in the mix. Roughly the following types of processing can be applied:

[14] Something that was not foreseen, since we had not had a chance to rehearse under the same circumstances (in the evening), but sheer serendipity.

[15] Sound effect as being defined by Patrice Pavis, *Dictionary of the Theatre*, Toronto 1998 (art. Sound Effects), p. 343.

- Influencing frequency:
  - -drastically (distortion, fuzz etcetera)
  - -to enrich (chorus, flange etcetera)
  - -adding transpositions (octave divider, pitch shift)
  - -filtering (equalizer, wah)
- Influencing amplitude (compressor, limiter, noise-gate)
- Influencing time (delay, reverb).
- Influencing location (location modulation: stereo, quadro, octophonic etc.).

Using block 6 has more radical consequences. It literally means the addition of another sound generator, which is able to produce a sound world that can be a complete opposite of the one of the traditional instrument, such as combining the sound of a flute with the sound of a chirping cricket in the example above. A good portion of unirhythm, unison or direct related musical gestures will be necessary to determine whether or not a relation can still be classified as audible, keeping in mind that one cannot or rather should not expect the audience to recognize the live electronic processing or the devices that are being applied to do the processing.
A strong example to illustrate the second consideration (music standing on its own feet) is not a live electronic work but Luciano Berio's *Sequenza V* for trombone. The piece asks for theatrical actions when performed in public and most of the introductory notes are spent on the theatrical elements as apposed to the musical notation[16]. I first got to know the piece through listening to a recording (the Wergo record, Vinko Globokar playing) and I was very impressed with what I heard. Only later, after attending a performance in a concert hall, it became clear to me that the piece had a strong theatrical side. While watching as well, I realized that the musical content of the piece was so strong and clear that the theatrical presentation, although a convincing and in fact an integral part, is not absolutely necessary. The music also beautifully survives without the theatricality.

[16] In addition to Berio's playing instructions, we find extensive remarks on how to perform this piece by the trombonist to whom the piece is dedicated.

4. Watching sound.

Two examples:

1. On stage in a concert hall a violinist starts to play her/his instrument, which is linked to a live electronic extension. From the loudspeakers the sound of the violin and of a mouthorgan are emitted. No mouthorgan player can be seen but it is clear that we are listening to ensemble playing. Is this Surrealist theatre in which reality and elusion can no longer be kept separate?
2. In 1994 I performed with my experimental rock group Kxtahpaph. In one of the pieces (*Oh Elsie*) I triggered samples of my speaking voice with my flute playing. Some of the people in the audience were acquaintances of mine who recognized the sound of my voice and who started wondering how it could be possible to speak clearly and play the flute on the same time.

Live electronics have theatrical potential[17]. Evidently every musician has to be aware of the fact that the audience in the concert space is not only listening but also watching[18]. Applying a live electronic extension makes this awareness even more important. In the two examples given above we can see that the theatrical consequences (whether the magic wand effect is deliberately being exploited or not) are registered by the audience and will therefore influence their perception of the composition that is performed. Some of the experiences I had with music theatre in the past, made clear that a combination of the two art forms does not necessarily make the final result stronger. Unfortunately rather the opposite happened. Possible reasons are:

- To leave enough space for the acting, music and music making are forced into a supportive and therefore marginal role and cannot be developed into a dramatic contribution.
- Musicians are not aware of their theatrical role and do not know how to use their actions (the playing of the instrument) as a theatrical one, or circumstances to do so are not being created.
- The music making forces itself into the foreground and makes the imagery change into a 'tableau vivant' in which, by coincidence, musical instruments are being played.

When live electronics are being used, the balance between traditional instrument and live electronic extension needs to be taken into account especially when it concerns MIDI sound modules or samplers. As apposed to musical material for orchestration, sounds could be interpreted as mere sound effects (artificially reproducing natural or man-made sounds[19]). The example of the crickets in the Castell Gala Dali (see chapter 3, p.7/8) is a typical borderline case.

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[17] The terms theatrical and dramatic as defined by Patrice Pavis, *Dictionary of the Theatre*: theatrical refers to the mechanism of how to perform and dramatic to what is being performed (including a possible fable/fabula) and –especially important in relation to music- the corresponding tension & release curve.

[18] One of the most hilarious reviews that was ever written about my concerts appeared in an Irish newspaper. Especially the graffiti-like patterns of my costume was discussed extensively, whereas hardly anything was said about the music that I performed.

[19] Cf. footnote 11

There is yet another aspect to be aware of. Whenever a live electronic set-up is not an extension of a traditional instrument, it becomes harder for the audience to relate the physical actions that are needed to produce sound to the actual sound production. The recent increase of playing the laptop is an example thereof. The physical action of typing a computer keyboard is a complete antithesis to the dramatic sound world that can be produced by the software. Personally I always end up having the feeling that the music could have had just as easily being recorded on a CD (and therefore should be moved from my category 3 to category 1) and that starting and stopping a CD player would have had the same theatrical impact as the live typing of the laptop performer, which demonstrates that not only my listening but also my watching is based on my prejudice: dramatic sound should preferably be paired with a hard working, sweating musician who struggles with his or her instrument. Another phenomenon I would like to touch upon is using video projection in music performances, especially when the video imaging is linked to the sound. Either visuals controlling sound or vice versa also in this area, technology has become more and more readily accessible (again mainly because devices have become cheaper). Software is available that can influence video imagery using sound sources as a controller. Another option is to use movement, registered by a video camera to control sound. I made use of this last option[20] in a live electronic piece I composed, called *The Longest Mauvais Quart-d'Heure*[21]. Also in this work I have tried to stay faithful to the idea that the music should be able to stand on its own feet, also when the visuals are absent. I do believe that the playing of the CD recordings (without visuals) proves that that is the case. A question that can be asked, though, is whether the audience was able to recognize the connection between the movement of the performer and the electronic sounds she was controlling with it (the singers movement were registered by a video-camera which controlled the sound of her accompaniment) and, even more important, whether combining music and theatricality were contributing to a stronger dramatic result.

[20] *BigEye*, a video-to-MIDI application by STEIM (Amsterdam) was applied for this purpose.
[21] In October/November 2004 this piece was performed several times in Holland and abroad.

5. Ear, eye and imagination.

The discussion, especially amongst musicians, about the application of live electronics seems to hardly have changed ever since its introduction, whilst the opposite is the case with technical developments. On one end we see the urge to judge live electronic music and its performance practice, taking music by Beethoven, Brahms or Bruckner and the tradition that comes with it as a standard. That might seem an obvious way, but is definitely not a very constructive one. At this point in time there is no place for live electronic music in the imaginary museum for music[22], not even for an exceptionally effective work like Boulez' *Répons*. I strongly feel, however, that this is not the thing to strive for. Furthermore, no one will be able to define a linear connection between the development of musical thinking and the increase of the total amount of musical instruments or musical sounds. That is the reason why I propose not to value live electronic devices as such, but to define their musical functionality and then decide whether it can fully, partly or not be used in the musical context that was chosen. An example of a similar line of thinking can be found at the time of writing this revision. The Technical Manual for Pierre Boulez' *Anthèmes 2* states the following:

> 'This manual contains no reference to any specific technology[...] A distinction is made between the principles and processes necessary for the electro-acoustic realization of the piece and the specific means (i.e. the hardware and software technology available) used for the implementation of the piece. Any manual making reference to any specific technology would soon be outdated.'[23]

Making fruitful use of live electronics is only limited by the imagination of those who are using it. A lot of experimentation (possibly with meagre results) is still necessary to establish a tradition in performance practice with live electronics. It has to be a new tradition (an oxymoron) that takes constructive elements from the classical tradition (mastering through dedicated training) but is not getting restricted by it. Those who want to explore this territory will have to work on obtaining a much wider horizon than the classical composer or orchestral player. In this respect it is highly recommendable to look at experiment from all different angles that are useful: the angle of the performer, the actor, the composer, the director and the music technologist, and it does not matter whether these roles are being played by five, four, three, two or even only one person. We have to constantly realize that we are dealing with a hybrid instrument which means the different roles are merging more and more. This is demanding in terms of competence in different areas (I tried to set myself a limit whereby the development of e.g. computer programming skills and gathering of knowledge of electronic equipment does not get in the way of the maintenance of my basic skills as a professional flautist).

What tradition really means and how fruitful it can be for the most recent developments constantly needs to be looked at in an extremely critical manner. In spite of all discussion and both fruitful as well as less fruitful experiments, I

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[22] After Lydia Goehr, quoted in Nicholas Cook, *Music, A Very Short Introduction*, Oxford 1998, p. 31 and p. 134.
[23] Pierre Boulez and Andrew Gerzso, *Anthèmes 2 Technical Manual*, Vienna 2007, p. 2.

personally find the niche acoustic-instrument-plus-electronic-network interesting and rewarding for several reasons:

- First: the freedom of timing. It gets totally lost in the category 'instrument plus fixed media' where a resemblance to karaoke is more than blatant. The option to perform a piece in a tempo and with an intensity that seems to be effective for a particular occasion or in a particular concert hall, whilst the live electronic programming of that piece directly responds to those elements, is creating unique and effective playing circumstances[24].
- Second: I find it useful to see that I evaluate my own playing in a much more self-critical way, since the control of the live electronic extension can demand a more extreme approach in terms of tone production or articulation[25]. One is forced, as it were, to be more flexible with ones instrumental techniques in comparison to the way they are being used in 'classical' playing.
- Third: the options that are offered by a live electronic extension in terms of improvisation. In practically all of my live electronic pieces[26] I have included sections with 'controlled improvisation' in which the interactivity between performer and electronics can be demonstrated. Here it is important to keep an ear out for the danger of making the acoustic instrument degenerate to being just a controller, loosing its role as an indispensable sound generator in the total soundscape.
- Fourth: the possibility to explore my interest in different tunings (other than 12 tone equal temperament, mostly from non-western sources) in my compositions and improvisations, simply because electronics offer a wealth of possibilities to use those.
- Fifth: (and definitely not last) I would like to mention the presence in flesh and blood of a performer, whose physical actions give direct results in both a musical as well as theatrical sense. In real concert life, where people come to a venue to experience a music performance, this will always remain a factor that simply can never be overrated.

[24] An example of successful programming can be found in a piece that was written for me by René Uijlenhoet in 1998, called *Het Geding*. The activity of the flute is translated into electronic activity (using Max and a Yamaha TX81Z synthesizer), practically avoiding a simple one-to-one connection. The activity is represented on the computer screen as 'flute steam' and the increase of flute steam will cause a more intense and dense response of the electronics, thus establishing a clear audible relationship.

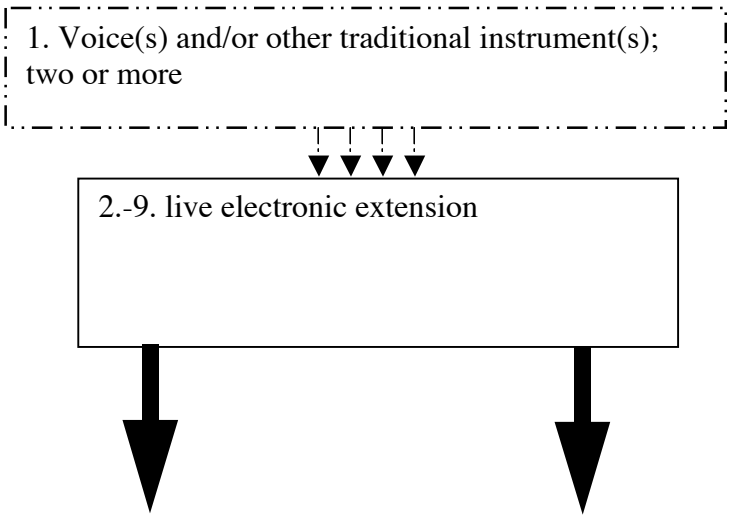
[25] In the case of my flute playing, for instance, staccato might sound perfectly clean with a punchy attack, but the computer software can still analyze a little fade in as opposed to a straight attack. This encourages me to look at staccato in a way that is different to the one used in classical staccato training, which therefore enlarges the possibilities.

[26] Like the piece I developed in 2003, called *The Flight of the Lead Balloon*.

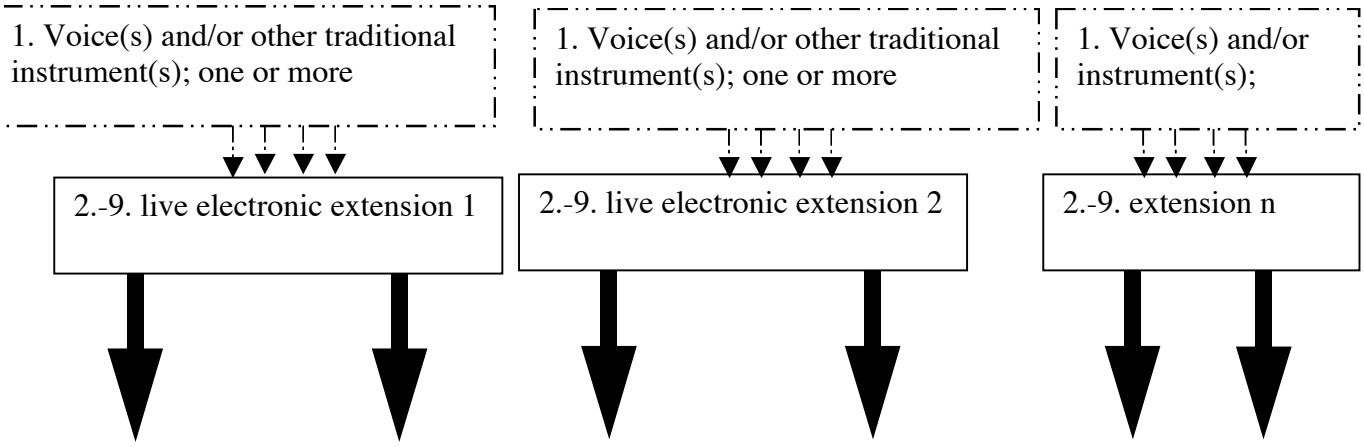
6.Realisations of the archetype.

Before going into more detailed examples of realisations of the archetype I used in past and present, it is worthwhile to make a remark about the usage of (a) live electronic extension(s) in an ensemle situation. Generally speaking, taking the block diagram of figure 1 as the starting point, there are three options to deal with more than one traditional instrument. Figure 2 shows the possibility to use one extension for more instruments[27], figure 3 represents the use of more extensions (each for one or more instruments) and figure 4 adds a module for communication among more extensions to the diagram of figure 3. The numbers in figures 2-4 correspond with those of the blocks in figure 1.

<Figure 2>

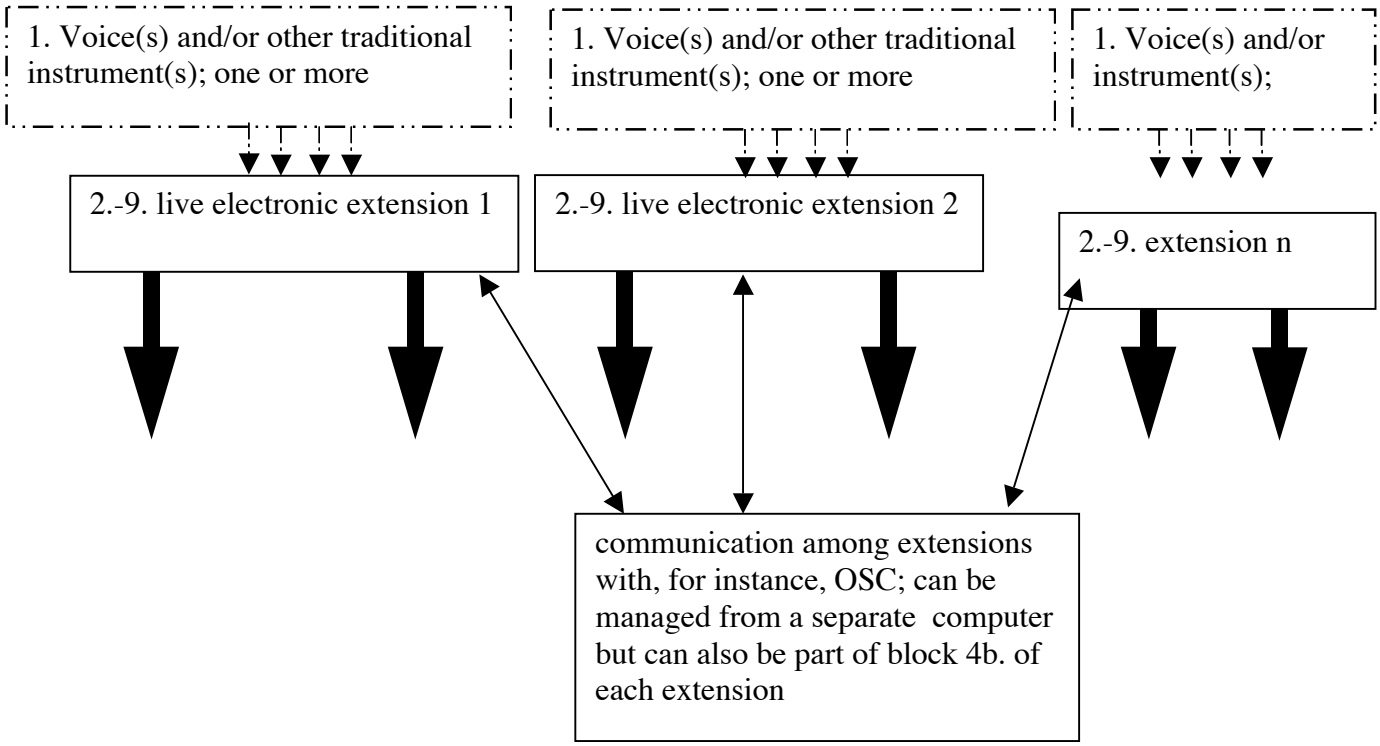


<Figure 3>



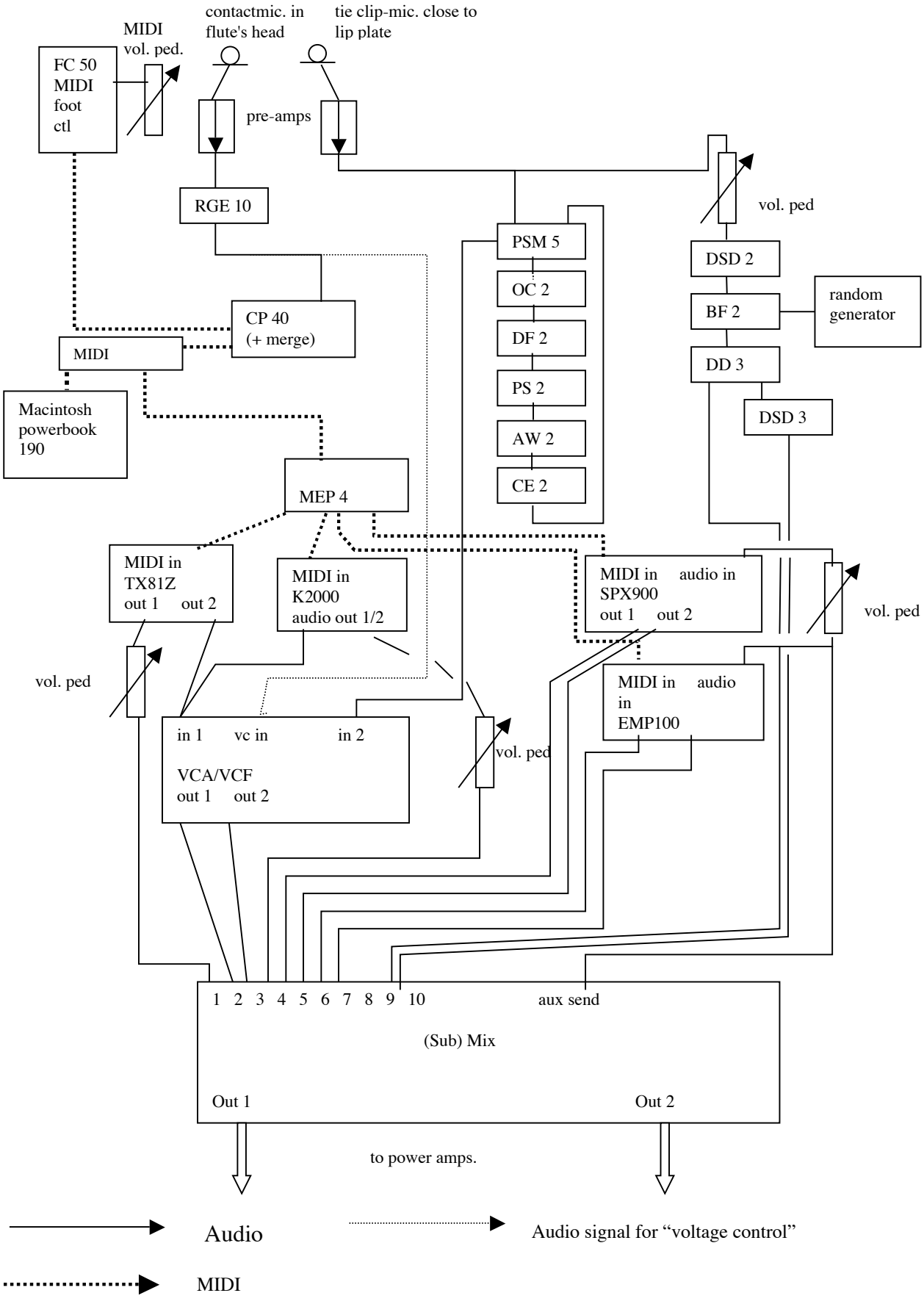
[27] The realisation in figure 7 corresponds with the diagram in figure 2

<Figure 4>



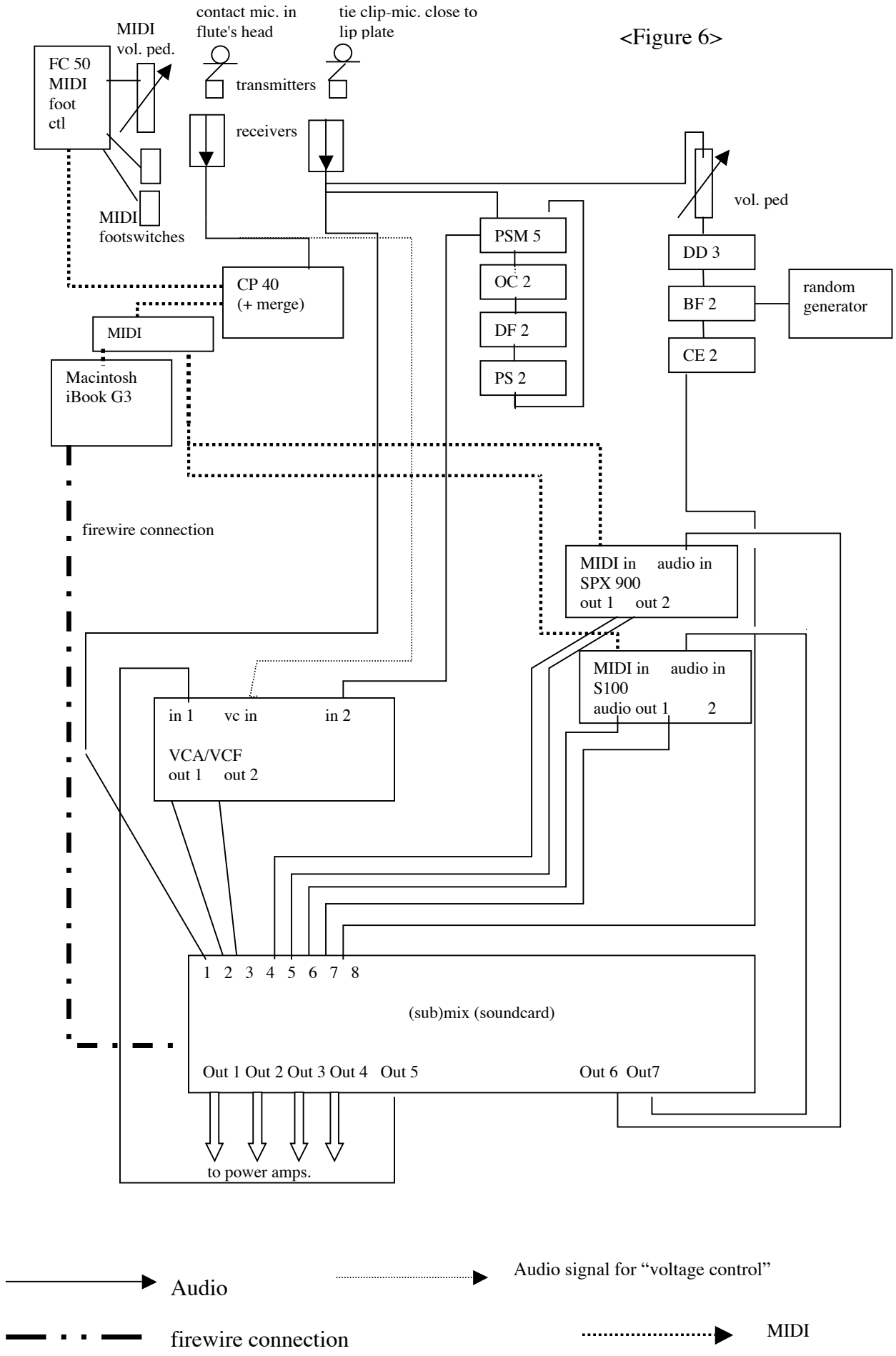
On the next pages three realisations of the archetype of a live-electronic extension are given. I would like to stress once more that, eventhough brands and types are being mentioned, these are not the ultimate or only solution for the role they play. It is partly a matter of taste, sometimes even prejudice or simply availability (it being used because it was there) and definitely not always a well-considered choice.
Figure 5 describes the set-up I used around 1996. Figure 6 shows the set-up as used from ca. 2002/3. Most of the pieces which I performed with the 1996 set-up, can still be performed on the second variant.
Recently, my set-up makes more and more use of the possibilities of the computer, as a result of which even less hardware needs to be carried around, which is especially handy when traveling in our post 9-11 era. An example is given in figure 7. It describes the set-up I used in 2007 for a composition of mine called *Säume Nicht* for voice, bass clarinet, trombone, piano and electronics (which includes video triggering).
It is obvious that the information the diagram gives becomes less and less detailed when more tasks are fulfilled by the computer only (more blocks of figure 1 become comprised in one device); next to figure 7 one should preferably analyse the Max/MSP patch that was used, to see which effects, sample playing, live sampling and so on were applied to which of the four players and how the vca/f was also part of that programming. An analysis of that patch (which is beyond the scope of this article) will make clear that all functions, described in figure 1, are present and most of them multiplied by four (for the four instruments) in just one computer.

<Figure 5>


MIDI
vol. ped.
contactmic. in
flute's head
tie clip-mic. close to
lip plate
FC 50
MIDI
foot
ctl
pre-amps
RGE 10
vol. ped
PSM 5
OC 2
DF 2
PS 2
AW 2
CE 2
DSD 2
BF 2
random
generator
DD 3
DSD 3
CP 40
(+ merge)
MIDI
Macintosh
powerbook
190
MEP 4
MIDI in
TX81Z
out 1 out 2
MIDI in
K2000
audio out 1/2
MIDI in audio in
SPX900
out 1 out 2
vol. ped
vol. ped
MIDI in audio
in
EMP100
in 1 vc in in 2
VCA/VCF
out 1 out 2
vol. ped
1 2 3 4 5 6 7 8 9 10
aux send
(Sub) Mix
Out 1
Out 2
to power amps.
Audio
Audio signal for “voltage control”
MIDI

Module	Remarks	In block #... of the archetype (cf. figure 1)
Contact mic in flute's head joint BarcusBerry, connected to Soundcraft LM 01 wireless	since the mic. is inside the head joint it hardly picks up environment noise. Only used for MIDI triggering and VCA/F	2
Electret mic. Sony ECM 150-T close to lip plate	brings the flute's sound to effects, live sampling and mix	2
Pre-amplifiers TC Electronic	set appropriate levels for effects	2
RGE10 Boss Equalizer	filters frequencies below ca. 250 Hz, avoiding that other sounds than the flute's influence the CP40 or VCA/F	2
FC50 Boss MIDI foot controller	program changes and control #16	4b
MIDI volume pedal	in combination with FC50, generates ctl #16	4b
CP40 Roland Pitch-to-MIDI converter	translates flute's pitch and dynamics into MIDI messages (notes on & off +ctl #11)	4a
MIDI interface Apple	to connect MIDI devices to the computer	5
Macintosh powerbook 190	MIDI processing with Performer or Max.	5
MEP4 Yamaha	MIDI event processor, modifies data of CP40, FC50 en Macintosh	5
TX81Z Yamaha	MIDI sound module, triggered by CP40, FC50 en Macintosh	6
K2000R	MIDI sound module, triggered by CP40, FC50 en Macintosh	6
VCA/VCF custom built (design jz)	voltage-control of effect pedals and selected output(s) of TX81Z and K2000R	7
PMS5, OC2, DF2, PS2, AW2,CE2, (Boss)	chain of effect pedals	3
DSD2, BF2 DD3	second chain of effect pedals	3
Random generator, custom built (design jz)	random change of BF2 settings	3
Mixing console Spirit Folio Notepad	small mixer with only one aux send	8
SPX900 Yamaha	MIDI multi-effect processor for overall effects (such as reverb)	9
EMP100 Yamaha	multi-effect processor for overall effects	9

<Figure 6>



Audio

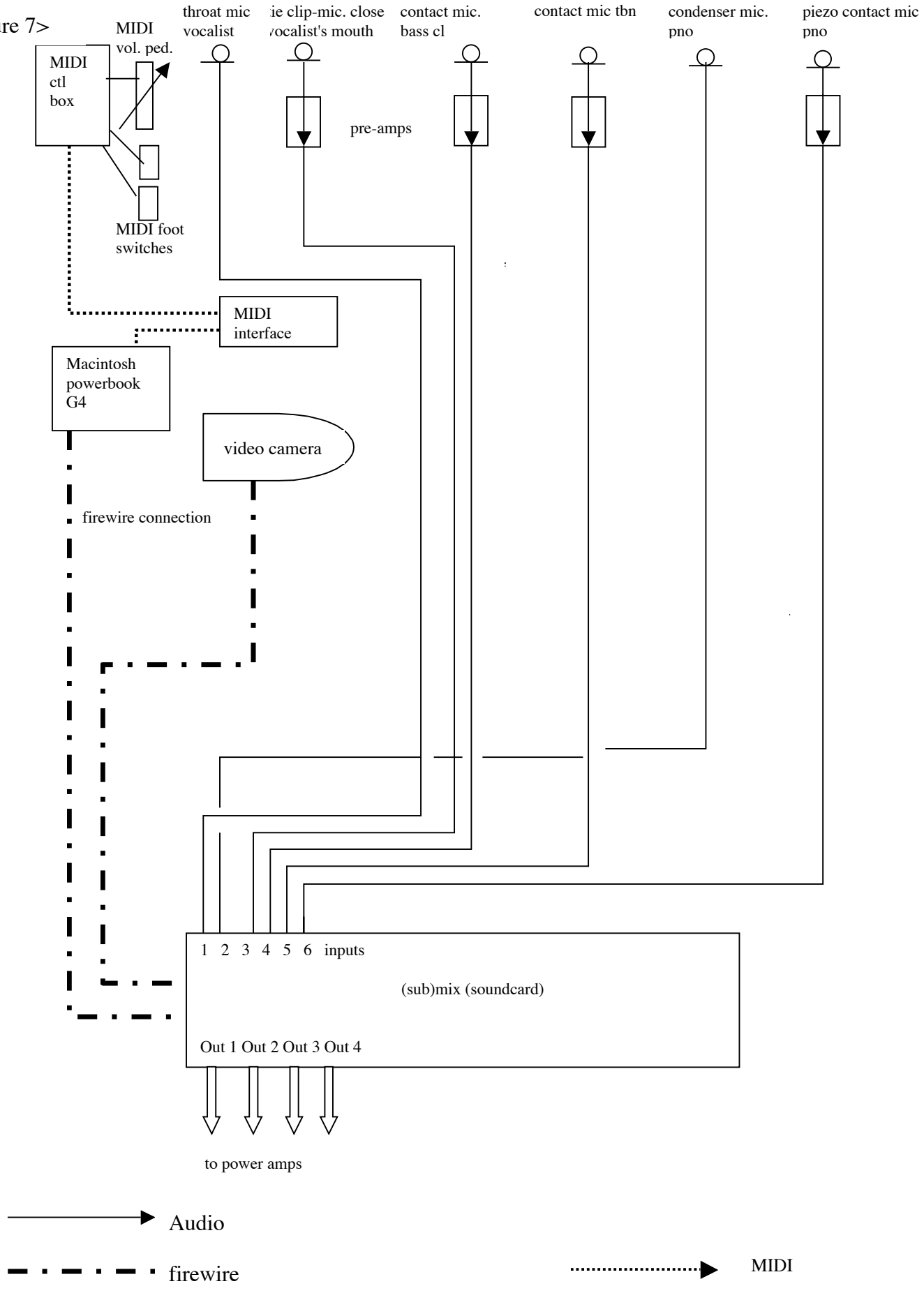
Audio signal for “voltage control”

firewire connection

MIDI

Module	Remarks	In block #... of the archetype (cf. figure 1)
Contactmic in flute's head joint BarcusBerry, connected to Soundcraft LM 01 wireless	since the mic is inside the head joint it hardly picks up environment noise. Only used for MIDI triggering and VCA/F	2
Electret mic. close to lip plate connected to AKG sr40 wireless	brings the flute's sound to effects, live sampling and mix	2
FC50 Boss MIDI foot controller	program changes and control #16, #64 and #80	4b
MIDI control pedal	in combination with FC50, generates ctl #16	4b
MIDI footswitches	in combination with FC50, generate ctl #64 en #80	4b
CP40 Roland Pitch-to-MIDI converter	translates flute's pitch and dynamics into MIDI messages (notes on & off +ctl #11)	4a
MIDI interface, integrated in the Motu soundcard	to connect MIDI devices to the computer	5
Macintosh iBook G3	running Max/MSP, LiSa and Junxion, handling pitch-to-MIDI, MIDI processing, effect processing, sound synthesis and live sampling. Also functions as submixer in combination with the soundcard	3, 4a, 5, 6, 8 en 9
VCA/VCF custom built (design jz)	voltage control of effect pedals and selected soundcard output	7
PMS5, OC2, DF2, PS2, (Boss)	chain of effect pedals	3
DD3, BF2, CE2	second chain of effect pedals	3
Random generator, custom built (design jz)	random change of BF2 settings	3
Motu 828 Mk2	soundcard, handling several tasks in combination with the G4 (see above)	3, 4a, 5, 6, 8 en 9
SPX900 Yamaha	MIDI multi-effect processor for overall effects (such as reverb)	9
S100 Digitech	MIDI multi-effect processor for overall effects	9

<Figure 7>


throat mic
vocalist
ie clip-mic. close
/ocalist's mouth
contact mic.
bass cl
contact mic tbn
condenser mic.
pno
piezo contact mic
pno
MIDI
vol. ped.
MIDI
ctl
box
pre-amps
MIDI foot
switches
MIDI
interface
Macintosh
powerbook
G4
video camera
firewire connection
1 2 3 4 5 6 inputs
(sub)mix (soundcard)
Out 1 Out 2 Out 3 Out 4
to power amps
Audio
firewire
MIDI

Module	Remarks	In block #... of the archetype (cf. figure 1)
throat mic. for vocalist; only picks up resonance of the vocal chords from the surface of the throat.	this mic. does not pick up environment noise; only used for MIDI triggering and VCA/F functions	2
Electret mic. Sony ECM150-T	brings the vocal sound to effects, live sampling and mix	2
Custom built contact mic .inside bass clarinet's mouthpiece	used to pick up sound to process as well as for triggering; this mic does not pick up environment noise.	2
BarcusBerry contact mic. trombone	used to pick up sound to process as well as for triggering; this mic does not pick up environment noise.	2
condenser mic. for piano	brings the vocal sound to effects, live sampling and mix	2
piezo, taped to the piano sound board	this mic does not pick up environment noise; only used for MIDI triggering and VCA/F functions	2
small MIDI control box, custom built	control #7, #64 and #80	4b
MIDI control pedal	in combination with control box, generates ctl #7	4b
2 MIDI footswitches	in combination control box, generate ctl #64 en #80	4b
digital camera Samsung	detects movement of the vocalist which influences certain aspects of MSP processing	4b
MIDI interface, integrated in the Motu soundcard	to connect MIDI device to the computer	5
Macintosh powerbook G4	running Max/MSP, Cyclops, LiSa and Junxion, handling pitch-to-MIDI, MIDI processing, effect processing, sound synthesis and live sampling. Also functions as submixer in combination with the audio card	3, 4a, 5, 6, 8 en 9
Motu 828 Mk2	audio card, handling several tasks in combination with the G4 (see above)	3, 4a, 5, 6, 8 en 9

7. Microphones and functionality

Block 2 of figure 1 contains the microphones that form the bridge between the traditional instrument and the live electronic extension. It is important to distinguish two different functions a microphone can have in a set-up:

1. feeding the extension with the sound of the of the instrument for processing or recording (live sampling); this signal will be used at the level that is audible.
2. feeding the extension with the sound of the of the instrument for triggering and controlling (e.g. pitch analysis to trigger MIDI note numbers[28] or analysis of dynamics to control filtering levels).

The first function needs a sufficient quality microphone that produces a clean representation of the sound of the traditional instrument.
The second function does, in my experience, not necessarily need to be of the highest quality, as long as pitch and dynamics of the instrument can be analysed, even if it is in a way that is relatively speaking simple[29]. The most important factor is that this microphone only listens to the one instrument it is supposed to pick up and absolutely not to the sounds from other instruments in the ensemble or the loudspeakers through which we hear the live electronic sound, which makes this point also valid for a solo instrument plus extension. Only then we can create circumstances where electronic analysis can clearly determine which instrument is playing and subsequently whether it is supposed to respond to it and, if yes, how. In the realisations, described in figures 5 and 6, a clear distinction of the two functions mentioned above is being made, meaning that one micropone has only one of the two tasks.
There are microphones that can perform both functions at the same time however, such as certain contact mics. for string instruments[30]. Also the pick-ups of an electric guitar or bass guitar are a clear example of such combination.
I've always felt surprised that these considerations are hardly ever explicitly taken into account in scores of live electronic pieces, although the distinction of which intrument in a live electronic ensemble is active is absolutely vital, technologically as well as musically.

[28] pitch-to-MIDI conversion
[29] The BarcusBerry, mounted in the tuning cork my flute's head joint, is a typical example thereof. I never use it for audio processing, but only for pitch-to_MIDI purposes, or to drive a VCA/F (cf. figure 5 and 6).
[30] Here it is difficult again to avoid mentioning brand names. Examples are a BarcusBerry contact mic. for brass, mounted in the mouthpiece or piezo-like mics. which are clamped in the bridge wing cutout of a violin, viola, 'cello or contrabass by Schertler.

8. Bibliography

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Mackay, Andy
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Nelson, Peter and Stephen Montague (ed.)
1991 *New Instruments for the Performance of Electronic Music*. Chur: Harwood Academic Publishers.

Pavis, Patrice
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Wishart, Trevor
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9. Discography

Luciano Berio, *Sequenza V*
Vynil: *Luciano Berio*
performed by: Vinko Globokar
Wergo WER60021

Pierre Boulez, *Répons*
CD: *Répons et dialogue de l'ombre double*
performed by: Ensemble Intercontemporain, Boulez
Deutsche Grammophon DG457605

Pierre Boulez, *Répons*
recording of 'Musica Nova' dutch radio broadcast (NOS, radio 3) of the first performance in Donaueschingen in 1981 (jz's personal library)

Jos Zwaanenburg, *Oh Elsie*
CD: "Hard Age"
performed by: Kxtahpaph.
Anserine Music ZJ001

Jos Zwaanenburg *The Longest Mauvais Quart d'Heure*
CD: *The Longest Mauvais Quart d'Heure*
performed by:Watt?
FMR records FMRCD174-i0505

10. Software sources

Information on the software that is referred to in this article can be found on the internet. Links to downloads (of demo versions) and documentation can be found there too. Below one can find the appropriate web addresses.

LiSa: a live sampling program for Macintosh by STEIM Amsterdam.
<http://www.steim.org/steim/>

junXion: a Macintosh tool which allows translation, mapping, rerouting and processing of incoming data from a variety of sources (MIDI interfaces, joysticks etcetera) and convert it into outgoing MIDI data.
<http://www.steim.org/steim/>

Max /MSP: a graphical programming environment for music, audio, and multimedia
<http://www.cycling74.com>

OSC: Open Sound Control is a protocol for communication among computers, sound synthesizers, and other multimedia devices that is optimized for modern networking technology and has been used in many application areas , a list of which can be found on the website below.
<http://www.cnmat.berkeley.edu/OpenSoundControl/>