Sustainable Interfaces for Music Expression

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Abstract. *The creation of Digital Musical Instruments (DMI) tries to keep abreast the technological progress and sometimes it does not worry about some possible side effects of its development. Obsolescence and residues, rampant consumption, constant need to generate innovation, code ephemerality, culture shock, social apartheid, are some possible traps that an equivocated DMI development can bring up to society. Faced all these possibilities, we are trying to understand what can be a sustainable Digital Instrument analyzing several dimensions of sustainability, from economical to cultural, from social to environmental. In this paper, we point out some possibilities to try to reach up more sustainable instruments development bringing up the human being and values like cooperation and collaboration to the center of the DMI development discussion. Through some questions, we seek to instigate a paradigm shift in art-science and provide a fertile field for future research.*

1 Introduction

Recently there has been a multitude of discussions about technological developments involving Digital Musical Instruments (DMI). This work intends to discuss the future of these instruments, especially in their social and cultural influences in order to promote a more sustainable relationship between people and these innovative products. By that, it is expected to think more sustainable DMIs, knowing how to meet people's current needs and allowing future generations to meet their own needs under an environmental, economic, social and cultural bias.

The creation of digital instruments tries to keep up with technological progress and often does not worry about the waste created by it, with the obsolescence of these interfaces and the rampant consumption that can be generated from the need for novelties tied to technological development. This points us to a first dimension of sustainability, **Environmental sustainability**, which can be thought of in the creation of these instruments. Of course, in bringing the issue of consumption, we also raise the possibility of discussing the **Economic sustainability** of these new instruments.

Some authors have already dealt with this factor in their research. Adrian Freed proposed a rework of the Stylophone integrating sustainability, longevity and design of instruments what generated the Fingerphone (Figure 1). This DMI "achieves low total material use, low energy cost and a small carbon footprint by using comparatively thin materials, recycled cellulose and carbon to implement the functions of the Stylophone without its high-energy cost and toxic materials: plastics, metals, glass fiber and resins"[1].

In addition, technological development and consumerism of new technologies can bring another imbalance up from a sustainable point of view, once this development disregards part of the population. **Social sustainability**, which proposes to bring social justice, democracy and peace culture, can be shaken if not thought of in this development. According to Barbosa et al. [2] "the design process is not focused on creating DMIs for a community with a particular culture - with established instruments, repertoire and playing styles - outside European and North American traditions". At many times, the builders of new musical interfaces advocate that new music is needed for these interfaces to be used. Creating a new music is not exactly a problem, but integrating these instruments into popular and already existing music can instigate the concept of **Cultural sustainability**, another aspect that must be brought to the light.

In this article, we will bring some discussions about sustainability and new interfaces taking into account these dimensions mainly in aspects of collaboration, interaction, creation, transparency and empathy with contemporary society. We aim to provide a breeding ground for theoretical, technical and artistic development for future studies in this area.

2 The dimensions of sustainability

Nowadays there are many discussions about what sustainability is and all its dimensions. A very general definition was set out in the UN report "Our Common Future" by Gro Brundtland in 1987: "Humanity has the ability to make sustainable development to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" [3]. Although this concept is correct, some authors like Leonardo Boff affirm that it is problematic when considering only an anthropocentric aspect of sustainability, not addressing an environmental aspect that is consistent with all forms of life [4]. Obviously discussing the dimensions of sustainability is seeking to integrate all its demands, be it environmental, economic, cultural or social demand.

Therefore, sustainability will be treated here as any action designed to maintain the social-political, energetic, informative and physical-chemical conditions that sustain all beings, especially the community of all types of

life, human life and its cultural expressions, aiming at its continuity and to meet the needs of the present and future generations [4]. Our greatest doubt is how to meet these demands from the perspective of digital art and technology since both are intrinsically linked to contemporary everyday life.

In this way, thinking about sustainability through digital art means thinking about a computer that embraces education, communication and creative processes, even if it is about digital musical instruments, so that this environment is open and democratic for the whole population. Much of the widespread poverty, environmental desecration, and waste of human life seen around the globe could be prevented by known (to humanity as a whole) technologies, many of which are simply not available to those that need it [5].

Also, thinking about sustainability in this kind of art permeates the dialogue and the active participation of the public. Based on the concepts of interactive art raised by Julio Plaza, the beginning of dialogism appears in the language studies of Mikhail Bakhtin, since "every sign results from a consensus between socially organized individuals in the course of a process of interaction (...) which must not be dissociated from its material reality, from the concrete forms of social communication" [6]. So, with the playful participation and the creativity of the spectator, the concepts of "art for all" and "do it yourself" fit in all forms of art, including the creation of DMIs.

2.1 Environmental impact

Since the industrialization process took part on the humankind history, enormous quantities of garbage have been thrown into the environment, heavily influenced by a society based on rampant consumption. This environmental impact can be reduced by adopting attitudes of reuse, not only of materials like hardware, but also of codes, music and art pieces. If hardware reuse is obvious a good thing to the environmental sustainability due the save of primary matter, code reuse can save energy, a resource that normally is produced by environmental damage.

In this regard, the environmental agenda can also be a theme to be explored by art, taking into account the current nature of our planet. A diseased planet, but through art we have the ability to help other people to understand their reality, creating a new mental paradigm in which we understand to be really part of nature and its cycles. The transition to a sustainable society must be guided by basic principles such as the reduction of consumption; the reuse and recycling of hardware and software. The question is: What would be a musical interface that causes less environmental impact?

2.2 Economic impact

In the case of economic sustainability we are faced with a dichotomy between the current economic system and the natural life system. The current economic system seeks to increase production in favor of consumption, which intrinsically requires the depredation of part of the planet and, as
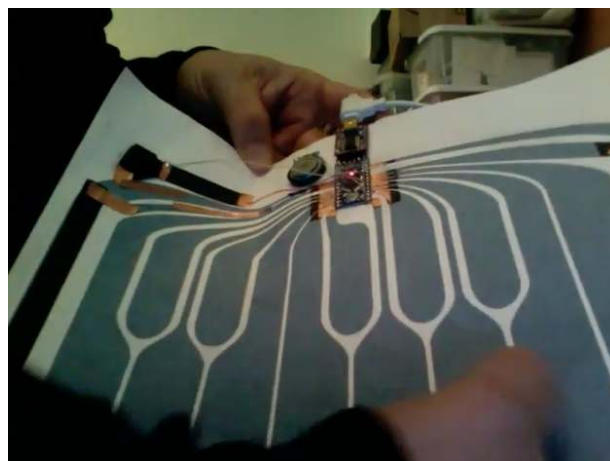

Figure 1: According to Adrian Freed, the first Fingerphone version was created to demonstrate the conductivity of the paper in East Bay Maker Faire. The next version used a pizza box as a resonator to emphasize reuse as the sustainability aspect.

a consequence, the production of perverse social inequalities. In contrast, the natural life system aims at balancing all the factors so that the planet can maintain its capacity to replenish the resources used by us and the integrity of its nature [4].

Figure 2: "Sobe Aí" was a Jam Session held in 2014 and has presented the last evaluation phase of the instruments created by the Batebit group. During this event, all those who worked in the "Edifício Pernambuco" sought to expose to the public what they were working into.

During the process of creation of new technologies or new art pieces, our intention is to think more about how I can produce in balance with nature, than how much I can profit. It is fact that technology is money, Art is money, and DMIs are technologies and Art, but how can the negative economic impact of a new instrument be mitigated? Investment in tech companies worth a lot, the investment in art does it too but what are we using these investments for?

For example, digital music, through MP3, has changed the world economy by taking away the economic power of record labels and taking them to online busi-

nesses. Does it change something for those who wants to listen music? We are moving from traditional instrument development to digital instrument development. Does it change something for those who wants to play? Is it at least more accessible?

Often, as researchers, we think of having a profit to pay for our work and this is important as well, but how not to have a negative impact? Is it possible to create richness without generating poverty? Can we do it with art and our research? If we do not consider this situation, the degradation will continue to a no longer sustainable limit that is being revealed by global warming.

One of the paths to be followed is the establishment of networks of reciprocal exchanges of knowledge, also known as Solidarity Economy. Some examples of organizations are Fair Trande, Co-operatives, Trade Unions, Social Centers, Give-away shops and Free Software movements. The structure of these networks allows non-hierarchical relationships between suppliers and users of knowledge of all kind increasing the quality of life of a region. The formation of human and material resources for Solidarity Economy projects, especially during music festivals (i.e. digital Jam Sessions), which have the greatest potential for generating work and income, can contribute to a higher productivity in the music sector.

2.3 Cultural impact

Unfortunately, for many years, the cultural and social dimension of Sustainability played only a tangent role in the debate and to the focus of this area of study. Only in recent years has these dimension become more conscious, as we can note in the UNESCO Action Plan "The Power of Culture" (Stockholm, 1998) and UN-Decade 2005-2014 "Education for Sustainable Development". These studies are important because they make clear that if part of the global crisis has cultural causes, then we need to think about cultural solutions [7].

Figure 3: Evaluation of Giromin and Pandiva, instruments created by the Batebit group, with Jam da Silva.

The transformation of local society by the dynamics of a global society, specifically in the creation of digital instruments, allows a new reflection on the impacts of music technology on traditional cultures, especially on the

trajectory of a media society and constantly submitted to the consumption of symbolic goods. In order to adapt to a more sustainable global social-political development agenda, we need to adopt new cultural sustainability strategies in harmony with a local agenda.

According to Davide Brocchi, cultures do not just define the boundary between the social system and the environment: they control communication and exchange between these systems, therefore cultures define groups of societies and subcultures - and vice versa [7]. To be in tune with cultural and social sustainability is to seek to understand theoretically the complexity of contemporaneity, the uniqueness of the composite character of its sociability and the meaningful inscription of communication, especially in its mediated version, in this peculiar structured circumstance acclimated by the media.

We must bear in mind that it is the place that provides an important part of the sense of belonging and identity, as well as being partly responsible for the generation of cultural expressions. In this regard, Luke Seghezzo quotes McShane in stating that feelings and moral lives are lived from the inside, in the first person [8]. Therefore, we should not only concern ourselves with the material products of DMI, but also with the inner life of the being that produces and consumes these products. To do so, we do not just need an education for sustainability, but probably also different media and communication structures [7].

The project developed in the Brazilian northeast called Giromin [2] (Figure 3) chose to apply a different modus operandi in the development of DMI. Through the methodology of Design Thinking, the group established ongoing contact with local musicians and developed their DMIs under what they called a more holistic perspective. "Musicians see their instruments as an unit, which means that timbre, gesture control interface, ergonomics and appearance are inseparable. This continuous contact allowed us to distance ourselves from a more technical perspective (i.e., what sensors and input technologies should we use?), and to get closer to the reality of musicians" [2].

From the point of view of cultural sustainability, this form of approach has the potential to guarantee self-confidence and self-determination of the identity of a population. According to the authors of the Batebit project, their greatest learning was that "DMIs should be somehow related to the instruments (and their respective playing styles) used inside the community; DMIs should allow musicians to perform the community's standard repertoire and DMIs should allow musicians to use the community's standard gestures and accessories" [2].

2.4 Social impact

Contemporaneity, apprehended as a society based on communication, has transformed information into one of the most valuable commodities. On the one hand, information runs from the means of production to consumption, giving support to a society of consumption and symbolic goods. Thus, information has the capacity to manipulate population activities in a social-political scope, depending

on the purpose with which it is being used. Following this line of thought, we are faced with the unsustainable attitude of exercising on a local musical knowledge a global and hegemonic musical knowledge for a specific group, directly influencing the culture of a given people through a hierarchical relation of knowledge.
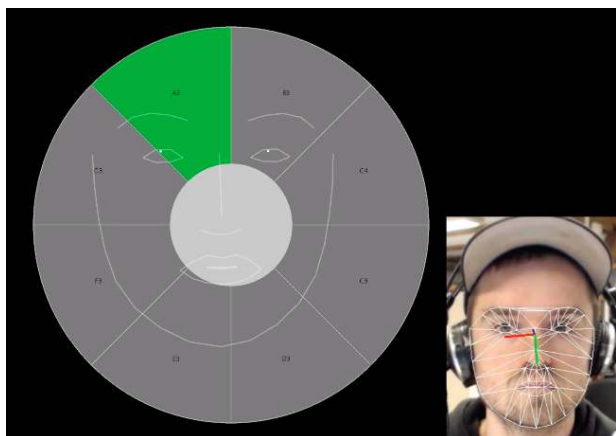

Figure 4: Eye Conductor is a customizable musical interface, created in an academic project by Andreas Refsgaard, with facial recognition that helps people with physical disabilities create music through eye movements and facial expressions.

In the dynamics of our society we find groups that are dominant and groups that are dominated which results in processes of exclusion that are often inhuman. When we consider social inclusion in our activities we are defining a range of activities that ensure the democratic participation of all in society, regardless of religion, gender, sexual orientation, education, social class or physical condition.

We often generate products thinking exclusively for a hegemonic group of people, but how can digital musical instruments contribute to the inclusion, participation, and socialization of people with cognitive, motor, and social limitations? How many people can be left out of the creation and use of these instruments? How does this not end up creating a barrier between the included and the excluded? By promoting free access to DMI programming, we can use it to raise awareness, teach programming, digital inclusion, and technology dispersion.

Finally, after pondering these issues, we must keep in mind that technology is a fundamental aspect of human existence in the contemporary world, and therefore, it is important for our society to include the production of DMIs in a global agenda for sustainable development. All aspects should be taken into account. We urgently need to think about recycling, adapting to existing cultures and not generating extremely expensive products to allow the population's accessibility. One of the possibilities to make this viable lies in technological openness and coding reuse.

3 The openness as a possible impact reduction

The concept of technological openness covers a broad range of things. Somehow, the concept of technological openness is on the opposite side of proprietary technology. Normally, people does not think how copyright, patents, and industrial secrets influences how we deal with our technological devices. In fact, there are a lot of technology that is not open because it belongs to a person or a company and one is not allowed to use it without the right permission. The idea of technological openness is a technology that can be used freely, and "free" here is not like "free beers" but like "free speech" [9].

It is possible to define our tech devices as a stack. At the top level we have data, applications, user interfaces. In the medium level we have files, operating systems and network protocols. At the bottom, the hardware. All these levels can have or should have an open choice of technology.

How the open technological choice can impact Digital Arts and sustainability? We chose some border interest field of art where the impact is clear.

3.1 Economics

A first impact of adopting open technology in art projects is on budget. Here, the "free" concept means with no costs. Therefore, a project based on FLOSS can have a reduced cost or no cost at all with software and licenses if compared with proprietary tools. Whereupon some people claims that open technology is harder to learn.

Assuming that open tools can be less intuitive than commercial solutions, what certainly is not true, the money saved with software license can be invested on learning an open technology if an abrupt learning curve really exists. The difference between both investments is that a software soon or later become obsolete but knowledge lasts a long time. Besides, the investment in learning can be local while the investment in buying uses to be global. If the investment considers to create a new software, a FLOSS existing application can be a start line to create the new solution. All in all, open source is more efficient and adaptable than proprietary closed, hierarchical systems [5].

3.2 Collaboration

According to Edmonds et. al. [10], collaboration in art practice has grown significantly since art adopted digital mediums to share data. Digital art gave a next step on collaborative art and the collaboration became huger evolving artists and other people from different disciplines with different skills [11]. Computers are the perfect machine for perfect copies and digital is the perfect medium to share data.

Since collaboration in digital art is possible and easy, what can disturb it to happen? The answer is obvious: Non shareable content. It is not possible to collaborate if we are dealing with copyright, patents and secrets.

The choice for open tech is evident when there are several people working together to develop a piece of art, like an instrument or a composition.

It can be necessary to use several different tools to create an art piece and it will be easier if they choose open file formats to exchange data between all these tools. A choice for FLOSS can easy the share of tools and applications, no piracy, no high costs to invite collaborators. The usage of open protocols can also easy the sharing between an art team.

3.3 Creativity

Creativity in arts is an obscure but fundamental process that involves imagination, exploration, discovery, experimentation and curiosity. In digital arts, it involves more than simply learning a new software. A software brings a lot of concepts in its design, concepts that presents the creativity of the software developer. Experiment with the software can lead to learn how the software was developed and how it can be hacked to a new functionality [12], adding new features that presents new artistic concepts.

Thus, A digital artist can consider computer technology as a way to enhance creativity [13], specially when it is possible to explore the software without the borders imposed by the developer. Develop a software is a work of creativity and can be an artistic work, based on experimentation evolving aesthetics meanings and not only functional questions [11].

Regarding creativity, open source software, open hardware, open data, protocols and file types can be a fertile kingdom to digital artists. Open technologies allow an artist to modify, correct, integrate, cut, copy and paste existing technologies to create new artifacts according to their personal needs [13].

3.4 Education

In education, open technologies works on the border of art and several other fields like Engineering, Math, Computer Science, Statistics, Physics and Telecommunication. It is almost impossible to learn digital art without understanding how computers work and the main idea of understand how a software works is the base of the FLOSS movement.

For this reason, Open technology in arts can be a great phenomenon for trans-disciplinary dialog [14]. An Art specialist needs the learning experience of several different areas, a strong educational approach not only for artists but for students which creativity and curiosity is an important value [12].

Another educational impact regards the relationship between students and technology. Computers tend to be a genius machine if one does not understand how it works. Using open technology is possible to demystify the computer and learn how it works and how it can be changed. It has good consequences in social and digital inclusion.

3.5 Adaptation

Open software can be adapted for other purposes. This action can facilitate its inclusion in other social environments taking place in diverse cultural and social inclusion projects. Even if software adaptation is one of the ways to improve productivity and quality of software, it is known that producing software with adaptability and high quality is still a complex process. In order to achieve the sustainability that we seek, we need to institute a culture of reuse in the development process, remembering that this can give us a more democratic environment by reducing the effort development and maintenance of a completely new system. For programmers and artists with a local agenda this can lead to reduced development time, reduction of error density, reduction of maintenance costs and reduction of total development costs.

4 Final Considerations

The purpose of this article was to raise some reflections about sustainability and its influence on technology and art, understanding this relationship as a viable alternative to achieve a certain degree of freedom and democracy in the creation of DMI, since expanding access to technology is an aspect of necessity human basis.

In addressing the dimensions of sustainability from the environmental to the social, we argue that technology must be distributed and shared not only as a product, but as a code that is part of a new mental paradigm that can be adapted to each local agenda according to the culture of a population and social inclusion.

Open technology has the potential to mitigate computational tools that create exclusion of people, either through accessibility based entirely on consumption or hardware and software waste. We are proposing to avoid this segregation and to consider in a technological adhesion that is sustainable and free. Obsolescence and waste, rampant consumption, constant need to generate innovation and code ephemerality were some of the problems we discussed and seek to minimize by proposing access to the source code of the products generated.

In order to provide greater knowledge to future researchers in this area, it is expected that the points discussed will instigate more dialogic relationships in our society by changing their rhythms, aspiring to a more powerful use of digital art and full enjoyment of their rights. Thus, local artists are not dependent on developers and can play a collaborative role in producing art, music, and interfaces for musical expression.

Once, someone told us that if you made a question in a scientific paper, you should answer it in the same paper. We are sorry if we did not answer all the questions we made. We do not have the answers and, believe us, we would love to have. We are worried about it and we know other people are worried too. Art is about creativity. We are using our creativity to think about these issues and we hope more people join us on it.

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