LOOPJAM: A COLLABORATIVE MUSICAL MAP ON THE DANCE FLOOR

Christian Frisson [1], *Stéphane Dupont* [1], *Julien Leroy* [1], *Alexis Moinet* [1], *Thierry Ravet* [1], *Xavier Siebert* [2]

[1] Laboratoire de Théorie des Circuits et Traitement du Signal (TCTS), Université de Mons (UMONS), Belgique
[2] Laboratoire de Mathématique et Recherche Opérationnelle (MathRo), Université de Mons (UMONS), Belgique

ABSTRACT

The purpose of the LoopJam installation is to gather people to collaboratively build a live musical atmosphere. A two-dimensional "sound map" is created by our software which analyzes sounds, as well as musical loops, and groups them by similarity. Musical loops are chunks of music content (typically a few musical measures long) that create rhythmic music when played repeatedly. Wandering through the installation, each participant explores this sound map and activates sounds by simple gestures such as raising the hand, clapping or stepping. The playback of each sound is synchronized by our software, allowing a collaborative audio composition shared between all participants. Networking technologies are used for the communication between the 3D cameras tracking the participant motions and the music and visual rendering components. Network communication can hence potentially be used to create interactions between distant installations.

KEYWORDS

Interactive installation, realtime aided music composition, audio similarity, crowd tracking, Kinect

1. INTRODUCTION

In section 2 we describe the architecture of LoopJam. In section 3 we analyze the purpose and potentiality of this installation. After reminding the context of the past exhibitions of LoopJam in section 4, we plan future improvements in section 6.

2. ARCHITECTURE OF THE INSTALLATION

2.1. Featured technologies

The installation combines a range of emerging technologies, including audio and music signal processing, immersive audio, music information retrieval, audio browsing, 3D computer vision, gestural control, behavioral recognition, social signal processing. The interaction is based both on individual and collective behavior, for instance when a tempo emerges from participants naturally synchronizing with each other.

2.2. An audio loops map using AudioCycle

2.2.1. *Organized by timbral similarity / by instrument*

LoopJam derives from an application developed within the numediart Institute since 2008: AudioCycle [2]. AudioCycle allows to organize audio loop databases by content-based similarity. Audio loops are visualized on a 2D map, where each loop is represented by a sphere and positioned according to its timbral features, tied to the type of instrument used in the recording.

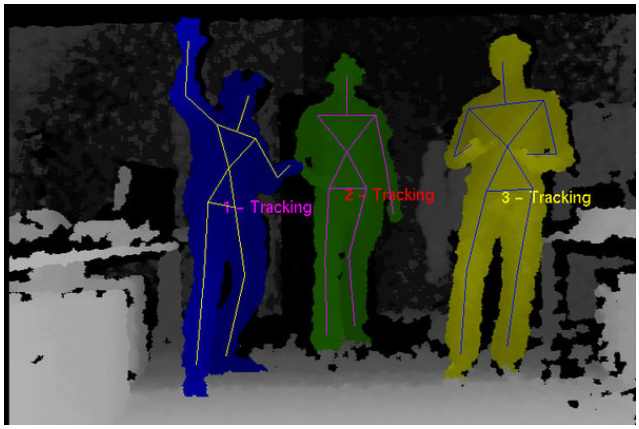

Figure 2: Visualization of a video scene with users skeletons segmented with OpenNI.

2.2.2. *Synchronized to a common tempo*

The loop databases usually loaded in the LoopJam installation are using the ACID format, where the tempo is encoded as metadata for optimal reliability, although standard audio format are supported as well. In the case of ACID databases, LoopJam automatically synchronizes the playback of loops and adapts the playback speed of each to a common tempo using a vocoder.

2.2.3. *Spatialized in the user plane*

The audio engine created for AudioCycle uses the OpenAL [1] library for sound playback and spatialization. The sounds are spatialized in the user plane, the default setting being for a stereo setup, but is compatible as well with a quadriphony setup used for LoopJam for an enhanced immersion while keeping the installation transportable.

2.3. Natural interaction with gestures

Users of the LoopJam installation are tracked using a Microsoft PrimeSense Kinect camera and the reverse-engineered OpenNI software development kit [6]. The barycenter of each user is mapped to a cursor on the AudioCycle browser. Figure 2 provides a visual representation of the video scene recorded by the camera, overlaid with skeletons of the users colored and segmented with OpenNI. The communication between an OpenNI-based application rapidly developed with openFrameworks and AudioCycle is based on the OpenSoundControl protocol previously integrated into the MediaCycle framework [3, 8] upon which AudioCycle is built.

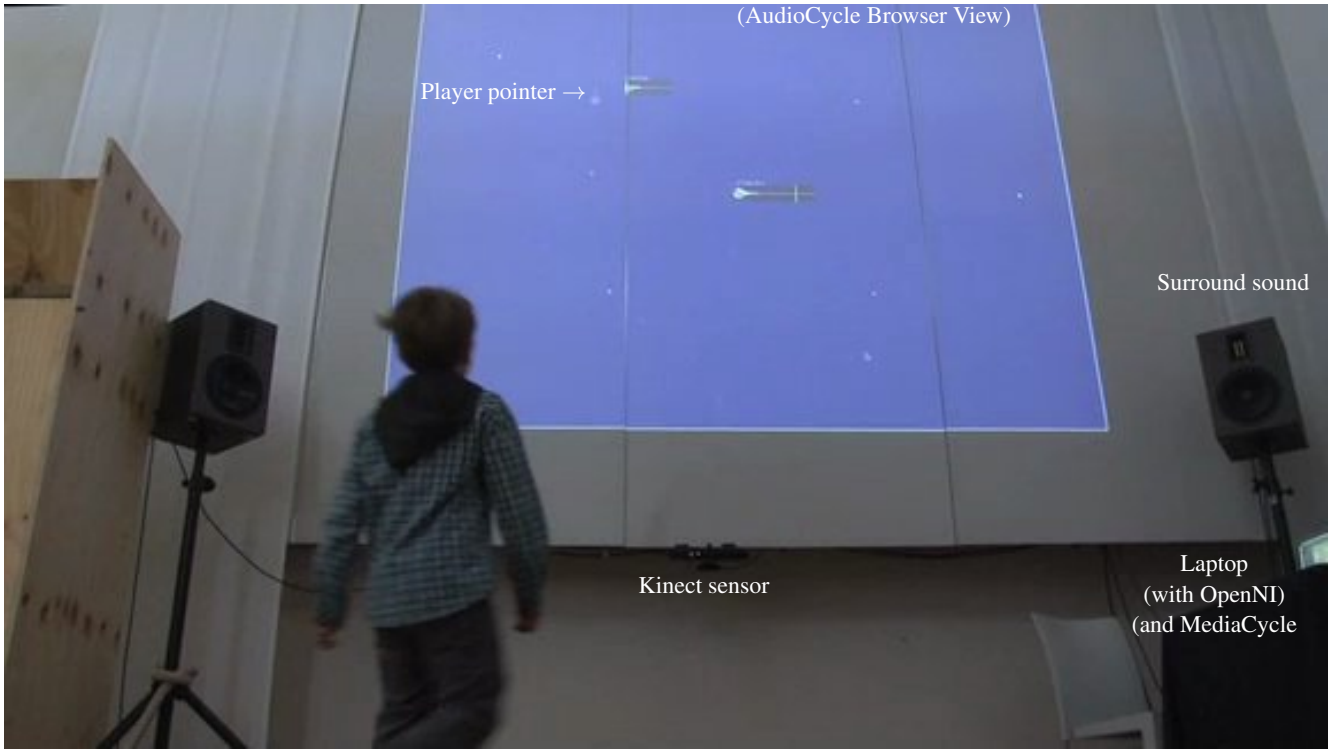

Figure 1: Photograph of one user browsing the LoopJam installation, annotated to describe its underlying architecture.

An option of the LoopJam system is to modify the tempo of the played audio loops by analyzing the movement of the users. We implemented a function that measures the rhythm that the users beat out. For the different characters, the speed of the left hand was extracted from the data of their skeleton movements. We sum these speeds and we extract the main frequency by computing the maximum power in the spectral analysis of this signal with a Fast Fourrier Transform algorithm (FFT settings: zero padded 512-point FFT of a 2-second window with 50% overlapping).

The obtained frequency is smoothed by a mean filter to avoid sharp modification; this value is used to control the tempo of the audio engine output with the phase vocoder algorithm implemented in MediaCycle.

The user who makes the larger movements influences the music tempo the most.

2.4. Equipment inventory

- 1 Microsoft PrimeSense Kinect camera
- 1 computer running OSX
- 1 1080p projector (4000 lm if avail.)
- 1 projection screen
- a scene of circa 4×4 m^2 in front of the screen
- 4 amplified speakers with analog input (XLR)

2.5. Available audio databases

The loop databases that have been used in LoopJam include:

- commercial but royalty-free ACID loop libraries from Zero-G (for instance the *Pro Pack* double DVD [9]) and Sony Creative Software (for instance *8-bit Weapon: A Chiptune Odyssey* [7]);
- opensource collections such as the One Laptop Per Child (OLPC) Free samples library [5].

3. POTENTIAL ARTISTIC PURPOSE OF THE INSTALLATION

The LoopJam installation has been presented to the 17^{nth} International Symposium on Electronic Art (ISEA), in September 2011 in Istanbul, Turkey [4], compared to existing artistic works featuring content-based similarity.

3.1. Artistic Merit

We believe that the audience attending artistic and cultural "events" more and more wants to engage and influence the audiovisual rendering, so that each individual can feel and embody the created content, beyond the artist to audience relationship that is quite totaliarian, and towards a more democratic communicative collaboration, where every participant can exchange ideas.

Figure 3: Photographs of users trying the LoopJam installation at the Seneffe Castle, in May 21-22.

There is an emerging community of music-inclined people that wants to access ideals, such as virtuosity, with a more steep learning curve, with instant pleasurability. Examples have been shown over the past years with the success of video games such as Guitar Hero. However, despite several spin-offs (for singers, drummers and DJ's), the success is declining. One possible reason might be that once skills are acquired to reproduce a diminished version of the score, the player finds the limits of the video game: his/her creativity and emotion aren't aroused.

With this installation, we re(de)fine the audience/artist relationship. The audience participates to the music performance by dancing, its behavior and movements affecting the choice of musical loops and hence the resulting mix, as well as the overall playback parameters (tempo, amplitude...). The DJ or curator responsible for the installation introduces her/his artistic sensibility by the choice of sound libraries, even more when sounds created by the curator herself/himself are featured, and can affect moods during the performance by altering meta parameters affecting the navigation/browsing: changing sub-libraries, re-organizing the library display spatially (zoom, rotations...) and in terms of contents (groups of sounds assorted by different facets such as timbre, rhythm...). The curator may therefore ensure a certain quality in the global performance (during the performance, and before, while choosing sound libraries), while the audience participates to the playback, whereas seamless sound synchronization and minimal automated musicianship is taken care of by the installation audio rendering back-end.

3.2. Distinctiveness

By creating fun together, the social interaction and networking, compared to traditional dance floors, is improved: not only gracious dance moves provoke the other people around, but emerging individual and collective musical skills create surprise.

4. PAST EXHIBITIONS

- Seneffe Castle, Seneffe, Belgium, in May 21-22, 2011 (as seen in Figure 3).
- Centre Wallonie-Bruxelles (CWB), Paris, France, from September 22 to October 23, 2011.
- Nominated in the top 5 of the Art Contest of the 2011 Networked & Electronic Media (NEM) Summit in Torino, Italy, September 27-29.
- At the numediart lab on November 23 2011 during the Week of Creativity organized by Creative Wallonia.

5. CONCLUSION

With the LoopJam interactive installation, participants collectively discover how to coordinate their movements to create satisfying musical pieces. Also, it is made very accessible and fun to experiment through the use of audio processing technologies that provide instant reward by allowing the synchronization of different instrumental tracks on the fly.

Moreover, as observed in several public experiments, some participants want to push the system further, for instance by alternating back and forth between close-by musical loops, in effect creating new textures, and developing musicianship skills related to the installation concept. As a consequence, some form of fun and improvised choreography also emerges from the individual motions.

6. PERSPECTIVES

6.1. Visualization adapted to human perception and cognition

We need to adapt the number of displayed loops for augmented playability: the more densely distributed the loops are, the harder it is for users to maintain the playback of one given loops, but the easier it is to quickly add variance to the mix.

6.2. Wider contexts of use

We plan to adapt the installation to other venues such as nightclubs, socio-cultural institutions, amusement parcs.

6.3. Optimization

Here, music tracks controlled by individuals are being processed in separate threads, allowing to exploit multiple processing cores. Within the related research project supporting these developments, we are also investigating the use of GPU optimization.

6.4. Recomposition beyond audio databases

A longer-term objective is to develop innovative concepts and tools for musical content creation through recomposition, extended to multimedia content and fragments. We plan to extend the concept to video content.

6.5. Networked installations

On the architectural side, the software is designed for networked use. Indeed, control parameters are received through the network (TCP/UDP using OpenSoundControl), allowing to explore different control devices and hardware artifacts for different purposes. The whole multi-party body control that is proposed here is one instance of that. As a consequence, people that are not co-located could participate to the experience and contribute at a distance to the music creation. Besides, real-time and efficient implementation of the audio processing path is a requirement.

7. ACKNOWLEDGMENTS

numediart is a long-term research program centered on Digital Media Arts, funded by Région Wallonne, Belgium (grant N°716631).

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