Rough-hewn Hertzian Multimedia Instruments

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ABSTRACT

Three DIY electronic instruments that the author has used in real-life multimedia performance contexts are scrutinised herein. The instruments are made intentionally rough-hewn, non-optimal and user-unfriendly in several respects, and are shown to draw upon experimental traits in electronics design and interfaces for music expression. The various different ways in which such design traits affects their performance are outlined, as are their overall consequence to the artistic outcome and to individual experiences of it. It is shown that, to a varying extent, they all embody, mediate, and aid actualise the specifics their parent projects revolve around. It is eventually suggested that in the context of an exploratory and hybrid artistic practice, bespoke instruments of sorts, their improvised performance, the material traits or processes they implement or pivot on, and the ideas/narratives that perturb thereof, may all intertwine and fuse into one another so that a clear distinction between one another is not always possible, or meaningful. In such a vein, this paper aims at being an account of such a practice upon which prospective researchers/artists may further build upon.

Author Keywords

Multimedia, Performance, Hertzian Design, DIY

CCS Concepts

•Applied computing → Media arts; Sound and music computing; •Human-centered computing → Empirical studies in interaction design; Empirical studies in HCI;

1. INTRODUCTION

This paper discusses three distinct DIY instruments—namely, 'THEBRICK', 'EMFME', and '*Hyperstition Bot*'—that the author has built and used in the context of real-life performance contexts. In some detail:

THEBRICK (Fig. 1) is a programmable device in a die-cast 140x215x105mm aluminum enclosure, capable of multichannel audio/video output and text printout, and featuring a minimal and rather cryptic UI.

EMFME (Fig. 2) comprises (a) an inductive loop in an electrically shielded square antenna (outer perimeter is 500x500mm, and a transversal section approximately 35x35x35mm), and (b) a line output driver for the loop hosted in a 75x145x105mm die-cast aluminum box.

Hyperstition Bot (Fig. 3) is an approximately 300x300x300mm block of concrete, with a net-wire facade, and enclosing an entire computational ecosystem that is, *inter alia*, capable of multichannel video, stereo audio, and text output.

Figure 1: THEBRICK.

The above instruments are examined hereinafter in the context of particular artistic endeavours, with the aim to provide an empirical account of an experimental hybrid practice where electronic instruments, their improvised performance and the poetic/aesthetic traits they pivot on may all intertwine and fuse into one another. In this vein, the different ways in which the design of the above instruments affects performance are outlined, and their overall consequences to the artistic outcome and to individual experiences of it are discussed.

Having briefly introduced the three instruments and the scope of this treatise, a section on background and related research follows. Then, the subsequent three sections scrutinise each instrument, respectively, with reference to related artistic endeavours. The following Discussion section is concerned with ramifications thereof, and zeroes in on how instruments of sort affect multimedia composition or performance as well as individual audience experience. A conclusion section follows.

2. BACKGROUND

Figure 2: **EMFME.**

Figure 3: **Hypersition Bot**
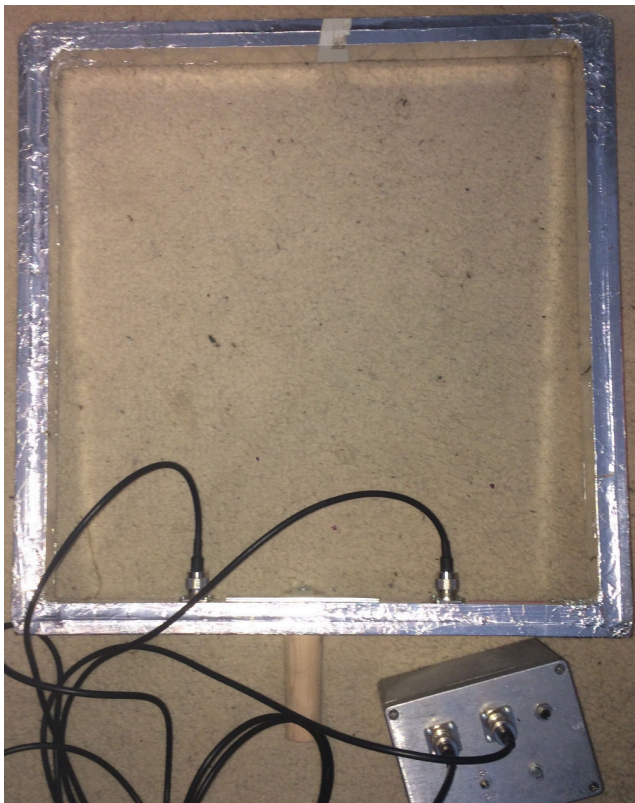
Following the recent thrust of relatively cheap and open-source prototyping hardware, and selectively drawing upon prior design/research practices concerning, *inter alia*, interactive art [14], HCI [8],[19], and DIY electronic music [16],[4], contemporary research in bespoke instruments and interfaces for music or multimedia performance is at its peak since at least a decade. Conferences such as the NIME series[1], TEI[2], or ICLI[3] regularly present relevant research concerning everything from physically re-configurable wearables [13] to computational embroideries [17], and from wine glass instruments [1], to gesture controlled augmented harps [18].

The author's research draws on a number of resources that are either theoretically, or practically, concerned with non-functional, experimental, hybrid, and 'post-optimal' instrument/interface design. The most important one to be straightaway mentioned is Dunne's account of 'Hertzian' critical design practices [5]. Dunne's work is an explicit call to explore the aesthetic and critical potential of electronic objects outside canonical commercial and functional norms. He specifically addresses the question of 'user-unfriendliness' in aesthetic and broader cultural respects. Drawing upon Dunne's work, the question of how to creatively challenge traditional 'hylomorphic' interaction paradigms [10] becomes the primary motor behind this endeavour.

Research literature is abundant in examples insofar as experimental instrument making of sorts is concerned; a few examples follow for reference. 'Ad hoc instruments'—that is, instruments that are produced in the course of interacting with them—and 'infra' instruments—that is, instru-

[1] http://www.nime.org Accessed January 27, 2020

[2] http://tei.acm.org Accessed January 27, 2019

[3] http://live-interfaces.github.io Accessed January 27, 2019
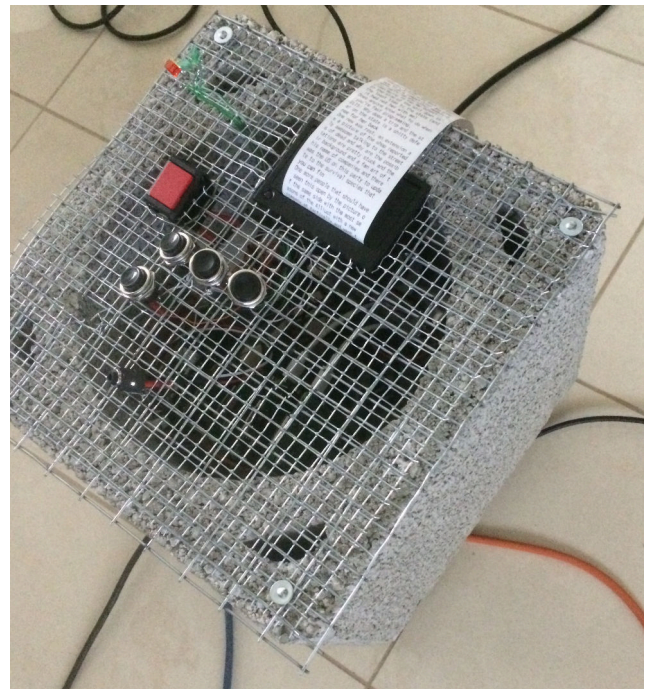
ments with restricted interactive potential—are discussed in [3], and [2], respectively. The idea of embroidery/knitting as some kind of computational interface has been explored in a few cases [17], [15]. A detailed account of empirical research pivoting on the use of rare minerals in art/music is found in [7], where the author suggests a 'literal critical' approach to DIY electronics that simultaneously employs the raw materials components are made of, while critically examining their material foundations. Human-plant instruments and other 'ecosystemic' approaches to site-responsive audio composition are discussed in [6].

Arguably, in many of the above cases DIY instruments embody and, eventually, become the very logic of the original artistic endeavour, so that the latter is meaningless without reference to the former. While it is, indeed, possible to talk of, *e.g.*, site-responsive human-plant instruments well within the norms of functional/commercial design and not necessarily in an experimental/hertzian fashion (this is not, of course, the case in the above given example), it remains entirely impossible for a project that critically examines the material foundations of some employed technology to do so without reference to the actual deconstruction of the latter. In the case of an 'ad hoc' instrument or of a truly 'literal-critical' approach, DIY making and the purposes it supposedly serves are, to a great degree, fussed with one another.

The instruments scrutinised herein are all inspired by such projects. Still, they should not be thought of as direct offshoots thereof. The motivation behind their construction is not to explore some intellectually articulated idea. Instead, their design and operation ought a lot to the particular logic/essence of the artistic projects they are associated with, and *vice versa*. This is further explained in the next three sections where the three instruments are presented in detail and in their proper context.

3. THEBRICK

THEBRICK has been originally made for the *Sāk vitt ok vītt of verǫld hverja* project (hence on, *Sāk vitt*), that concerns

a multi-level exploration of the North Nordic landscape in terms of image, video, audio, interviews, scientific data sonification, gastronomy, and various found, as well as, fabricated artefacts. THEBRICK originally emerged as an *ad hoc* instrument to facilitate live multimedia performances with materials of sort in diverse performance scenarios— *e.g.*, audiovisual, audio-only, video-only, multichannel audio. Fig. 4 illustrates a real-world performance set-up with the instrument alongside various other objects/artefacts that are encountered in *Sāk vitt*.
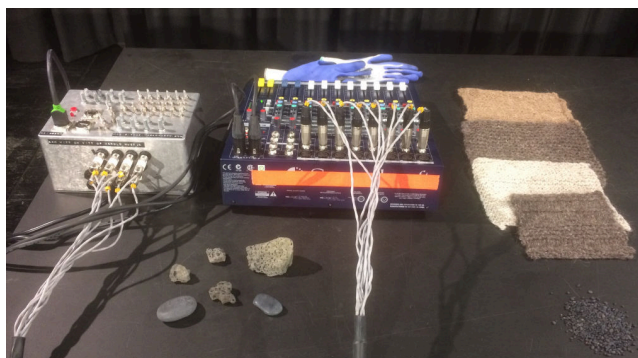

Figure 4: *Sāk vitt ok vĩtt of verǫld hverja* **real-world performance set-up (Dokk 1, Aarhus, DK, 2019).**

THEBRICK is a programmable device capable of realising live video, image, audio, data, and text printouts in loosely structured fashions. In this way, it may both fuel multimedia improvisation within certain constraints, as well as aid define what exactly these constraints should be about. It has been envisaged not so much as a "solution" to presenting *Sāk vitt* related material, but, instead, as an experimental instrument that would further nonstandard performance/composition schemata in this certain context. That is to say, that the particular multimedia narratives to be realised by the instrument did not preexist it, but rather emerged in the process of building, programming, and improvising with it.

The instrument comprises two distinct single-board computers that may perform arbitrary tasks with respect to the available inputs, outputs, and hardware controls. In principle, one of them is responsible for multi-channel sound synthesis: it can drive up to eight unbalanced audio outputs and may process up to two channels of input audio (even if this feature has not been put to use hitherto). The other reproduces video and/or text by means of an HDMI output and a built-in thermal roll paper printer. It features three distinct UI zones (plus a fourth that is merely responsible for selectively turning the integral micro-computers ON/OFF) that respectively control, printing, video/image reproduction, and audio synthesis.

The printing UI features seven toggle switches, plus one more for mode change, so that up to 14 different printing routines may be triggered. *Sāk vitt* performances typically involve printing scientific data or cooking recipes and sharing them with the audience. Fig. 5 illustrates the instrument printing such a recipe. Another six lapse switches are utilised to selectively trigger the six available streams of video. The audio UI features eight toggle switches to select one among the available audio parts, another eight ones to change subparts within them, and several knobs that are assigned to various synthesis parameters with respect to the active subpart. Each subpart comes with its own interaction schema, so that, *e.g*, on one, the first few potentiometers would control the volume of simultaneously reproduced audio files, while on another the same potentiometers would affect the speed and the density of a granular synthesis data sonification algorithm. Feedback from the instrument is rather spartan: there is a green LED blinking whenever video plays back, and a red one that flashes once and slowly, whenever different parts are selected, or a few times and rapidly, on subpart changes.

Figure 5: THEBRICK printing a recipe.

Realising a particular multimedia narrative with THE-BRICK calls the user to select video parts for reproduction, to load the desired audio parts/subparts and to improvise with them, and to print (and possibly share with the audience) paper strips at the appropriate moments. Audio/video parts should be thought of as mini-narratives comprising performance elements to improvise with; they do not necessarily correspond with one another, nevertheless. Once a video part is selected, its integral parts are reproduced sequentially and the user may only pause this stream, or switch to a different part altogether. Once an audio part is selected, the user may spend an indefinite amount of time improvising with the available synthesis parameters, before s/he moves the next subpart in an incremental fashion, or before s/he switches to another part. In practice, most audio subparts eventually die off after a few minutes, and only offer a minimal degree of performance freedom so that at every given moment the performer may select among just a few limited alternatives. Then, the material loaded to the instrument would typically allow for the realisation of a few different possible multimedia narratives (and, of course, contingent versions thereof). It should be noted that certain data sonification algorithms aside, most subparts pivot on the juxtaposition of audio recordings of various sorts.

Employing such an interface in an experimental fashion and in order to assemble meaningful multimedia narratives from the available material has arguably led to very different outcomes than what, *e.g.*, straightforward timeline-based sequencing would result into. Here, emphasis is put on groups of related micro-narratives and gestures that may be realised contingently and that may be juxtaposed with one another in a few different fashions. Such an approach is in tandem with *Sāk vitt* being all about exploring a broad geographical region in many phenomenological and cultural respects and in not strictly demarcated fashions. In any case, decisions on what particular kind of material should be loaded on THEBRICK, and what particular multimedia narratives should the performer strive for during a live act, have largely taken flesh in the process of building and improvising with the instrument.

4. EMFME

EMFME is a VLF receiver comprising an electrically shielded antenna sensitive to the magnetic part of electromagnetic waves, and an appropriate driver circuit to convert registered activity into an audio signal that can be subsequently amplified and/or recorded at will. The overall design loosely draws on Feletti and Romero 'IDEALLOOP'[4]. EMFME is a very simple instrument to use: one simply holds (or fixes) the antenna against an EMF field to immediately audify it into a line audio signal that may be recorded or amplified *in-situ*.

EMF has been originally conceived for the *Tactics Against Antiquity: The Contemporary Ancient Messene* (hence on, *TAA:TCAM*) artistic endeavour—a site and occasion specific 50' and approximately 1Km long technologically mediated sound-walk within the ancient city of Messene in South Pelopenese (GR). It took place in the context of the Tuned City festival, the June of 2018. *TAA:TCAM* aspires to expose the contemporaneity of the ancient city and to foreground its being a place that is sociopolitically and culturally practiced in present time and in order to generate (convenient) historical content, while, at the very same time, it remains a habitat accommodating a wide range of nonhuman species and objects that ever interact with one another to bring forth localised phenomena of all sorts. The endeavour draws on the authors prior research insofar as soundscapes, soundwalks, and 'peripatetic' approaches are concerned [9]. Throughout the actual public performance, the author lead the audience through the ruins of ancient Messene employing a portable loudspeaker, microphones, miscellaneous probes, and other instrumentation, *inter alia* audifying and amplifiying localised EMF, acoustic, and geophysical phenomena.

Figure 6: EMFME in the context of *TAA:TCAM*

EMFME is employed here to explore the area for EMF activity during a preparatory exploration phase, and is also utilised during the actual soundwalk in an improvised fashion: audifying naturally occuring magnetic currents while walking Southwards alongside a small water stream. It has been especially designed to be used both as the technological means to register EMF activity and, much more importantly, as a very prominent performance element in itself. As demonstrated in Fig. 6, EMFME arguably adds a certain theatricality to the event, and proclaims an explicit DIY ethos throughout. These aspects are of particular poetic and aesthetic relevance to the *TAA:TCAM* project which

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[4]http://www.vlf.it/feletti2/idealloop.html Accessed October 13, 2019

has been envisioned in the first place as pivoting on the juxtaposition of all sorts of technological means, and of their acoustic output, with the ancient city ruins. EMFME contributes substantially to such a vein in phenomenological terms, soundly introducing bespoke DIY technology to (an otherwise technologically sterile) archaeological site.

5. HYPERSTITION BOT

Hyperstition Bot is designed for the purposes of the homonymous artistic endeavour. The device features an entire local network of micro-computers inside a block of concrete and beneath steel net-wire. It comprises four micro-computers, two fans, a network switch, a power supply, and a thermal printer. Each of the micro-computer asks, and if the main network allows so, is assigned a specific IP address by a built-in network router. One of them runs an instance of an Evolvable Media Repository—a rather complicated system to crawl the WWW for related media content at regular intervals and in an evolutionary fashion [12]. Accordingly, it forwards the retrieved media to the other nodes so that a series of modular synthesisers may utilise them to generate new content algorithmically and in an automatic and unsupervised fashion. In some detail, these synthesisers concern (as of the first version of the work):

text an AI system that is ever-trained on retrieved music lyrics in order to algorithmically generate and print text output

video three distinct video synthesisers fragmenting and mashing up video files retrieved over YouTube

audio a context-aware sound synthesis module generating three channel output audio

3D data a synthesis module generating 3D-models—roughly based on the author's prior research on generative solid modelling employing data retrieved over Thingiverse [11]

Figure 7: Hyperstition Bot exhibited in *Children of Prometheus*.

Fig. 7 illustrates the device as installed in the *Children of Prometheus* group exhibition in Limassol (CY) November–December 2019. In this particular exhibition only the video and text synthesizers are active. It should be underscored that *Hyperstition Bot* is still a work-in-progress so that the device is expected to be upgraded sometime in the future

with additional synthesis modules and, maybe most importantly, with social media uploaders.

But for the various cables needed to interface the device with the outside world, the interface here is spartan as the device is not meant to be operated in the first place, but merely to be switched ON/OFF and let do work alone and unattended. There are four black push buttons that turn each of the constituent micro-computers OFF, and a relatively sized red toggle button that powers ON everything contained in the device but for its power supply (that is turned on automatically when the instrument is plugged on electricity). There are, also, four LEDs, that will merely indicate whether each of the constituent micro-computers is indeed ON. The same LEDs can be also used to the allow audience download generated 3D on their portable storage devices (by means of blinking in different patterns to indicate that some storage device has been detected as well as that the download process has finished and that the device is unmounted and safe to remove).

Hyperstition Bot, more than any of the other instruments discussed herein, proves itself particularly non-optimal and user/audience unfriendly. It is bulky, heavy, and at the very same time rigid, fragile, and dangerous to fiddle with. Concrete makes the device rock-solid and heavy, but at the very same time susceptible to crumbling. Accordingly, moving/installing the instrument is both made more difficult and potentially more dangerous. The net-wire on top is rough-edged and will cut through flesh and cause minor injuries if touched recklessly. To boot, dangerous electric currents appear near the power supply so that touching the instrument is entirely inadvisable. Yet, the device is also rather fragile since it comprises sensitive electronic equipment that should not be tampered with and, thus, should be kept dust/moisture free. The various buttons, LEDs, and the thermal printer are, in turn, loosely mounted and only afford gentle pressure else minor damage would occur.

In such a fashion, *Hyperstition Bot* brings forth a certain kind of dialectics between materials and design strategies that are not very often seen together in the context of electronic devices and cybernetic systems. Construction materials are juxtaposed with rather delicate electronic components, while a certain 'see but do not touch' quality is advertised throughout (even if some certain cautions have been taken, of course, to ensure that no one will be seriously hurt if they follow the instructions).

6. DISCUSSION

All three cases presented heretofore celebrate a prominent hertzian attitude towards interface design—one that draws on both DIY nonfunctional aesthetics, as well as on instruments as agents of/for new, original, or alternative ways to create, perform, and eventually make-sense of particular materials and processes in situated creative contexts. In all these cases, the pursue of some clear-cut predetermined 'ideal' is decelerated, if not altogether abandoned, so that a post-optimality of sorts becomes an intentional and desired trait. This is not merely for the sake of some technological or design fetishism—or at least not exclusively for it—but, instead, because it can be a genuine creative force enabling both creators and audiences to operate well outside their usual comfort zones. Insofar as the projects discussed above are concerned, it is argued that this is indeed the case in all phenomenological and pragmatical respects.

Pinpointing the artistic consequences of the various instruments, all three of them are shown to make possible nonstandard compositional paradigms in some respect. As already discussed, THEBRICK is not the means to actualise

in situ an otherwise pre-composed narrative, but rather the means to come up, and to compose, a series of such narratives in the first place. Then, *Hypersition Bot* ends up being the very composition it is supposed to realise. Indeed, the generative logic governing the multimedia output is distributed among the various integral software/hardware submodules, so that it is impossible to formally abstract the former—part of the process remains ever-disclosed to intentional, emergent, and fortuitous cross-interactions between the system's constituents. In simpler words, the instrument implements an algorithm that is only fully defined later on, and with respect to the specifics of this particular implementation. In turn, EMFME makes it possible to immediately listen to the otherwise inaudible and invisible EMF activity in a location. The *TAA:TCAM* soundwalk is, accordingly, contrived to follow a route where it is indeed interesting to listen to such phenomena, so that the eventual composition is, at least up to some extent, grounded on the new possibilities opened up by EMFME.

It is worth emphasising, that while some element of interdependency between a composition and the instrument(s) to actualise it can be said to exist in all cases, not all approaches to composition, and certainly not all approaches to instrument building pivot on, or aim at, creatively exploring this inter-dependency—see [10] for more on this topic. The three instruments discussed heretofore are all shown to be built so that they largely further nonstandard, and otherwise not possible, experimental composition paradigms. The same cannot be argued for all (similarly looking) NIMEs. Consider, *e.g.*, Franco's 'MITT'[5], which does resemble THEBRICK in that they both feature a minimal interface with no immediate indication on how it should be used. Yet, MITT is clearly meant to enhance performance options, while THEBRICK clearly aims at restricting them, and in diverting the composition process towards altogether different grounds.

Their multimedia output aside, it is quite obvious from the provided illustrations that all instruments under scrutiny herein bear unique phenomenological footprints. They all advertise their being DIY, cryptic, and with unspecified purpose or mode of operation. Being encountered almost exclusively in a performance/exhibition context, they naturally trigger the curiosity of attendees so that audience awareness is somehow alerted towards the design and the operation of the instruments. This typically leads to more active audience engagement, *e.g.* asking the artist questions about mode of operation or technologies/techniques employed.

The case of EMFME is rather special in that, through casting perceptible an environmental property that is normally concealed, it intensifies a certain sense of being-in-a-place. On the contrary, both THEBRICK and *Hypersition Bot* further a rather 'schizophonic' dislocative effect. In the context of their parent projects, living audiences confront the tension between reproduced audio/video that is often very descriptive and highly referential in nature (concerning, *inter alia*, on location recordings, and excerpts from popular music or films), and bespoke (even nonsensical, if encountered from a functionalist's eye) technology that does not immediately relate with the former. This may imbue a Schaeffer-ean, 'reduced', listening mode in certain cases; notwithstanding, without reference to the broader laptop-music or acousmatic traditions, but rather with respect to DIY approaches such as Bowers [2] or Richards [16].

Finally, to present in real-life performance or exhibition

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[5]`https://prynth.github.io/instruments/mitt` Accessed April 20, 2020

contexts technology that proclaims such prominent rough-hewn aesthetics and an overall DIY ethos is, on its own sake, an act that bears rather bold political/ideological connotations. Links with, *e.g.*, anti-functional, anti-mass-production, or anti-capitalist rhetorics are evident. From a strictly phenomenological stance, these instruments resonate a certain aura of non-optimality (potentially suggesting dysfunctionality, non-usefulness, unpredictability, unintelligibly, danger, fragility, failure, haphazardness, *etc*), so that, in this way, they soundly announce the artist's preference for experimental and *ad-hoc* tactics insofar as both instrument design, and artistic performance, are concerned. Accordingly, in situated performance/exhibition contexts, audiences are implicitly called to inhabit an ideologically charged space so that they may, or may not, engage with the work presented at an intellectual level as well.

7. CONCLUSION

Three multimedia instruments that have been made intentionally rough-hewn and non-optimal are presented hereinbefore, and the particular ways in which they relate and/or embody the particular concerns their parent projects revolve around, have been elaborated upon in some detail. The particular consequences of their interface, and of their overall design, to the eventual multimedia outcome is scrutinised accordingly. It is then shown, that in all cases and to a varying degree, a strict hylomorphic understanding of the compositional process altogether fails. These instruments do not merely implement predetermined composition/performance ideals but, instead, pragmatically precondition and co-formulate them with respect to the constraints of their interface and to the particular logics governing their making. In this vein, it is demonstrated that the creative potential to affect and to define an eventual composition largely lies in their being rough-hewn. Interface 'user-unfriendliness' and hertzianess of design results in devices that may no longer function as means that simply give flesh to otherwise pre-composed narratives. Instead, composition tactics are themselves co-produced with respect to the instruments and the broader artistic affairs they pivot on, in a recursive and mutually reciprocal fashion. The instruments also incur content at a symbolical/ideological level that, in turn, further re-conditions the the phenomenological specificity of a performance. Having demonstrated how exactly the above manifest in real-life contexts and with reference to the actual processes that they simultaneously rely upon and aid actualize, it is eventually argued that in the context of such exploratory artistic endeavours, hertzian instruments of sorts, their improvised performance, the material traits or processes they implement or explore, and the ideas/narratives that perturb thereof, all intertwine and fuse into one another in a hybrid practice.

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