QUALIA: A Software for Guided Meta-Improvisation Performance

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ABSTRACT

In this paper we present *Qualia*, a software for real-time generation of graphical scores driven by the audio analysis of the performance of a group of musicians. With *Qualia*, the composer analyses and maps the flux of *data* to specific score instructions, thus, becoming part of the performance itself.

Qualia is intended for collaborative performances. In this context, the creative process to compose music not only challenges musicians to improvise collaboratively through active listening, as typical, but also requires them to interpret graphical instructions provided by *Qualia*. The performance is then an interactive process based on "feedback" between the sound produced by the musicians, the flow of data managed by the composer and the corresponding graphical output interpreted by each musician. *Qualia* supports the exploration of relationships between composition and performance, promoting engagement strategies in which musicians participate actively using their instrument.

1 INTRODUCTION

Traditional Western music notation privileges pitch and duration over timbral attributes (which apart from instrumentation) are hardly considered [12]. It's longstanding use suggests its effectiveness, however, recent compositional approaches have been providing alternate notation strategies to enhance dimensions of sound (notably timbre), which have been neglected so far. Among these, we can highlight compositions exploring graphical scores as a medium for music notation and expression. Graphical scores represent one approach to handle such aspects but, at the same time, challenge musicians in aspects such as: how to interpret, how to map graphics to sound or how to rehearse such scores. Some examples of graphical scores are included in Cage's book *Notations*, Sauer's *Notations21* or Villa Rojo *Notación y grafía musical en el siglo XX*. This book, besides the graphical scores itself, reflect composer's concerns related to the relationship between musicians, interpretation, and graphical representation of sound and sound itself [13]. Nonetheless, these are graphical scores that are "frozen" just like conventional notation, which means that such scores are static. Musical works like *Cypher* by Pedro Rebelo, *Six Graphic Scores* by John Teske, *Constelazzione* by Lombardi or *4 Systems* by Earle Brown, represent such approach.

Composers like Ryan Ross Smith, Cat Hope, Candas Sisman, Jesper Pedersen, Lindsay Vickery or Leafcutter John have also used graphical scoring. Their work is focused on developing animated notations (i.e. not static) and developing graphics that can be easily grasped by performers [10]. About this subject, Ryan Ross Smith tells us that animated notation "does not lead to a random performance or purely free improvisation. The composer defines the limits. Animated notation is simply a different approach to music composition and interpretation."[10].

In the last decade, there has been a growing interest in generating scores in real time whether graphical, traditional or mixed. Mapping *data* to generate scores in real time has been one of the main challenges. [3] While some approaches rely on pre-defined mappings [3], others require an operator (e.g., composer) to manipulate and map the data (e.g. *Õdaiko* by Filipe Lopes, *Peripatoi* by Rui Penha, *Spam* by Luciano Azzigotti or *Leave no Trace* by Michael Alcorn). Mixed aproches can be found in (e.g. *Zero Waste* by Didkovsky, *Anticipatory Score* by Wyse and Yew). This trend has been capturing the attention of the academic community, especially since computers are able to generate graphics in real-time and communicates wirelessly. [1]

Qualia collects inspiration from all these approaches. The issue that formed the base of its development is: How to manage the mapping of audio *data* to guide a performance using graphical scores generated in real time?

2 QUALIA

Qualia is a digital application that generates graphical music scores in real-time. It targets collaborative performances, in which the audio features extracted from a live instrumental performance drives the generation of graphics. A computer operator is then

[1] The International Conference on Technologies for Music Notation and Representation (TENOR), born in 2015, is dedicated to this area of investigation.

responsible for routing the graphics resulting from the input signals analysis to the instrumentalists, thus creating a feedback system with complex mapping and contrapuntal capabilities. The system was developed in *Max/MSP* [4] and *Processing* [10]. *MaxMSP* is used to analyse and process the live audio input signals, which result is then sent to *Processing*, that interprets the data to create graphics on a rolling screen.

2.1 Flow of data

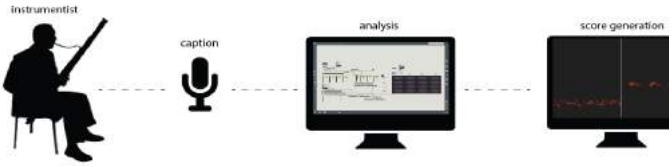

Figure 1. Example of an Individual Analysis and Score Generation scheme
(instrumentist / caption / analysis / score generation)

The input of the system is based on the sound collection. In this case is produced by musical instruments. The audio stream of each instrument is captured individually. For each stream a Bark spectrum representation is extracted using the ZSA.Descriptors library [7]. In greater detail, the audio input signal is represented by a list of 24 values, which express the loudness of logarithmic-distributed frequency bands closely aligned to the psychophysiological parsing mechanics of the auditory human system. [14] Finally, the Bark spectrum analysis of each instrument is sent to Processing using the Open Sound Control (OSC) protocol. Fig. 1 shows the an Individual Analysis and Score Generation scheme, Fig. 2 presents one of the musicians playing with an visual input and Fig. 6 shows a rehearsal moment.

This work was conceived as a musical creation tool in performance. This was idealized from the beginning to be presented in concert in order to validate its usability. For that, a quartet of different instruments was chosen: electric guitar, bassoon, cello and percussion. This diversity of instruments made it possible to perceive the diversity of reactions that the system would generate to different inputs. Each player has its particular computer monitor in front, which displays the graphics as a rolling score that represents a window of about 7 seconds, on the individual screen, and 15 seconds on the group screen.

Figure 2. Cellist experiencing the suggestion monitor side of *Qualia*.

The screen is divided into two parts: a) from the centre to the left, it shows the representation of the sound analysis of the instrumentalist in real time; b) from the right border to the central bar, the gesture indication suggested by the pilot composer. The drawn graphics include circumferences expressing the loudness of each Bark frequency band at each 1024 ms analysis slice (represented vertically). To distinguish participating instruments different colours are applied. Fig. 3 shows an individual monitor.

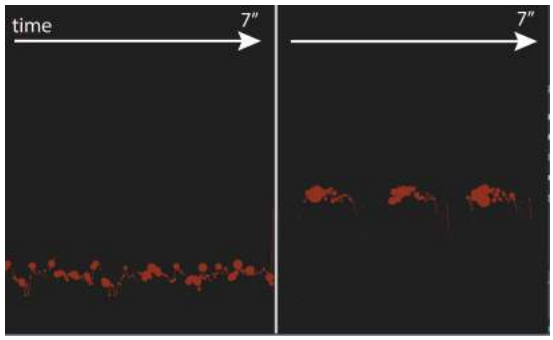

Figure 3. Individual Score.
[a) – Real Time Representation / b) – Graphical Suggestion]

The composer / pilot, as well as the audience during the performance, has access to the overall visualization that is being created according to the same process of the previous one - figure 4 - with the exception of only presenting the final real-time result of the four instruments**.**

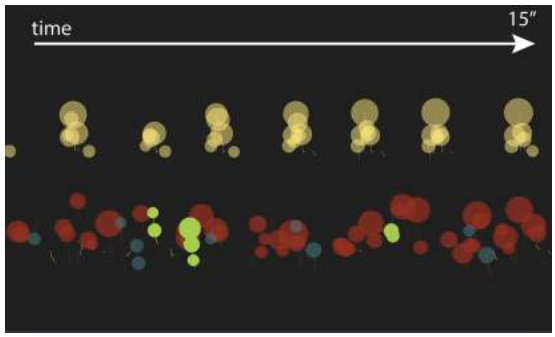

Figure 4. Full Score.

The composer / pilot interface consists of two MIDI controllers that command the signal input level of the Max sliders and simultaneously activate the matrix buttons that direct the signal between the various players' screens. The returning of the information to the player is achieved through a matrix in which the pilot/composer redirects that information through buttons that control the matrix and sliders that control the amount of signal that is sent.

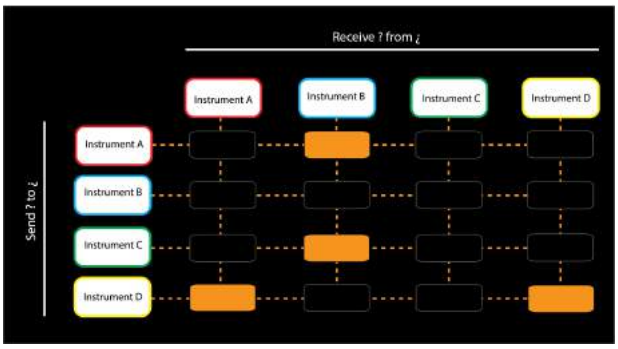

Figure 5. Instrument Matrix

Figure 5 shows a diagram of the matrix that controls the signal flow between the different players:

- The player A is receiving information from the player D.
- The player B simultaneously receives information from the player A and C.
- The player C is in free mode – he is not receiving any suggestions beyond the representation of him or herself (left side).
- The player D receives his own information on both sides of the screen.

3 COMPOSING WITH QUALIA

Creating music with *Qualia* required some time of experimentation, which naturally developed in three tests stages to develop a satisfactory working method.

The first stage was an individual test with the musicians. Each player was submitted to a set of software rehearsal tests, which aimed to analyse how the player related with the graph. In order to understand what would work best, were used some different graphics until was reached an effective version. Each musician was asked to freely experiment the reaction of the graph to what was presented to him or her and then to respond to a list of gestures and instructions given by the composer.

The second stage was combined a quartet of musicians in a similar set of tests. We analysed the different reactions between the graphs that travelled from one to another. We played the *telephone game*[2] with basic gestures like "*short attack*" or "*descending melodic line*" - in this version of the game the message was controlled by the composer and passed through the screen of each musician. During the group tests, some questions were raised by spontaneously discussing the reading and interpretation possibilities of what was exposed to them. Each player realized in what ways he/she could reorganize the ideas presented, in what aspects he could have to adapt his instrument to the approaching chart and, above all, to the music that was being created.

The last stage was the most exciting and challenging.

[2] Telephone Game is an internationally popular game in which one person whispers a message to the ear of the next person through a line of people until the last player announces the message to the entire group

Until this moment, the musicians had acquired some notions of how to interpret the graph they saw, which was a representation of a sound that they heard a few moments before. After several approaches to reading techniques were compared, the exchange of ideas and the rules of reading and interpreting messages were tested, we had to find some ways of overcoming the literal view of a graph and interpreting it in other ways, making music, as well as some rules of interpretation to support the performance. The answer to these questions came naturally as a set of rules was established so as to help to construct a balanced performance as shown in fig.6:

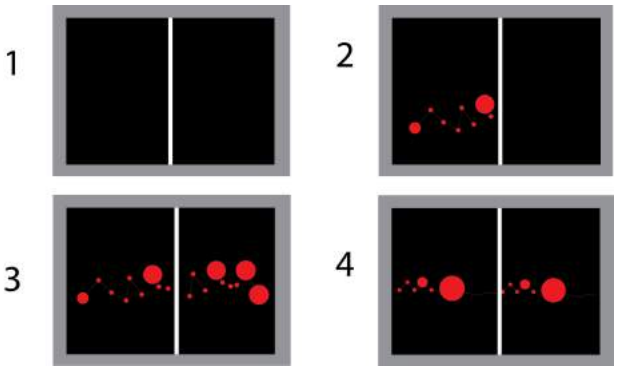

Figure 6. Instrument Matrix

1 - If both parts of the screen are off, do not play.
2 - If you have only direct return of your intervention (left side) you can play freely.
3 - If you have suggested musical information (right side) you should try to adapt your interpretation to the present musical moment.
4 - If you have both sides reacting equally to your interventions, you must assume that you are in solo mode and are free to significantly change the character of the joint musical result.

From this moment forward, we had only to rehearse these ideas. It was possible to perceive what we suspected, the more contact the musicians had with the graphic, the more comfortable they felt, and this was audible in the quality of the music they made. Through several conversations with them, it was possible to perceive that the graphic had stopped to be a merely imposing score of a musical order to accomplish. It was now a hint to a direction they could give to their performance. All the rest was communication in the form of sounds and graphics.

When this system is referred to as an Guided Software for Meta-Improvisation, it is intended to make it clear that *Qualia* is an interactive musical system managed by a composer / pilot, where each musician is constrained by a set of stimuli, graphics and sound generated in real time by other players, which influences him or her in their freedom of improvised performative decision.

4 CONCLUSIONS AND FUTURE WORK

The main premise of this project was the production of a multimedia tool capable of creating improvised performances, through real-time composition, based on ideas triggered by the musicians that are symbolized by a representation graph of their sounds. It was while searching for a unique tool that it was concluded that the best option for this project would be a mixture of the advantages of all these concepts.

After all the tests, trials, final concert and the analysis of the results, it is safe to say that *Qualia* proved to be an effective system for the guidance of improvised performative motions, as intended; The musicians have connected to a type of graphic that was introduced to them as an interactive representation of the sound they produced, thus allowing for the communication and performative control of a small ensemble through graphics arising from this analysis, which are shared among the various participants. Concerning the first reactions to the graphic, the musicians revealed some strangeness and confusion towards a graphic that was drawn from impulses created by them. It took some experiments for a few weeks to make the relationship closer and to increase the intuitive reaction to the stimulus. We can say that this system is effective for composer-interpreter communication. While not creating an immediate connection, musicians feel tempted to experiment further and quickly create a natural connection to the stimulus. *Qualia* also enables the technical development and the intuitive approach of the musicians to their instrument and, consequently, to the perception of the possibilities of their surroundings and communication with others. And as a result it was possible to create music that is not only based on the mixing of gestural habits and intrinsic to player, but results from a sharing of experiences and knowledge.

As a summary, it may be noted that the system surprised the musicians. They had never been contextualized in this type of creative practice using multimedia tools. On the other hand, as the project advanced and the experience within the system increased, it was also from that freedom that they had greater pleasure from the alternatives of reading to a visual stimulus and the counterpoint of another visual impulse.

Figure 7. Rehearsal Moment.

4.1 Work Links

All this work was started in Manuel Brásio Masters Thesis in Multimedia: Interactive Music and Sound Design from Faculty of Engineering, University of Porto. All the interested ones can access the following link to download the document in Portuguese: https://sigarra.up.pt/feup/pt/pub_geral.show_file?pi_gdoc_id=792261, and this next link to the website of the main author where it is possible to find more audio-visual details about the project: http://manuelbrasio.xyz/research

4.2 Future Work:

In the near future, we will seek to implement this system on several operating systems and look for a solution that allows the reduction of the number of machines required. We also intend to further explore these ideas and to understand if intervention in the perfomative and creative role of the musicians is indeed enriching. We also think that Qualia could have a lot of potential in the pedagogical environment. Where it can be used as a tool for gestural exploration, improvisation and sound awareness of young musicians.

Qualia showed to be the concretization, even if it is no more than a prototype, of a compositional and performative idea, with a strong intervention function in the role of the musicians in the music they make, and with the potential to be deepened.

Acknowledgements

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