

EDITORIAL

Ubiquitous music: Culturally grounded approaches to interaction and creativity**Damián Keller^{1*}**, **Victor Lazzarini^{2*}**, and **PerMagnus Lindborg^{3*}**¹Amazon Center for Music Research (NAP), Federal University of Acre, Rio Branco, Acre, Brazil²Department of Music, Maynooth University, Maynooth, Co. Kildare, Ireland³SoundLab, School of Creative Media, City University of Hong Kong SAR, Hong Kong, China

“Ubimus” is a neologism formed from the combination of two words: ubiquitous and music. Rather than a fixed or static set of techniques and tools, it may be understood as an ethos or a movement. This fluidity might be problematic for newcomers to this field because there is a strong tendency within established musicological and technological artistic research toward formalization along genre lines. Within the ubimus community, music is described as an experience influx that may incorporate both tangible and intangible resources.¹ However, outside of ubimus, there is a recurring tendency to objectify music as sound or, in tool-oriented terminology, as an object or “a thing.” This oversimplification equates music to a product or a process constrained within a specific infrastructure or a musical genre.

Spearheading an alternative to a reified perspective on music, second-wave ubimus frameworks tend to incorporate versatile notions of musical processes,² such as flexible temporalities, aesthetic pliability, and musical stuff. The present Special Issue engages with these concepts as components of the endeavors documented in this volume, while providing an overview of recent ubimus developments to set the stage for the analysis of results from a culturally grounded perspective.

Rather than prescribing ready-made solutions or attempting to impose an overarching paradigm, the ubiquitous music community strives to establish bridges between current artistic and scientific initiatives that stem from diverse perspectives with the aim of expanding access to creative music-making. As a result, this volume highlights the community efforts to overcome both geographical and cultural boundaries in creative pers included in this Special Issue were authored by contributors riginally from or currently based in three continents.

1. Think, design, and deploy

Frameworks, not rules or genres, should guide practice. Over the last few years, we have observed several ubimus initiatives coalescing around key concepts linked to emergent ways of doing. “Paradigm” is not an appropriate label for these forms of musical knowledge because an established paradigm involves the accumulation of a significant body of evidence through replicable and falsifiable procedures.³ While it can be argued that practice-led research yields replicable forms of knowledge, it is challenging to determine whether alternative approaches to music-making are effectively falsifiable. Furthermore, selecting a specific approach may involve a complex set of dynamically interrelated factors that are informed by cultural traits. This is possibly why part of

***Corresponding authors:**

Damián Keller
(dkeller@ccrma.stanford.edu);
Victor Lazzarini
(victor.lazzarini@mu.ie);
PerMagnus Lindborg
(pm.lindborg@cityu.edu.hk)

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the aesthetic views of the 20th century has been packaged as prescriptive directives strongly aligned with idiosyncratic choices rather than proposing strategies to encourage experimentation or critical thinking (on this issue, see the analytical perspective laid out by Windsor, 1995⁴).⁵¹

Within ubimus, a creative cycle involves at least four stages: think, design, deploy, and share. Each of these stages includes material, social, and temporal properties, thus enabling full musical experiences. To be validated, a framework would need to support the deployment and replication of musical experiences, without imposing genre-specific boundaries. Consequently, the label “framework” provides a reasonable fit to the genre-agnostic aims of deployable ubimus support, emphasizing design qualities such as explorability, discoverability, diversified aesthetics, and non-hierarchical social interaction.

Since 2018, ubimus proposals have strengthened their complementarity of purposes, encompassing a search for concepts and methods tailored to current aesthetic needs, while incorporating advances in technological infrastructure with the aim of tackling either exploratory or previously established musical practices.⁶ Examples of initiatives to recover legacy resources are provided by ubimus archaeologies,⁷ musical internet-based proposals,⁸² ubimus sonification, and auditory display techniques.⁸ In particular, ubimus-oriented sonification may require an increased awareness of the cultural context.

Acoustic-instrumental thinking limits creativity to actions exerted by humans on resonant objects designed exclusively for humans. The incorporation of multiple temporal and spatial scales within sonification-based music-making scenarios, involving both human and non-human agents, helps to dissolve the artificial boundaries enforced by acoustic-instrumental thinking. Approaching sonification from a ubimus perspective, Lazzarini and Keller^{9(p14)} point to a search for “new conceptual frameworks that address a musical presence that has become widely distributed, increasingly ephemeral, increasingly mundane, less centralized, less manageable, and as a consequence, less obvious.”

According to Lazzarini and Keller⁹, a question emerging from the confluence of auditory display methods with ubimus research is how to manage or, alternatively, how

to bypass the categorizations of musical genres. Genre-agnostic frameworks, such as ecologically grounded creative practice and ubimus-oriented computational thinking, may be applicable to a wide range of cultural scenarios. However, genre-centric sonification techniques probably demand further adaptation to yield replicable and shareable knowledge.

The collective performance proposed by Vincze and Oeser¹⁰ indicates that dealing with musification within the context of distributed group-based creative activities that involve casual participants presents a persistent methodological challenge.^{11,12} Furthermore, sonification techniques may enhance the palette of improvisational approaches that intersect with ecological thinking, as recently exemplified by Aliel *et al.*'s¹³ “ecomprovisation” proposals. This research thread implies a raised awareness of the impact of contingent factors on aesthetic decision-making. Therefore, neither the enforcement of simplistic mappings nor the mechanical incorporation of internet-based resources is enough to tackle relevant local cultural traits.³

Some researchers, such as Bhagwati¹⁴ and Lewis¹⁵, have argued that centralized and hierarchical temporalities tend to reinforce a hegemonic notation-based aesthetic, typical of the acoustic-instrumental perspective. The flexibilization of temporalities is an interesting research question because it resonates with a growing resistance to corporate-controlled generative techniques.¹⁶ A central issue here is not whether the participants choose any particular genre but whether their choices are restricted to legacy genres by design. The difference is subtle but consequential. If the ecology of tools and resources only allows for behaviors that reproduce commercial genres, then there is a tendency to reinforce both the existing musical assets and the ways of doing. Over several iterations, the variability of resources tends to be reduced until reaching a highly homogeneous bulk of regurgitated materials. This dynamic is much easier to control and monetize than the open-ended practices that work from local resources and tacit knowledge.¹⁷

Reification contributes to the corporate tendency to monetize internet-based musical resources. Turchet and Rottondi^{18(p1786)} highlight the centrality of reification within the context of Internet of Musical Things (IoMusT) endeavors: “Music-related information refers to data sensed and/or processed by a musical thing, and/or communicated to a human or another musical thing for musical purposes. A musical thing is a device capable of sensing, acquiring, actuating, exchanging, or processing

¹ This is, of course, open to discussion. An initial critical reading from a ubimus perspective of the philosophical groundings of music is sketched in Keller *et al.*⁵

² Ubimus research features frameworks centered on the Internet of Musical Things and on the Internet of Musical Stuff (see Messina *et al.*⁸ for a detailed treatment of this topic).

³ Our aim here is to highlight a research gap. Future frameworks may, in fact, address the complex and delicate balance required by the incorporation of local resources and the use of automated data-gathering procedures.

data for musical purposes.”^{18(p1784)}. For instance, the usage of ecosystem implies constraining its meaning to the realm infrastructure, “the core components of an IoMusT ecosystem are of three types: (i) musical things, (ii) connectivity infrastructure (e.g., wireless sensor networks based on Wi-Fi or 5G), (iii) applications and services.”^{18(pp1786-1787)} Despite these caveats, if the limited scope of the deployment of musical things is kept in mind, some features of this initiative can be repurposed as contributions to ubimus frameworks. The proposal of a semantic representation of IoMusT components is a case in point.⁴ This proposal features computational classes that can be incorporated as components of platforms, such as the Ubimus Plugging Framework, to move toward the development of ubimus embedded infrastructure.¹⁹

Given the extant pressure toward reification, a valid question is whether ubimus can be characterized as a research area focused on “musical things.” Well, musical things are valid objects of study when employing resources of the Internet of Things, one strategy among many to expand the available spaces for musical actions.²⁰ Nevertheless, ubimus frameworks are not just infrastructure. They also involve creative processes that are neither static nor tied to an isolated technological asset. Turchet and Rottondi^{18(p1786)} stress this fact: “It is important to note that ubimus is not statically linked to a particular set of applications and that it is an evolving area of research. While it has concerns that cross-cut into networking technologies and musical practice involving these, that in itself does not necessarily [define] the area.” Hence, the implementation of infrastructure remains a strong thread of ubimus developments. But its deployment is parsimonious to avoid undue restrictions on musical experiences. This indicates that the usage of the term “paradigm” for infrastructure-oriented frameworks is problematic.

Ubimus practice emphasizes parsimonious deployment of technological resources (economy of means) and the support of computational thinking. Ubimus frameworks foster musical experiences as a way to assess the caveats and opportunities granted by specific technological resources in an effort to gauge the impact of music-making on local communities of practice. Deployability, sustainability, and respect for the commons are typical targets of ubimus research. These qualities are independent of any musical genre or idiolect that may be chosen by the designers or participants. They highlight the need to consider musical activities not only as strategies that enhance and improve social interactions, but also point to the environmental implications of creative actions exerted within the local socio-technical ecologies. As a result, ubimus frameworks

strive for a parsimonious incorporation of technological means, highlighting a heightened awareness of the potentially negative impact of the current corporate push toward digitizing everyday settings, particularly in sensitive spaces such as the domestic environment.²¹ Therefore, the term “economy of means” is applicable to two stages of the ubimus development cycle: design and deployment. When applied to design, it involves caring for the commons and awareness of the long-term impact of design choices on the environment. When applied to deployment, it entails prioritizing terseness, local resource usage, and aesthetic pliability.

In this Special Issue of *Arts & Communication*, Jagwani and Lazzarini²² present the Interactive Audio Toolkit, which focuses on the seamless integration of sound generation with sensors to create interactive sonic experiences with low-power, low-cost microcontrollers. This C++ toolkit is structured around sensor input and audio output classes, providing a straightforward programming interface to generate flexible audio responses from sensor data. Their paper details the toolkit’s structure, components, and interface, highlighting its ability to foster new forms of sonic and musical support for artists and audiences. A case study of an installation utilizing the toolkit is included.

The Interactive Audio Toolkit initiative aligns well with a line of ubimus research stemming from do-it-yourself and maker community experiences.²³ It also aligns with efforts to simplify and make computation hardware accessible to a wider range of users, as discussed in Brown and Ferguson.²⁴ This approach also connects to the idea of re-appropriation and re-targeting of technology from non-musical to musical applications. A typical example of this is the use of computer-driven motors as sound-making devices within an ecosystem of electro- and mechano-acoustic sources.²⁵

Their approach to accessibility provides an answer to the management challenges that emerging technologies pose to ubimus design. Although provided as a library in C++, it supports a friendly entry point similar to the widely used Arduino-style programming. It also resonates with the approach taken by the ubimus plugging framework,²⁶ which features pluggable components for high-end computing devices, enabling fast prototyping and deployment. This aspect of ubimus do-it-yourself/hardware/devices research also connects well with the work developed within the sphere of lite coding.²⁷ This thread deals with emergent aspects of creative coding, illustrating strategies that feature a close rapport between computational thinking and music-making, highlighting terseness, resilience, scalability, aesthetic pliability, care for the commons, and knowledge sharing.

⁴ Refer to the website: <https://fr4ncidir.github.io/IoMusT/>

A key principle in ubimus design practice is the resistance to a preset mentality. Closely tied to a critical stance toward the fast incorporation of technological resources in everyday settings, ubimus frameworks have also avoided the adoption of a “preset mentality” in musical interaction. Conversational techniques featured in large-scale language models²⁸ frequently use tokens employed by commercial music labels to describe musical outcomes.⁵ Granted, the ability to speak to an oracle and ask it to give you a sonic output specifically tailored for your aesthetic needs is something of a utopian fantasy since the early days of computing.²⁹ If viewed as a human–computer interaction task, the problem narrows down to finding the right terms for the musical outcome you seek. Apparently, this is easy. Try a thought experiment. Sit still for 30 seconds and listen to your surroundings. Now, grab a piece of paper and a pencil. Describe every event you heard, including the basic sonic parameters required to replicate the sounds. After completing the exercise, hand the instructions to your friendly over-the-counter programmer (or a large language model-based generative tool) and ask it to turn that information into sound. Then, listen to the result.⁶

This is the musical opposite of applying a Turing test.³⁰ This task does not yield a right or wrong outcome, but it illustrates the number of unknowns involved in the process of formalizing a short musical experience as a set of computable resources. This process can, of course, be automated as exemplified in the well-established area of computational auditory scene analysis.³¹ If we aim at a human-centric way to interact with computational assets, there is a limit to how much we can automate. At the core of formalizing subjective musical experiences, there are human decisions that need meaningful representations shareable with other human stakeholders. Otherwise, we are within the realm of protocols of information exchange between computational entities rather than among human stakeholders. Since a key target of ubimus research is to encourage diverse forms of participation in music-making, meaningful human knowledge-sharing is a core requirement.

⁵ Refer to the website: <https://github.com/EmulationAI/awesome-large-audio-models>.

⁶ This task could be construed as an antithesis of R. M. Schafer’s exercises, geared toward soundscape composition. While Schafer attempted an idealized “connection” with a Platonic sonic environment, the incorporation of large language models in music-making involves a dystopian acceptance of the Internet as a universal sonic reality and the implicit adoption of corporate aesthetics as the preferred form of musical interaction.

All this may seem unrelated to an argument against a preset mentality in musical interaction design. Nevertheless, the mounting evidence of an increased corporate pressure to force the adoption of generic commercial labels in tandem with a widespread usage of internet-based resources to train generative models unveils a pressure not only on the artistic resources but also on the ways we interact with computational infrastructure (see Truax³² for a critical view on the quality of internet sonic repositories).⁷ In other words, we may be released from the cage of acoustic-instrumental thinking, just to become imprisoned by the straitjacket of commercial labels.⁸

Ubimus can deploy flexible temporalities. Two of the artistic projects featured in this volume showcase the application of prospective and legacy frameworks. The proposals laid out by Barros and Costalonga³³, as well as Vincze and Oeser¹⁰, both feature improvisational and distributed-agency components. Well-aligned with extant ubimus frameworks, these artworks emphasize the relational aspects of musical interaction based on contingent and local factors.

Sonic immersion with an interactive mobile web app (Vincze and Oeser¹⁰) discusses the use of mobile web applications within two audience-centric experimental works. Both projects incorporate structured interaction windows, ensuring moments of focused listening alternating with more relaxed participation. The first of these, *Freedom Collective*, is an interactive opera that utilizes audience smartphones for sonic diffusion. Designed for large theatrical spaces where latency and jitter are embraced as artistic elements. In contrast, *Exo Signals* took place in a smaller venue, with the audience seated in a circle around violinist Roberto Alonso and surrounded by a 23-component loudspeaker system.

According to Vincze and Oeser¹⁰, there are various technical limitations to be surmounted to achieve effective support for non-musicians. Private networks often restrict certain functionalities or throttle bandwidth, which can occasionally slow down transmission. To mitigate this, they propose minimal data exchange, reducing the dependency on continuous high-speed internet access. Additionally, the audio quality was reduced from the full pulse code modulation standard to a compressed format, decreasing bandwidth consumption while maintaining

⁷ We do not abide by the usage of “paradigm” in this context. See comments above.

⁸ Just to be explicit, there is nothing wrong with the adoption of commercial labels as a way to buy or sell musical products. Our argument is focused on the design of technological resources for musical interaction with an emphasis on community-building, open, and grassroots approaches to the production of artistic and educational resources.

a reasonable quality for live performance. Within the context of mobile platforms, these limitations may also be explored as a low audio-quality aesthetic signature. This is one of the repurposing strategies for everyday resources fostered by ubimus, which stands in stark contrast to a “prescriptive paradigm,” highlighting the use of adaptive and opportunistic strategies.

The development of Freedom Collective and Exo Signals suggests the flexibility of ubimus-oriented interaction strategies. The modes of engagement are shaped by the local technical constraints, audience profile, and performance settings. The Freedom Collective model, designed for large-scale operatic settings, leverages network latency and spatial diffusion as compositional tools but presents caveats in usability, possibly due to a lack of audience familiarity with digital interaction. Meanwhile, Exo Signals targets intimacy, fostering direct audience engagement through structured participation, leveraging the audience’s sonic literacy and the technical support of a controlled performance setting.

Vincze and Oeser¹⁰, mention that while the first artistic project prioritizes large-scale diffusion and artistic control, the second proposal fosters a more intimate and participatory model, engaging audiences through more structured but still flexible interaction modules. The structured affordances of these creative–action metaphors align with research on performative engagement and gamification in ubimus environments by Koszolko and Studley³⁴, where clear interaction pathways encourage participation. The trigger module, for example, adopts a grid-based interface reminiscent of interactive game mechanics, allowing the audience to engage playfully with the sounds.

Barros and Costalonga³³ explore the intersections between ubimus and the development of improvising machines, with an emphasis on free improvisation. A key aim is to blur the traditional boundaries in performative music-making, embracing non-hierarchical, adaptive, and collaborative approaches to creativity. The FLOSS nature of this initiative enhances its potential for widespread adoption and improvement, encouraging adaptations prompted by local needs. This goes against the grain of the closed and opaque commercial solutions based on generative techniques that have dominated popular media discussions on creative technology. The proposal relies on dynamic relationships between agents, peers, and local resources, fostering ecosystems that highlight interaction and adaptation while targeting adaptive, non-hierarchical, and community-oriented musical experiences.

Within the context of improvisational practices, despite

some conceptual differences, there is a potential for dialogue between aesthetic practices that avoid idiolects, such as free improvisation and ubimus design. To enable this dialogue, it is necessary to find a common ground that addresses the development of strategies for collective decision-making. There seems to be a gap in this respect. This is sometimes occluded by discursive twists, such as “artistic freedom” or “tabula rasa.” Starting every improvisational project from a clean slate may lead to the adoption of clichés while imposing an unnecessary investment in long and arduous training (see also Stolfi *et al.*³⁵ for alternative approaches to these issues).

Regarding the cultural dimensions of prospective and legacy frameworks in ubimus, Keller and collaborators^{36(p8)} point to emergent frictions: “An open research issue in ubimus is how to approach diverse musical traditions and cultural contexts without subscribing to the prescriptive or culture-cleansing tendencies that plagued music theory during the 20th century.” They argue that an interesting path is suggested by Kramann’s 2020 piece *In X*. Kramann incorporates constraints in his generative processes that emulate the techniques applied by Terry Riley’s *In C*. Despite shaping the generative techniques after Riley’s compositional strategy, Kramann’s proposal does not configure a stylistic study. In this case, the objective is to create a new musical process with its own internal logic while establishing an open dialogue with the extant repertoire.

Three design qualities emerge as common trends of ubimus frameworks that either incorporate, complement, or (if not treated with care) erase local cultural traits. Flexible temporalities ensure support for various strategies to organize both musical outcomes and the creative–action metaphors involved in the design of ubimus infrastructure, highlighting the role of contingency in musical experiences.⁹ Avoiding a preset mentality may become a key challenge when approaching the use of spoken and written languages to interact with generative musical processes. The language divide, including a tendency to overlook cultural traits that are difficult to articulate in standard English, may increase in proportion to the dependency on internet-based resources. The economy of means involves a parsimonious approach to incorporating new technological resources, along with an awareness of the potentially negative impacts of deployments on local socio-technical ecosystems.

⁹ See the bridges between free improvisation and ubimus design in Barros and Costalonga³³ and the relaxation of synchronicity in Vincze and Oeser¹⁰. These examples provide a sharp contrast to the networked music performance techniques.

Currently, we are observing how big corporations (Meta, Suno, Udio, Musical AI, Rightsify, Appen, Scale AI, Spotify) scrape web-based music resources for training deep neural networks to be used in a large range of audio applications. Whether challenged in the courts or not, these techniques may harbor radical consequences throughout the media landscape, with potentially disastrous outcomes on musician-led creativity. Where monetizable approaches lead the way, “human” might become a niche commodity, available to a privileged few.⁸ As an antidote to a dystopian game of musical recombination, if only to slow the technologically driven development and yield more time and resources for philosophical and ethical reflection, ubimus places an emphasis on Creative Commons rather than copyright, open tools rather than monetized assets, and intellectual exchange rather than corporate-driven dissemination.

2. Share

We addressed three proposals that feature complementary approaches to the usage of acoustic instrumental performance and synchronous strategies for collaboration support. One is geared toward genre-specific variables, highlighting the potential for quantification when adopting a meter-centered temporality. The other two artworks engage with improvisatory tendencies in ubimus practice, providing an expanded form of participation for non-musicians and audience members and pushing toward an increased centrality to machine-based aesthetic decision-making. This diversity of techniques reinforces the idea that second-wave ubimus furnishes a playing field for post-2020 practices beyond the prescriptive recipes that characterized 20th-century music trends.

Despite the contributions within the areas of design and artistic deployment of the proposals discussed above, another thread of ubimus initiatives emphasizes the need to support knowledge sharing. This stage of the ubimus creative cycle is particularly prone to encountering barriers due to domain-specificities and local cultural traits. Fortunately, there is a growing literature of ubimus initiatives that encompass highly contrasting scenarios, targeting both professional and everyday musical creativity. Yu and Lindborg³⁷ expand the ubimus multicultural perspectives of educational practices with examples drawn from Lima *et al.*³⁸ in Southern Brazil, Rudi³⁹ in Norway, and Brown *et al.*⁴⁰ in Eastern Australia. The project “Push the Envelope,” a two-year program curated by Contemporary Musicking Hong Kong and designed by a team of professional sound artists, instrument designers, experimental musicians, and composers, aims to introduce sound as a medium for creation and collaboration while fostering ubimus community activities based in Hong Kong. A dimension

that aligns the “Push the Envelope” project with ubimus practice is the intensive usage of local sonic resources. Multiple ubimus initiatives have targeted local resources as material for creativity, encompassing time tagging, site sampling, and other creative-action metaphors. Koszolkó⁴¹ and Byrne⁴²’s artworks are two recent examples. According to Keller and collaborators³⁶, the respective artworks of these authors provide complementary techniques for the usage of local resources that hint that ubimus may be reaching beyond the realm of soundscape composition: do-it-yourself techniques, usage of transitional settings for creative purposes, and a strong reliance on collaboration are well represented in these works.

Soundscape methods entail a studio-centric perspective, involving, most often, a single composer’s engagement with sonic resources removed from the settings where the interesting action takes place. Villena⁴³ argues that soundscape compositional techniques are truer to their origins than the ubimus metaphor of time tagging (tailored for mixing in place). In fact, soundscapes do not provide sufficient technological support for collaborative music-making or casual participation. Current advances in ubimus may serve to unveil the conceptual limitations of legacy frameworks, such as soundscapes. The issue here is not only the type of support (or lack thereof) but the magnitude of the creative outcomes. Every day, musical creativity seems to demand creative-action strategies that take into account the requirements of casual participation. This aim falls beyond the realm of legacy-oriented know-how.

According to Yu and Lindborg³⁷, the project “Push the Envelope” aims to provide accessibility to sound resources while cultivating an interest in sound-making by means of design, an approach resonating with ubimus research and involving ubiquitous systems of human agents and material resources that afford musical activities through creativity support tools. As seen in the artistic projects featured in this volume, this type of endeavor demands a delicate balance between technological deployment and support for local ways of doing. For instance, based on a survey of the digital tools used in music education in Norway, Rudi³⁹ discusses the need to provide more knowledge and guidance for educational strategies in music technology. A similar need is evident in Hong Kong: the Music Curriculum Support Resources page of the Education Bureau of the Hong Kong SAR government contains no materials related to music technology, contemporary music, or related artistic practices. The authors argue that this absence may reflect the limited local investment in the sonic arts of a cultural framework shaped by the British colonial educational system. This observation highlights the need to incorporate the dialogic and decolonial ubimus approaches articulated by Lima *et al.*³⁸, Gómez *et al.*⁴⁴, and

Dantas *et al.*⁴⁵ We envision further developments of this thread, emphasizing comparative and culturally oriented ubimus educational frameworks that take into account local ways of doing.

In summary, knowledge-sharing is an area that warrants special attention in post-2020 creative practice. Ubimus initiatives have been documented in Norway, Australia, and Brazil. Yu and Lindborg³⁷'s report on Hong Kong-based ubimus initiatives provides a fresh perspective that complements the extant cases by highlighting local specificities and indicating a potential to establish multicultural research platforms that avoid the incorporation of Eurocentric notions. Their observations resonate with the dialogic perspectives of ubimus, which have yielded promising results within contexts of social vulnerability.

Conflict of interest

The authors declare no conflicts of interest.

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