Full-Body Interaction for Live Coding

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ABSTRACT

This paper describes the integration of a full-body interactive system for its use in live coding performances. The system has an interactive mat of grid layout, which is located on the floor and serves as a guide for the user to move within its 17 areas in which it is divided. The body gestures made by the user are mapped to modify the execution of the algorithms that generate the sounds and the visuals in real time. Thus, the audience can participate in the improvisation through full-body interactions and without having programming knowledge. The system allows the live coders to manage the parameters manipulated by the user during the interactive experience. It was noted that users recognize the interactive mat as a space of interaction with the system and also that users move intuitively on the mat. In addition, we found that the users recognize the feedback of their body gestures, by observing the change in the outcomes of the visuals and sounds, during a live coding performance.

1. INTRODUCTION

Live coding focuses on the possibility of generating visual and sound compositions in real time, using algorithms or programming codes. This practice focuses on the person or group of experts, live coders/performers, who use the code to generate the visual and sound sets, without taking into account the participation of the audience, whom cannot be part of the creation of the composition.

In this work we explore the possibility of intervention of the audience by body gestures, within a practice of live coding. This project seeks a symbiotic performance between a person of the audience and the live coders in real time. The execution of the algorithm created by the live coder is modified by the movements of the body, which generates a collaborative composition between the user and the live coder to jointly create a sound and visual discourse.

To achieve this goal a programmable system was proposed using the following tools: Processing (Reas and Fry 2006), SuperCollider (McCartney 1996), TidalCycles (McLean and Wiggins 2010), Hydra (Jackson 2018) and a Kinect device (Zhang 2012). These tools allow to generate a live coding performance, in a sonorous, visual and interactive way, integrating the capture of the movements in real time with the full body tracking device, Kinect. Moreover, an interactive mat was developed as a space divided by areas where the user can move and interact.

2. PROBLEM AND MOTIVATION

The processes of improvisation in live coding are executed by specialists in the generation of sounds and visuals. However, during the live coding performances, a high interest of the audience in participating in the improvisation has been observed. Nonetheless, the lack of specialized knowledge does not allow the audience to participate in the improvisation.

A system was developed in order to let the audience to participate in the composition of a live coding performance. It allows the user to use the movements of its body to modify the algorithms, which are being written by the live coders in real time. This system is able to modify the outcomes of the visuals and the sounds of a live coding performance without knowledge about programming languages.

3. BACKGROUND

There is a broad debate about the study of Human Computer Interaction (HCI) for live coding performances, and specifically, this debate focuses on analyzing how the different types of interaction can influence the outcome of the performance. Therefore, there is a clear interest in researching and experimenting with unconventional forms of interaction in the practice of live coding (Collins and McLean 2014; Baalman 2015; Salazar and Armitage 2018; Sicchio and McLean 2017).

The Algorave movement has developed different techniques such as: touchscreen devices (Salazar 2015), haptic actuators to embed sensation in wearables (Sicchio et al. 2016) or choreographies (Salazar and Armitage 2018). In fact, one of our inspirations for this project was the performance "Hacking choreography" (Sicchio 2014), this considers the possibility of seeking a dialogue between the dancer and the coder artist, improvising visual instructions for the body and therefore, hacking the traditional choreographies programming their movements through coordinates and instructions that border on the poetic. As described by Sicchio, the performance was:

"A feedback loop between the movement code and the sound code is thus created ... In this piece, both the dancer and the live coder were manipulating the code and changing the performance in real time". (Sicchio 2014)

Understanding this kind of performance as a feedback loop, induced us to consider the possibility of also creating a process of data transfer, or energy, where at the same time it was reintroduced with new information for the system, generating a feedback. Thus, with this idea, we began to imagine a feedback loop between the live coder and an external participant, who was aware of the modification of the parameters in the system.

4. DEVELOPMENT

According to the problems raised, for the development of this project, it was necessary to integrate the following tools: Microsoft Kinect as a full body tracking system, the SuperCollider audio synthesis software (McCartney 1996), the live coding software for sound improvisation TidalCycles (McLean and Wiggins 2010), the visual generation tool Hydra (Jackson 2018) and the in-house software Dosis for the integration (Nemocón 2018) which was developed in Processing (Reas and Fry 2006). The following is the description of the development process of each system module and its integration process.

4.1. Tracking System

In order to recognize the full-body gestures made by the user, the Microsoft Kinect device was selected to support this process. This device is a specialized 3D camera for the detection and tracking the whole body, which capture the user's gestures and their location in the space. The information detected by this device is sent using a network communication protocol, to the different modules of the system, where it is used to modify the outcome of the visuals and the sounds.

4.2. Interactive Mat

In the field of Immersive Virtual Reality (IVR), human-scale applications have been developed for the purpose of navigating within virtual buildings (Dam 2000) or exploring large-scale 3D reconstructions (Betella et al. 2014). To navigate these virtual worlds have been used devices such as: motion platforms (Shanklin 2016) or pneumatic gloves (Connelly et al. 2010).

The interactive mat developed for this project is inspired by the concepts of navigation used in the field of (IVR). We define this passive device with a grid layout, which is divided in 17 areas. Each area has a color and allows the user to move the objects in the directions: right, left, up, down and apply behaviors on the objects such as: speed up and speed down, increase and decrease the speed of the rotation, increase and decrease the quantity of the objects, change the shape, change size and rotate the objects on clockwise or counter clockwise. Also the user can have located at a starting point in the middle of the grid, see Figure 1.

The user's movements in each area are detected and converted into information by the tracking system. Then, this information is used to modify parameters and therefore the execution of the algorithms that generate the visuals and the sounds. These algorithms are also being manipulated simultaneously, by the live coders in real time.

Figure 1. Interactive mat design

The 17 areas of the interactive mat are described in the following table:

AREA	DESCRIPTION
Go Up	This area moves all the objects up
Go Down	This area moves all the objects down
Go Left	This area moves all the objects to the left
Go Right	This area moves all the objects to the right
Starting Point	This area is located in the middle of the grid and it does not have any behavior associated
Speed Up	This area increases the velocity of the all objects
Speed Down	This area decreases the velocity of the all objects
Speed Up Rotation	This area increases the velocity of the rotation of the all objects
Speed Down Rotation	This area decreases the velocity of the rotation of the all objects
More objects	This area increases the quantity of objects

Less objects	This area decreases the quantity of objects
Shape Changer (Forward)	This area change the shape
Shape Changer (Backward)	This area change the shape
Rotate Clock	This area rotates all objects in a clockwise direction
Rotate Counter	This area rotates all objects counter-clockwise
Size Bigger	This area makes all objects bigger
Size Smaller	This area makes all objects smaller

Table 1. Description of each area of the interactive mat

4.3. Sound Generation

One of the main challenges in this project was to develop a system that would allow a user from the audience to intervene the sound directly. To achieve this challenge, several SynthDef were developed in SuperCollider, which receives the information of the corporal gestures sent by the Dosis system (Nemocón 2018). These SynthDef modify the sound variables: pitch, frequency, amplitude and harmonics.

In a performance as the used for this project, the live coder associated with sound generation is not only focused on the execution and reproduction of the SynthDef from TidalCycles. He or she must also balance the level of control over the algorithms associated with the actions of the external user. The audio control is not only based on the live coder, the outcome of the sound is the integration of the live coder and the user from the audience.

To develop a friendly interaction between the user and the sound variables, we adopted a system similar to Theremin. The system of this project uses both hands as described below:

HAND	VARIABLE	DESCRIPTION
Right X-axis	Frequency	The movement of the right hand on the X axis changes the frequency of the sound.
Right Y-axis	Amplitude	The movement of the right hand on the Y axis changes the amplitude of the sound.
Left Y-axis	Dynamic effect	The movement of the left hand on the X axis changes the sound effect.

Table 2. Description of the mapping between hands and sound variables

4.4. OOP Visuals

For this project we have developed a series of visuals, which are composed by different sets of geometric figures. During the live coding performance, the live coders and the user located on the interactive mat, can change the properties these shown figures such as: position, direction of movement, direction of rotation, speed of rotation, color, size and even the quantity of the figures. The change of these properties by the user from the audience is associated with the gestures recognized by the full-body tracking system.

The visuals of this project have been developed on the framework for live coding Hydra, using Atom as text editor. These tools allow to develop and execute p5.js code on live. P5.js is a JavaScript library of Creative Coding for visual arts (McCarthy 2017). For this project, we implemented the code in accordance with the paradigm of Object-Oriented Programming (OOP) (Greenberg 2007; Antani and Stefanov 2017). The use of this programming paradigm in p5.js allows us to represent each geometric figure through objects using OOP classes, which implement the methods to handle behaviors such as resizing, color, direction, speed or rotation (Olaya 2018). These methods allow us to map the body gestures of the user with the behaviors of the geometric figures. Figure 2 and Figure 3 show some of the visuals used in this project implemented in Hydra using the principles of OOP for JavaScript:

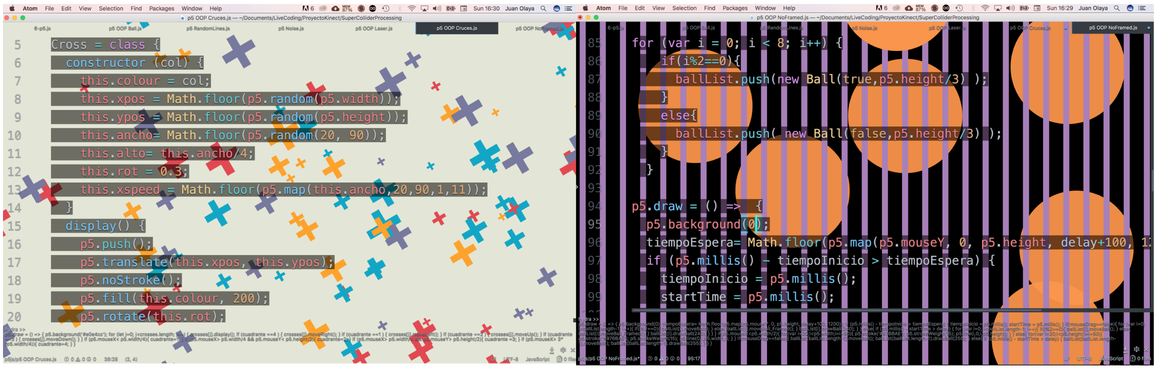

Figure 2. Object-Oriented visuals developed on Hydra using p5.js

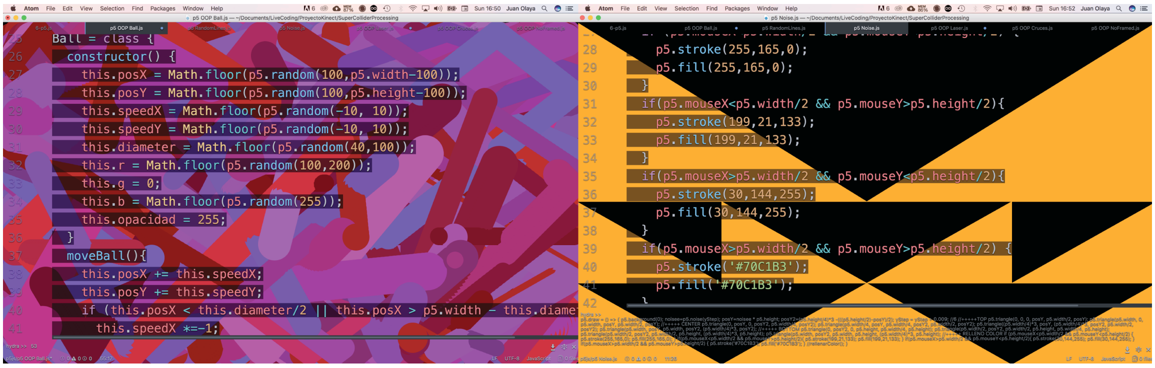

Figure 3. Object-Oriented visuals developed on Hydra using p5.js

4.5. Integration

The last stage of this project involved to communicate the three system modules: sound, visual and tracking to achieve an organic and understandable result.

Each software used in each system module, such as: SuperCollider + TidalCycles, Hydra and Dosis, are hosted in different computers allowing a collaborative work between three livecoders and the user from the audience that interacts with the gestures of the body. Communication between the three computers is done through the OSC communication protocol, Open Sound Control (Schlegel 2015), which allows the flow of information to be transparent and work as a single system. The Figure 4 shows the communication diagram between modules.

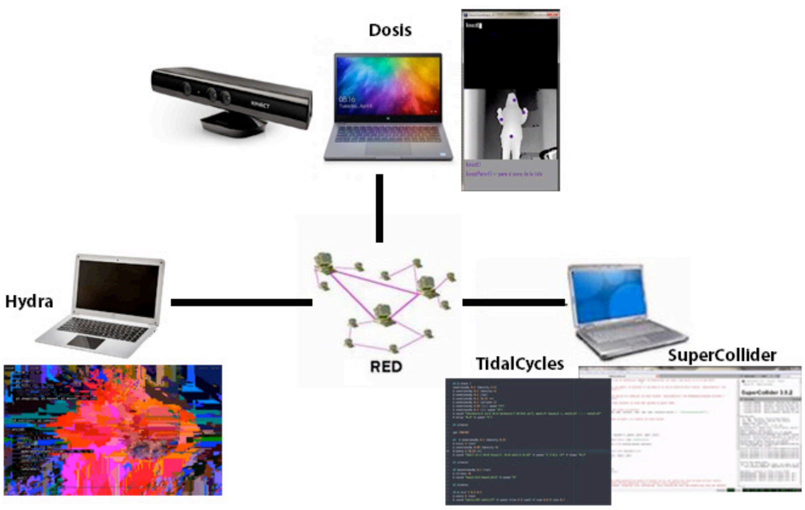

Figure 4. Communication diagram between modules

This structure allowed us to include a user from the audience, as if he or she were another member of the live coders group, generating a flow of information that allows us to develop a collective creation process in real time where we seek to conceptualize a performance with loop characteristics, taking into account the feedback from the rest of the live coders.

Our system captures the user's gestures located on the interactive mat. From the Kinect, the data is sent to SuperCollider and then from SuperCollider to TidalCycles to modify the audio synthesis. The same data is sent to Hydra, where the visuals are also modified in real time. In Figure 5 the view of the camera is shown during the capture of movements.

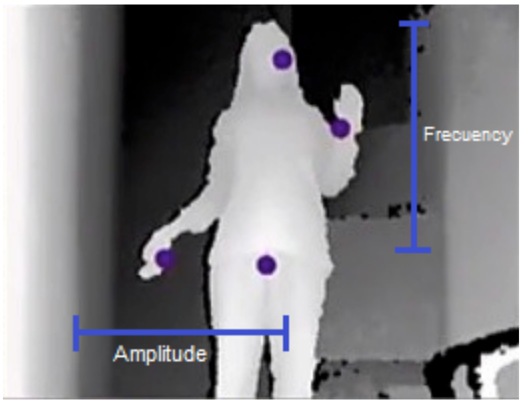

Figure 5. Capture of physical gestures

5. INTERACTION TEST

During the system test session, users reported that they were able to recognize the interactive mat as a space for interaction. The users were able to recognize the feedback of the visuals generated by their displacement on the different areas of the mat.

However, users reported not being able to continuously recognize the feedback during the entire interaction between the body gestures and the audio outcome in the performance. Therefore, to improve the user experience for future performances, it is recommended to analyze and adjust the parameters involved in the interaction between the user and the audio. The Figure 6 shows a photo of the system test session.

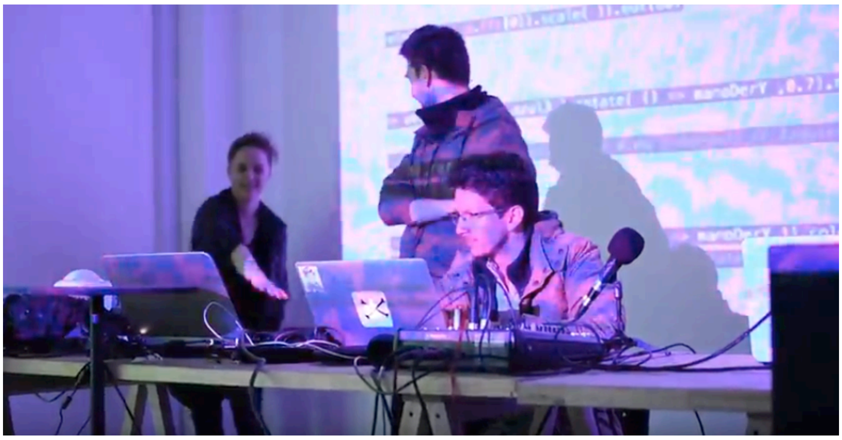

Figure 6. User from the audience testing the system

CONCLUSIONS

Including a person from the audience as another member of the group of performers, involved a creative, analytical and perceptive exercise. It required us to think about what parameters could be modified by the user and to what extent. We had to imagine the user as an instrument that is activated by the movement of his or her body. Nevertheless, because the body is the instrument and the creator at the same time, it goes beyond the functional or creative.

This project allowed the inclusion of the audience within the sound and visual composition hosted by the live coders, through a body tracking device. As a result of the integration between the tools used in this project, a collaborative audiovisual composition system was created, where live coders create sounds and visuals and which can be modified by a user from the audience in real time.

It was noted that the users recognize the interactive mat as a guide to perform full-body gestures during a live coding performance. In addition, users reported that from the change of the user's location on the mat, they observe a direct feedback shown in the visuals. However, in the sound intervention, it is necessary to instruct the user to perform the gestures correctly. Therefore, it has been proposed as future work to improve the user experience associated with the sound intervention.

Regarding the audio, it was determined that the sounds intervened by the user must have a higher priority in the volume within the sound composition, with the purpose of the user recognizing the sound feedback within the performance.

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BIOGRAPHIES

J.F. Olaya-Figueroa, obtained the degree of Computer Engineer from the Pontificia Universidad Javeriana in Bogotá Colombia in 2011, the Master's Degree in Cognitive Systems and Interactive Media from the Pompeu Fabra University of Barcelona Spain in 2014. From 2016 until now he has worked as a teacher in the university, Escuela de Artes y Letras of Bogota in the Digital Media Engineering program. During his teaching experience he has taught the subjects: Introduction to Programming, Object-Oriented Programming, Computer Graphics, Software Engineering, Artificial Intelligence for Videogames and Virtual Reality. Among his research interests are: Human-Computer Interaction, Serious Video Games and Computer Science Education. https://juanolaya.github.io/

L.V. Zapata-Cortés, is known for her fascination for explore and play with sounds. In her creations she has blurred the borders between the different disciplines that transit from the relationship and participation of the body, the plastic, the performative to representations of the historical and social issues. In her creative journey she has explored the soundscape, minimalism, deep listening, electroacoustic, performance, improvisation and live coding. She deeply believes in the need to assume political positions and advocate for inclusion, the visibility of minorities and the defense of human rights. As a teacher, she believes in alternative pedagogical approaches that emphasize meaningful learning and the development of emotional intelligence. In her Bachelor of Music, she was apprenticed to professors José Miguel Luna and Daniel Álvarez at the Universidad del Bosque in Bogotá, Colombia.

C.A. Nemocón-Farfán, Industrial Designer graduate from Andes University, Bogotá - Colombia, with complementary studies in Systems Engineering (academic option in visual computing) and in Art (academic option in art history). With a Master's degree in Systems and Computer Engineering from Andes University, the Master focused on the area of visual computing, visual analytics and interaction.

Work experience focused on development, management and production of projects with interactive technologies, whose strength is in object-oriented programming, with knowledge in languages such as java, C++, js and C#. At the design level the focus is on modeling 3D and 3D animation, and in the area of art the focus is on digital art and interactive installations.

The professional vision focuses on teaching, management and research in technology and innovation projects, and the development of interactive artistic projects.

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