Democratizing Live Electronic Performance for Instrumental Trumpet Studies

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Abstract: The objective of this article is to make the new possibilities of live electronics for trumpet studies more accessible using Pure Data to recreate the technological tools of two works of the XX century: *Ultimas Flowers em forma de trompeta,* from 1998, by the composer Ana Maria Rodriguez and the second work *Manipulation V* for trumpet and live electronics in 1984 by composer Miklós Maros. This was developed in collaboration between two researchers: a) Elielson Gomes, who was responsible for researching the musical works and their execution; and b) Igor Aguilar, responsible for creating the technological part and developing the patch in Pure Data. The methodology used in this research was action research. Despite the plurality of perspectives, action research is known for being a set of methodologies that succeed each other in a cyclical or spiral process comprising three phases: planning, action and reflection, through which improvement is promoted. Development decisions are fueled by previous experience gained in this process (Robson, 2002). Because it is a collaborative work, we sought the possibility of sharing the patch for replication by beginner musicians, and that they are easily accessible due to their usability and ease of learning (Blaine & Fels, 2017). We hope to contribute to the development of research in the area in order to encourage this type of repertoire and highlight the importance of this creation for performance.
Keywords: Performance, Pure Data, live electronics interactivity, Trumpet

Introduction

This study began to develop from the meetings at the Live Looping laboratory (Labloop) at the Electronic Music Research Center (CIME) within the scope of the Doctoral Program in Music at the University of Aveiro and is centered on the performance of music for trumpet and electronics Live.

During these meetings at the Loop Laboratory, we began to research works for trumpet that used some kind of electronic device in real time during their performance. So, the process of artistic investigation was started with two main motivations, practical and personal (Maxwell, 1996). (1) the practice with an interest in recuperating a repertoire for trumpet and live electronics that was forgotten by the community of trumpet players, (2) personal to my interest in exploring the possibilities of music for trumpet and live electronics, identifying interpretive alternatives that consider other visions of this repertoire and that can be explored by other instrumentalists.

To survey the works, we used Michael Barth's doctoral thesis Entitled: Music for Solo Trumpet and Electronics: A Repertoire Study of 2011 as the main reference. The author of this thesis concentrated on researching the repertoire for solo and electronic trumpet, he did an investigation of 200 compositions written between 1965-2009, so with this information, we chose works that we could obtain information regarding artistic creation and performance, supported by description of the processes involved either by the composer or people who were part of the creation process, and that we could have access to the scores, or some symbolic annotation or some plan that showed the creation process at the time the works were created and or possible recordings if there was. Therefore, we limited our research to works

made in the 1980s and 1990s. Over time and with the increasing availability and sophistication of digital technology, particularly in terms of computers and software, the technologies originally used at the time these works were created have become obsolete and currently impossible to execute.

About the technological discontinuity, the authors Bernadini and Vidolin raise a question about the permanence of this type of repertoire, with technological advances, most of these works can hardly be realized, therefore they can disappear if nothing is done (Bernardini, 2005) Following the same direction, says the author Leite:

Electronic devices, when they become obsolete and tend to disappear in a short period, (...) works with electronics in real time, where the sound material and the treatment processes take place live, this conversion to other formats or more current programs is not so simple to be realized. (Leite, 2012).

Two works were chosen, the first work was *Últimas Flores em forma de trompeta* (English translation and will be mentioned as *Last flowers* from here on) from 1998 by the composer Ana Maria Rodriguez and the second work *Manipulation V* for trumpet and live electronics, from 1984 by the composer Miklós Maros.

These two works had not been played for a long time due to technological discontinuity, so we asked each composer of the respective works for suggestions, if they knew of any current technology that would be possible to recreate the technological part of their works? The answer that the composers informed me is that it was possible in the MAX-MSP, however one said that he could not program and another one had no way to recover the technological information contained in his old computer.

We started researching a program that was affordable and had high performance, allowing us to develop a new tool. It would be possible to create a tool that had the same effects as the historical technological devices while also not requiring the support of programmers on stage, allowing a new set of performance skills to be incorporated in common practice of the instrument. Therefore, the program we chose to recreate the technological aspects of the works is Pure Data (PD). The objective of this tool was to allow the execution of these two pieces, they were selected due to their historical importance, because when we surveyed the works for live electronic trumpet from the 1980s and 1990s, for example, the work Ultimas flores em forma of trumpet by the composer Ana Maria Rodrigues is the only female composer who appears in the reference works of this period and continues to actively produce this type of repertoire. Miklós Maros is a composer who composes for various musical formations, but from the 1970s onwards he began to produce works that used some kind of electronic and electroacoustic tool, as is the case with the work chosen for this research Manipulation V for trumpet and live electronics in 1984.

Since they use similar effects within different artistic paradigms of gestures. And understanding how these gestures can be generated with the same effects, we would open up a variety of different possibilities transcending these specific pieces. Thus it was understood that if we allowed different calibrations or presets in the tool being able to be programmed by the performer without the need of additional studies as a programmer, or the presence of someone else responsible for operating the electronic apparatus. This tool would then be able to be used in a new standard instrumental practice.

Brief Musical Analysis of the artistic works

As the selected works have already been mentioned, the first work was *Last Flowers*, from 1998 by the composer Ana Maria Rodriguez and the second work *Manipulation V* for live electronic trumpet, from 1984 by the composer Miklós Maros.

About The Work Ultimas Flores em forma de trompeta

This work was created by the composer Ana Maria Rodriguez, in the year 1998 according to the author she was interested in the music improvisation scene in Berlin and among these improvisers he met the trumpeter Axel Döermer, as he found his performance fascinating and proposed to write a piece for him. Thus was born the idea of the work : *Últimas Flores em forma de trompeta* , and this work was part of a project by the author called Trumpet and extensions.

According to the author, the title of the composition *Últimas Flores* was taken from William Faulker's novel called *Sanctuary* from 1931, *Sanctuary* refers to these bell-shaped flowers that open during the day and close at night, and then it is a moment in the romance at sunset when darkness falls, the flowers begin to close, (Rodriguez, 2020, intv.).

About The Work Manipulation V for live electronic trumpet

Since the 1970, composer Miklós Maros began to produce works that used some kind of electronic and electroacoustic tool. The work Manipulation V for trumpet and electronics is part of a series of works with the same title, but for other types of instruments: Manipulation I for bassoon (1976), Manipulation II for soprano (1977), Manipulation III for bassoon and cello (1978) / Manipulation IV for soprano and zither (1979) Manipulation V for trumpet (1984). In an interview with the composer, he said that Manipulation V was created in 1984 and written for the trumpeter Jarmo Särmile, (Maro,2021, intv.).

Performance analysis of works

Live electroacoustic music is a very abundant field that provides many examples with a great diversity of contexts and configurations (Bernardini, 2005).

In this part of the article, we will address the cooperation process between the sound designer and the performer, and the performer's first impressions when using the technological tool. The process here aims to seek a desirable artistic sound result (Dalagna *et al*, 2020), however this search is related to the combination between the live technological tool and the acoustic performance of the works.

The performance of the works *ultimas flores em forma de trumpet* and *Manipulation V for trumpet and electronics,* present significant challenges in the execution of the set, firstly technology can act as the "other artist", (Mendes et al., 2018), in this process the performer does not need to be a programmer (unless the performer is interested in being a programmer), however, it is indispensable for performance, the understanding of the technological tool. And finally, another more important or demanding aspect in the execution of both works was the coordination between the soloist and the technological part (Barth, 2011).

The two works were created in very different periods, however the works present very specific sound environments, so for the technological tool to be used in both works, it was necessary to adjust the tool for better performance.

It is worth mentioning that the collaboration of the composers during this process was essential for the development of the performance, both composer Miklós Maros and composer Ana Maria, gave complete freedom for the performance of their works, in the piece *ultimas flores* for example, the composer Ana Maria gave us freedom to improvise when necessary, during the performance, as an "open work" (Eco, 1968). Therefore, the work never closes in on itself, but gives freedom as new paths of artistic construction through creation, this offers maximum possibilities of fruition for other performers. That way we will be preserving not only a unique and memorable performance, but also the ability to play, study and reinterpret the same work repeatedly, because different performances can propose different interpretations, (Bernardini, 2005).

The strategies and paths adopted for better compression will be discussed in the technical difficulties and solutions section.

Technical difficulties and solutions

Initially, the difficulties presented were related to the gestures in relation to the Setup (trumpet, technological tool). The technology used in the works gave the trumpet new sound possibilities, that is, the trumpet will be electronically connected with sensors to measure the gestures of the performance. giving the artist the ability to control extra sounds or musical parameters, (Miranda, 2006), (Thibodeau, 2011). simply that they are linked by their physical properties. For Thibodeau, quoting Morrill and Cook states: that trumpets are ideal candidates for augmentation technology due in large part to the "extra bandwidth" of the players - that is, the parts of the body that are left unoccupied when playing the instrument. The left hand does not critically affect performance and can be used to interact with sensors rather than just supporting the weight of the instrument. (Thibodeau, 2011). Therefore, the augmented trumpet proposed in our research does not use any type of peripheral attached to the instrument as many authors have already used or use, such as potentiometers, buttons and switches, but we will use the cell phone as a gesture control. The cell phone is on the trumpeter's left arm because that way he can view the cell phone screen and interact with the sensors, but the performer maintains the traditional technique of how he plays the trumpet. In this way it is possible to share the technological tool with other trumpeters.

As for the gestures, this implied an exploratory study together with the technological tools and the effects of the expanded techniques indicated in the score. So, this process proceeded as follows:

Setup Gestures

In this approach (trumpet and electronic instrument) we faced some technical-instrumental questions, which were: the study of the synchronicity of the interpreter's movements (gestures) in the interpretation, between the setup and the live electronics of the trumpet. (Mendes et al., 2018), citing (Rocha, 2008), states that acting with live electronics means a high degree of interaction between the performer and the electronic device, where the system must be able to respond to sounds and/or gestures. produced by a musician. For this question, we thought of using the gestures proposed by (Chaib, 2007), called by him an intellectual gesture (where all the interpreter's expressiveness will be the result of the combination of a series of factors), it is necessary to trace the origin of where come these movements and their intentionality, therefore, this brings consistency to the performance.

In the work últimas flores em forma de trompete

In the piece *Últimas Flores*, the author utilizes technical resources that are not part of what is usually be called the traditional technique of the instrument, which are the expanded techniques, (Tokeshi, 2004) although some techniques such as pedal notes and flutter tonguing, for example, were once considered expanded techniques, but today they have been incorporated into traditional trumpet pedagogy due to their extensive use in woodwind music (Cherry, 2009), Even knowing some of the effects of the techniques, it was necessary to work daily to investigate the sound possibilities of the instrument itself, which is conducive to the development of these techniques. The cooperation between instrumentalist and composer was fundamental for the development of the expansion of instrumental techniques (Toffolo, 2010)

In the work *Últimas Flores em forma de trompeta* eight types of expanded technique are used, they are organized in five groups that are: Lip Techniques, Tongue Techniques, Vocal Techniques, Valve Techniques, Mute Techniques and these effects are processed

electronically. See figure 4 below for explanations of the expanded technique effects that the composer used.
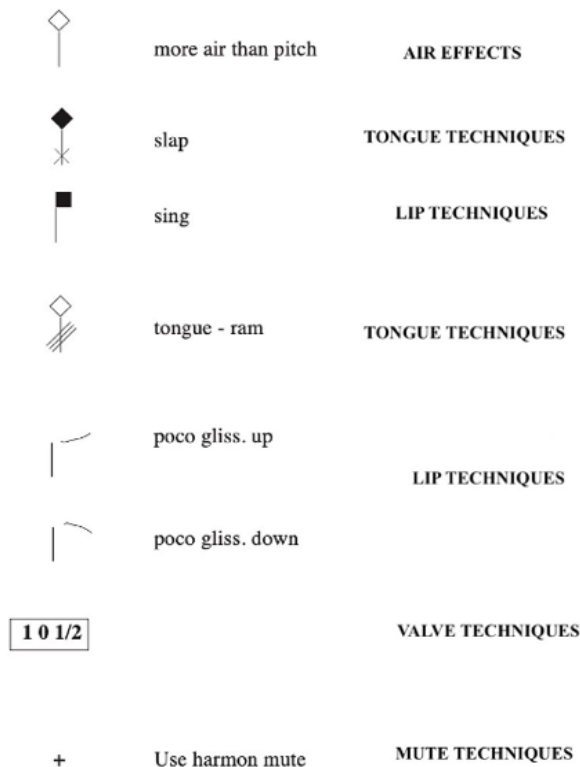

Figure 1 explanation of the expanded technique of the work últimas flores em forma de trombeta

Valve techniques the order of the numbers from left to right means the 3 valves of the trumpet. The different numbers show the valve position variants: 0 = valve is open, 1/2 = valve is 1/2 open, 1 = valve is closed
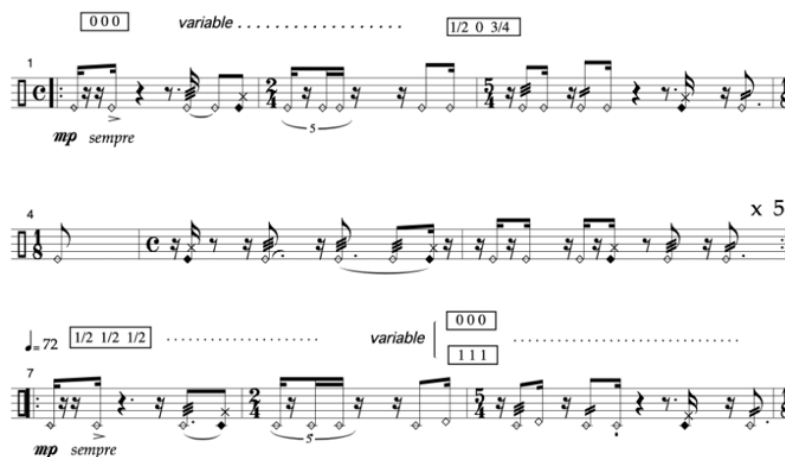

Figure 2 the variants of valve positions in the score

Manipulation V

In an interview with the composer Miklós Maros, in order to better understand his work, which includes the use of technology and how he developed the written part (score) of the composition, the author told me about this issue. Firstly, it was about live electronic

technology, so when the composer composed this work there weren't many processing options, but there were different boxes, mostly made for guitar like the phaser shifter. About the writing, the composer reported a problem with live electronics, as these devices were not very available everywhere, the author directed the writing of the score of the work as he thought it should sound, according to the composer it would be exactly how the scores are organ, where the organist decides a large part of the register, the effects can also be adapted to existing equipment. check in figure 3 below:
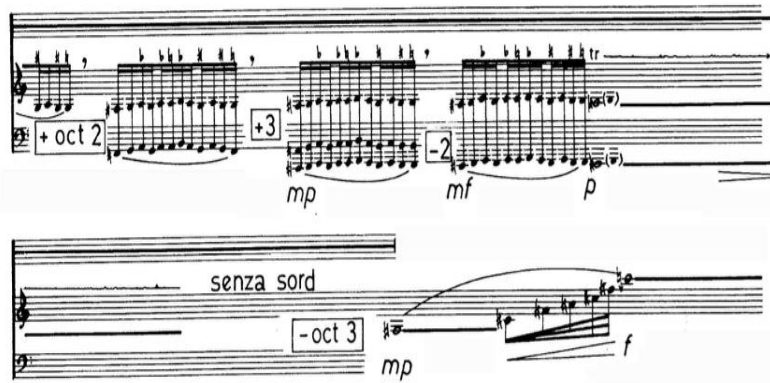

Figure 3 raider original from Manipulation V

Technical Development
Últimas flores em forma de trompeta

The piece is a simulation of the mechanical idea of the loop. The main sounds, transmitted through the center speaker, are confronted with their own live-generated repetitions from the left and right. This presentation, which does not occur simultaneously at the beginning of the piece, uses the game of repetition, which always appears different. The simple idea of the spatial arrangement (main speaker with two looping satellites) is superimposed by the object/subject dialectic: after all, only trumpet sounds played live can be heard from the right satellite. The initial technological process of the work *Últimas Flores*, the setup for the performance of the work originally in the work were (Sampler Akai Computer and 3-channel PA), (as in the figure 4 below)
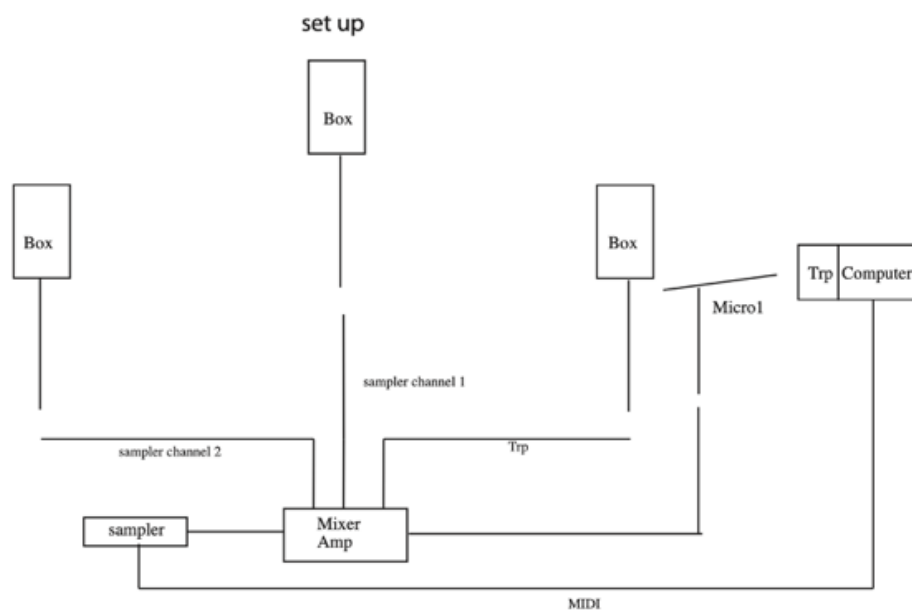

Figure 4 raider original from ultimas flores

Manipulation V for live electronic trumpet

According to the author, a description was made in the score (raider) of the work was based on (analog) boxes of the trumpeter himself, after he gained new devices the trumpeter himself made some changes in the performance using harmonizer, reverberation and changing the title to Manipulation 5bis , as in figure 5 below**.**
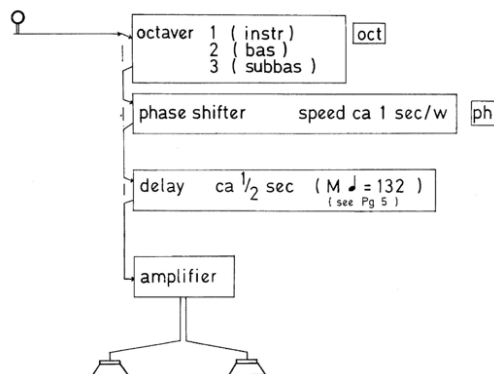

Figure 5 raider original from Manipulation V

The affordances required

The affordances required to perform these pieces were that of *pitch shift* and delay. The *pitch shift* algorithm was based on the file in the Pure Data audio examples "G09.pitchshift.pd". We used this as an abstraction that could be used multiple times in parallel allowing a *pitch shift* at input and at output. The *delay* parameter is a simple loop algorithm of storing a signal onto a buffer and reading that buffer after a desired amount of time. This is a common algorithm for reverb, echo or loop effects, allowing different uses by defining how long is the delayed output time. It is important to note that even though these are standard and basic algorithms for audio DSP, it is important to understand the paradigm in each musical piece to properly control these parameters in an expressive performance. For this we have the following diagram of the signal flow in figure 5:
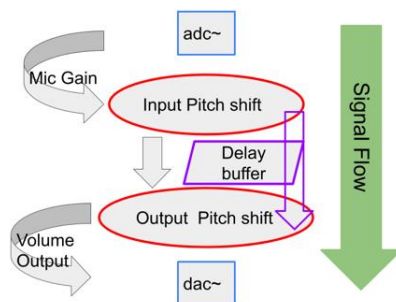

Figure 5 DSP Flow Algorithm

How the pieces differ in applying the technology

From a technical perspective the primary use of *delay* in *Últimas flores* has the artistic purpose of allowing the user to perform with themselves in a delayed point across the entire piece. While in *Manipulation V* the paradigm is closer to making an ambient of sounds at the beginning of the performance which becomes an independent layer of sound to the subsequent actions in the piece. As to *pitch shift*, *ultimas flores* it is as a gradual pitch bend up and down 7 semitones (a perfect fifth), creating a slightly nuanced set of this control .In *Manipulation V* the pitch shift is primarily only downwards, with two possible options, either one or two octaves lower (12 and 24 semitones respectively). This means it would be needed to "jump" towards these controls rather than smoothly alter along them as a spectrum. Thus

the physical performing gesture needed to be different for the pieces. Which prompted the need of different types of *User Interface* (*UI*, from here on).

Designing optional *UI* for performance

We developed multiple *UI*'s using *Mobmuplat* (see figures 7 and 8), within a single file to control the affordances of the tool. This can be run on a mobile device or a tablet, sending the controls via *OSC* messaging on a local network and controlling the effects running on a computer. Ideally, we designed this so that it can be controlled on the arm of the performer by fixating the phone to the support hand just below the wrist using a sports cell phone armband. This allows the user to have easy access to controls and calibration while performing. This then makes it accessible to change configuration in between musical pieces without the need of an additional person monitoring the technological aspects of the performance. Each form of control provides different possible gestures that can be chosen as a specific form of interpretation. The first page is for calibrating the parameters where the performer can change the maximum and minimum values of *pitch shift* (input and output separately) from ±7 to 36 semitones (from a perfect 5th to three octaves above or below). The delay time can range from a maximum of 300 to 5000 milliseconds and the minimum from 250 to 1000 milliseconds. Once configured the maximums and minimums, one can use either the first page of the file to control these values using buttons and knobs or the subsequent pages for alternative controls The second page has the first form of control imitating the same design as the controls on the computer. Having from top to bottom the flow of signal with the same sequence of colors for each parameter. The third page allows for control via the orientation of azimuth and roll of the device. Allowing the performer to bend forwards and backwards for one parameter and side to side for another parameter.
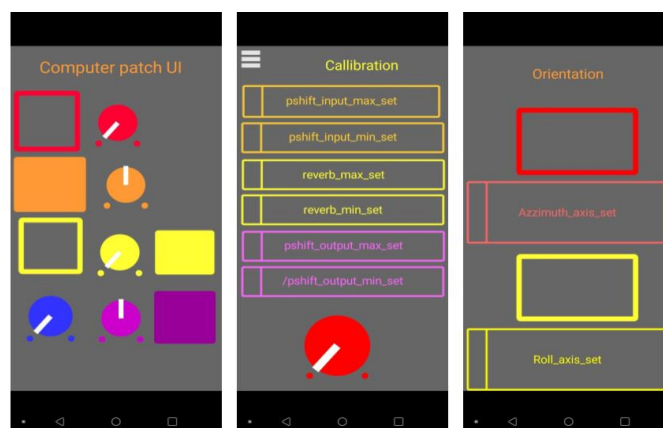

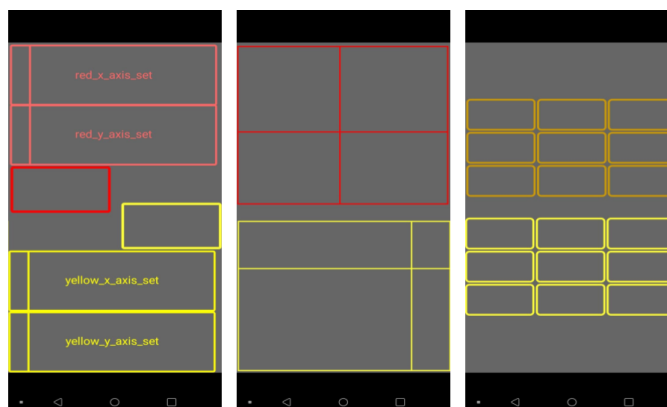*Figure 7 pages 1 through 3 of OLEPI in Mobmuplat*

Figure 8 pages 4 through 6 of OLEPI in Mobmuplat

Hardware implementation

The physical use of the tool is intended to be with a mobile phone attached to the left arm of the performer, while with the right hand interacts with the software. An example of this can be seen in the figure 9 below:

Figure 9 using the tool while performing.

REFLECTIONS AND CONCLUSIONS

In this study we worked on the recreation of the technology part of the works, Ultimas flores em forma de trumpet, from 1998 by the composer Ana Maria Rodriguez and the second work Manipulação V for trumpet and live electronics in 1984 by the composer Miklós Maros. Originally these works were not thought to be controlled by the trumpeter on stage, until then the concern that the trumpeter had at the time these works were created was to interpret the score, he was not concerned with technology. Now with technological recreation, the interaction between the performer and the technological tool needs to be considered, therefore, having a certain knowledge of the technological part is essential for the performance of these works.

The recreation of the technological part of the works was centered on the use of Pure Data as this tool to recreate the technological part and using the Mobmuplat application on the smartphone as a control of sensory gestures.

We believe that by sharing accessible and low-cost technology, we are cooperating and guaranteeing the continuity of this repertoire for the trumpet community and providing new interpretation possibilities, and young trumpet players who have few resources have the opportunity to learn about this type of repertoire. The link to the github for this project can be found here (Aguilar & Gomes, 2023).

For future implementation, we believe that utilizing this tool within the forked version of Pure Data called Plug Data developed by Timothy Schoen (Schoen, 2023), can assist making tools as the one developed here to achieve even more accessibility as then the tool can be opened as a VST file in a DAW. This tool is also in the public domain so that others can use it as a template for similar types of implementations.

And we hope that this work will contribute to the development of new research on trumpet and live electronics repertoire.

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