

Violet Ivy:

A visual Motion Capture-Based Audio-Visual Live Performance

Jin Wen, Michael Cella, Natalia Quintanilla, Qi Shen

ABSTRACT

This paper discusses 'Violet Ivy,' an audio-visual work that utilizes a visual motion tracking system for creating a real-time audio-visual performance through hand gestures and movements. 'Violet Ivy' is a multi-dimensional experience that encompasses the live manipulation of both sound and visuals. The performance intricately weaves together two core elements: the dynamic 'playing' of a MIDI-equipped *Bösendorfer* piano, controlled by MIDI, and the simultaneous creation of visual art. As the performer moves through the space, the grand piano responds to their hand movements, translating gestures into musical notes. Concurrently, the performer engages in drawing on a digital canvas. This dual interaction unfolds in real time, exploring the synergies between live music performance, visual art creation, and movement. The result is a unique and immersive experience designed to captivate both the performer and the audience.

Keywords

Motion capture, motion analysis, expressive movement, interaction design, Max MSP, Processing.

CCS Concepts

- **Computing methodologies** → Motion capture; Motion processing;
- **Human-centered computing** → Interaction design
- **Applied computing** → Performing arts

1. INTRODUCTION

Motion capture systems are integral across diverse fields, including healthcare, sports, art, entertainment, and the gaming industry, as well as in industrial design, ergonomics, and robotics applications [1]. This paper explores an audio-visual performance that leverages the 'Qualysis' visual motion tracking system, which enables a highly precise and accurate method for detecting and mapping movements. The captured movement data is transmitted to a Max patch, a real-time audio processing programming environment, facilitating control over a MIDI-equipped Bösendorfer piano (Fig. 1). Simultaneously, a Max MSP patch transmits data to a Processing sketch, a programming environment primarily used for creating visual arts. This allows the performer to engage in real-time drawing on a digital canvas (Fig. 2).



Figure 1. The MIDI-equipped Bösendorfer piano plays back MIDI data



Figure 2. 'Violet Ivy'

'Violet Ivy' was initially conceived as a project embodying the principles of 'embodied interaction' (Jensen, M. V. [2005]). [2] This approach involves the "design and analysis of interaction that considers embodiment to be central to, even constitutive of, the entire phenomenon." Implementing this concept in art-making allows for the amalgamation and exploration of synergies across disciplines, resulting in a comprehensive performance that incorporates music, visual art, and dance. This supports Jensen's idea that "movement originates from the body, signifying both emotion and expression." [2]

1.1 Related Work

The common threads running through the selected repertoire are the exploration and integration of innovative technologies in the realm of motion tracking based musical and visual expression. Each project represents a unique fusion of artistic and technological elements, creating immersive and interactive experiences. Key themes include interactive technology, synthetic exploration, innovative instruments, cross-disciplinary collaboration, experimental and performative.

Tapis Magique: A Choreomusical Interactive Carpet, suggests a multidisciplinary project that combines elements of choreography, music, and interactive technology, particularly in the form of a carpet [3] (Fig.3). The term "Choreomusical" implies a connection between choreography and music. The project explores how dance movements interact with or influence musical elements, creating a symbiotic relationship between the visual and auditory components.



Figure 3. *Tapis Magique*: A Choreomusical

Veremin, conceived by Va Barbosa and John Cohn, is a video theremin leveraging PoseNet technology. [4] Adapted from the PoseNet Camera Demo, the project transforms hand and arm movements captured by a web camera into musical

expressions (Fig.4). PoseNet predicts wrist locations in the video, converting these predictions into browser-based tones or MIDI values for connected MIDI devices.

INT036 - AirSticks is a new audio-visual gestural Instrument for real-time electronic improvisation music, invented by Alon Ilsar and Matthew Hughes. [5] The designers have curated an extensive repository of movement-to-sound mappings, accompanied by a real-time visualization system. This system harmonizes handheld motion controller data, seamlessly blending sound, graphics, and movement (Fig.5).



Figure 4. *Veremin*: a video theremin



Figure 5. *AirSticks*. The original, partly-mimed performance.

Transient is an audiovisual concert featuring two motorized pianos and video projections, created by Quayola and Seta. The performance seamlessly intertwines sounds and visuals, yielding perfectly synchronized synesthetic expressions, and liberating pianos and paintings from conventional hand gestures (Fig.6). Non-human virtuosity, animated through mathematical functions, breathes life into keys and canvas, exploring novel parametric possibilities.



Figure 6. *Transient - Impermanent Painting*, by Quayola and Seta, in Teatro Aefentina, Roma.

In summary, the overarching trends across the examined repertoire include a strong emphasis on interactive technology, synesthetic exploration, instrument innovation, cross-disciplinary collaboration, a focus on experiential performances, and technological influence on composition. These trends collectively showcase the transformative potential of innovative musical interfaces in reshaping the landscape of live performances and artistic expressions.

2. SYSTEM & INTERACTION DESIGN

The performer in 'Violet Ivy' utilizes the Qualisys motion capture system with only two markers of an AIM model: LFIN (Left finger) and RFIN (Right finger) (Fig.7). The motion data is then translated into MIDI values, controlling pitch and dynamics on the grand piano, and into the mouse position in the Processing sketch. This capability enables the performer to create drawings and dynamic music through hand movements.

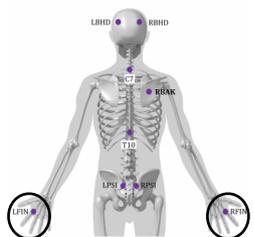


Figure 7. Marker Placement

In this specific audio-visual work, the performer integrated Quasi-Taichi as their choreography. The motion data generated was

transmitted to Max, where it was intricately mapped into MIDI

numbers. Consequently, as the performer gestures and moves their hands, the corresponding piano keys are played, with the velocity of these notes adjusting dynamically as the performer navigates the space. For instance, moving towards the right (from the audience's perspective) results in *forte* dynamics, while moving towards the left corresponds to *piano* dynamics.

The motion data received and transmitted to the Max/MSP patch is also being utilized for the mouse position in the Processing Sketch. Through OSC communication, the Max patch transmits the motion data values, mapped into the dimensions in pixels of the Processing canvas, sending them to the Processing sketch as mouse positions: Left Hand - Mouse position Y, Right Hand - Mouse position X. This enables the performer to use the space in the motion capture system as a canvas for drawing visual art. (fig. 8)

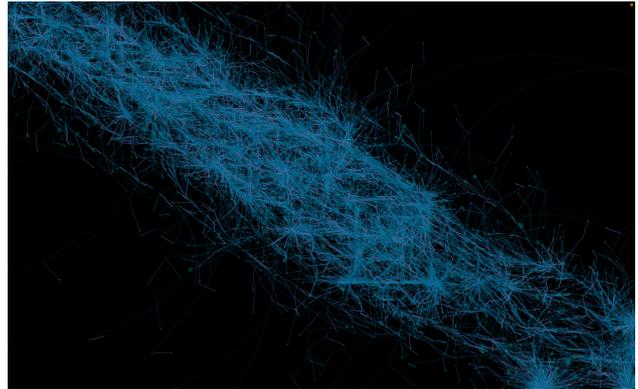


Figure 8. Processing sketch - generated visual

3. SYSTEM REVIEW & INSIGHTS

THE artistic design based on the 'Qualisys' motion capture tracking system (MoCap) introduces certain challenges rooted in its site-specific nature, imposing constraints on users' freedom of movement. The inherent requirement for a designated space and associated hardware throughout the interactive design process limits the flexibility of users. To address these limitations and enhance the user experience, a solution lies in the development of a motion data recording and playback system. This coding solution allows for the capture and storage of motion data during interactive sessions, enabling users to later analyze and manipulate the recorded data without the necessity of being tethered to the original captured space and hardware. In the Max patch, we stored 6 channels of motion data, three from each hand, into a 6-channel .wav file, so that we could "mock" the real time motion data while developing the software without being constrained to the physical location where the motion capture system is located (Fig.9).

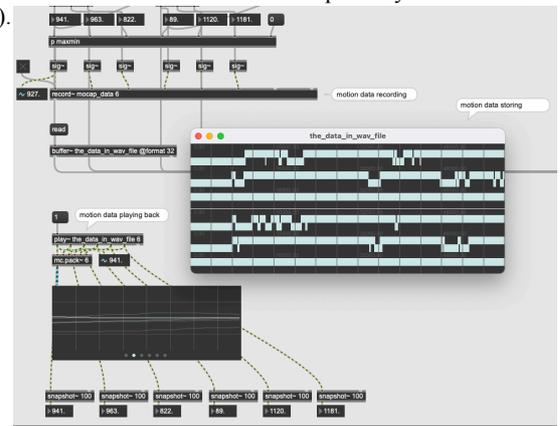


Figure 9. Max-based solution for motion data recording, storage and playback

This approach not only provides a more adaptable and user-friendly interaction design for sound, visual, and body movement elements but also empowers artists and creators with greater freedom in exploring and refining their artistic expressions.

4. FUTURE ITERATIONS

The potential for future enhancements and refinements to *Violet Ivy* is vast. One such avenue for expansion would be to calculate the velocity vector of the motion data and use those additional variables for audiovisual control. Using these could provide a more intuitive mapping for human expression, where sudden, expansive movements generate louder sounds, while smaller, more gentle movements produce quieter sounds, without having to move the body across the physical motion capture space. For example, the velocity of motion could control pixel brightness or color. This approach aligns with the natural human tendency to associate rapid, large-scale movements with high intensity, and slower, smaller movements with subtlety.

A separate path for future iteration could involve the integration of diverse movement styles or instruments for sound generation. Various forms of dance, or entirely different activities, such as woodworking, miming, or even the performance of a musical instrument such as upright bass or drum set, could yield dynamic motion data. This approach could potentially unlock new dimensions of interaction and expression within the *Violet Ivy* system.

5. CONCLUSION

Violet Ivy, an innovative application of motion capture technology, blends visual art and live music into an immersive performance, exhibiting the intersection of movement, emotion, and expression. It offers a unique framework where hand movements control a MIDI-equipped piano and digital canvas in real time, creating an audiovisual experience that is isomorphic to, but physically separate from, the dancer's body. The devised interaction design provides a robust blueprint for future explorations, suggesting enhancements like linking motion velocity to sound and color intensity, as well as extending the system to diverse activities or dance styles. Ultimately, *Violet Ivy* emphasizes the transformative potential of technologies like motion capture in redefining artistic expressions.

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