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SOUNDCOOL: ENABLING EASY-TO-CONFIGURE INTERNATIONAL COLLABORATIVE PERFORMANCES WITH MINIMAL TECHNICAL KNOWLEDGE AND AI

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ABSTRACT

Soundcool is a modular multimedia system designed for collaborative performances with minimal technical requirements. Originally developed for educational purposes, it has evolved into a powerful tool for professional music and audiovisual productions. Its intuitive interface allows users to configure and control modules remotely, enabling international performances with ease. During the COVID-19 pandemic, Soundcool's remote capabilities were leveraged for distributed concerts, such as the piece "Poliacordes Audiovisuales," demonstrating its potential for creative collaboration. In this paper, we explore its applications for live networked performances and international educational projects, highlighting its role in democratizing multimedia creation. Additionally, we present the latest version, Soundcool 5.1, which introduces videomapping with minimal hardware requirements.

Keywords: *Networked music performance, Collaborative multimedia, Remote audiovisual creation, Live videomapping, STEAM education.*

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1. INTRODUCTION

In recent years, the concept of networked music performance (NMP) has gained significant attention, enabling musicians and artists to collaborate remotely in real-time. However, many existing solutions require advanced technical knowledge and specialized hardware, limiting accessibility for broader audiences. Soundcool addresses this challenge by providing an intuitive, modular multimedia system that facilitates international collaborative performances with minimal technical expertise.

Initially designed as an educational tool for STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning [1][2], Soundcool has evolved into a versatile platform for both educational and professional creative applications [3][4]. Its modular nature allows users to connect and control audio and video modules using standard computers and mobile devices. This ease of configuration fosters innovation in live multimedia performances, allowing participants to engage in complex projects without requiring extensive technical training.

During the COVID-19 pandemic, Soundcool's capabilities were expanded to support remote collaboration over the internet, enabling distributed performances through video conferencing platforms [5]. A key example of this is the project "Poliacordes Audiovisuales", developed and conducted by Francisco Valero, the director of the orchestra at the Universitat Politècnica de València. This performance demonstrated the potential of Soundcool for remote artistic collaboration, as musicians and visual artists controlled the audiovisual elements in real-time from different locations.

Building on these capabilities, the latest version, Soundcool 5.1, introduces videomapping functionalities that further





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enhance its potential for live performance and interactive installations. With only a standard computer and projector, users can create immersive audiovisual experiences that can be controlled remotely. These advances position Soundcool as a powerful tool not only for artistic and educational projects but also for international networked performances that democratize access to high-quality multimedia creation.

function over the internet, enabling distributed performances through video conferencing. This capability has proven invaluable for artists and performers, allowing them to collaborate and perform together remotely, regardless of their physical location. By simplifying the technical aspects of multimedia production, Soundcool democratizes access to high-quality performance tools, making it easier for a diverse range of users to engage in creative and collaborative endeavors. In this paper, we describe the remote collaborative approach of Soundcool and various experiences with networked performances for professional applications and their outcomes.

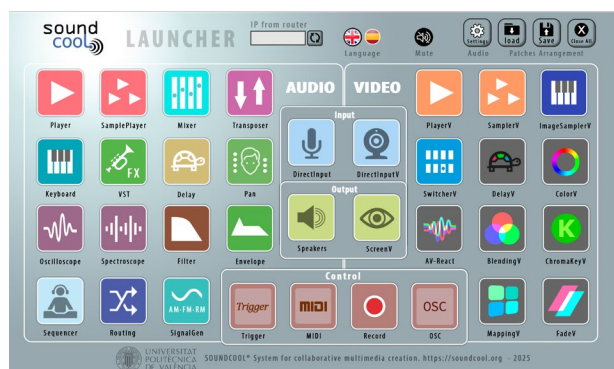


Figure 1. Soundcool 5.1 audio and video module launcher application for PC or Mac, with Audio modules on the left and video modules on the right.

This paper explores Soundcool's approach to networked performances, highlighting its applications in professional and educational settings. We present experiences from past projects, including "Poliacordes Audiovisuales", and introduce the new videomapping features in Soundcool 5.1, demonstrating how the system continues to expand the possibilities for creative collaboration in distributed environments.

2. NETWORKED MUSIC PERFORMANCE

Soundcool is a modular software system designed for live collaborative multimedia projects. It features very simple audio and video modules that operate on a computer and can be controlled via Android and iOS devices. Originally developed for educational purposes, particularly in Project Based Learning (PBL) and STEAM (Science, Technology, Engineering, Arts, and Mathematics) education, Soundcool has evolved to support professional musical and video performances. The system's intuitive design allows users to easily configure and connect modules, facilitating international collaborative performances. This accessibility makes it possible for individuals with minimal or no technical knowledge to participate in complex multimedia projects. During the pandemic, Soundcool was adapted to

3. SOUNDCOOL SYSTEM OVERVIEW

The Soundcool architecture is based on independent modules that handle different media types, including audio processing, video manipulation, and interactive control. These modules can be combined and customized to create complex multimedia compositions, making the system highly flexible for both educational and professional applications.

One of the core strengths of Soundcool is its intuitive graphical interface, which allows users to interconnect modules easily without requiring programming skills. The system supports remote control through mobile devices running iOS and Android, enabling real-time interaction with multimedia elements. This feature has been instrumental in expanding the accessibility of Soundcool for artists, educators, and students worldwide.

Soundcool operates on standard computers and integrates seamlessly with video conferencing platforms such as Zoom, Microsoft Teams, and Google Meet. This capability was particularly valuable during the COVID-19 pandemic, allowing musicians and visual artists to perform collaboratively from different locations.

A significant innovation introduced in Soundcool 5.1 is the incorporation of videomapping capabilities. While this feature was not present during the Poliacordes Audiovisuales project, it represents an important feature for multimedia performances. Unlike traditional videomapping software, which requires high-performance hardware, Soundcool's videomapping functions operate on standard computers and projectors. This makes it a practical solution for educational institutions and artists seeking to create immersive visual experiences with minimal technical resources.

The modular design of Soundcool, combined with its networked capabilities, positions it as a versatile tool for both live performances and online educational projects. The



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system continues to evolve, integrating new features that enhance its usability and creative potential.

4. CASE STUDY: POLIACORDES AUDIOVISUALES

The project “Poliacordes Audiovisuales” was a collaborative audiovisual performance conceived and conducted by Francisco Valero, the director of the orchestra at the Universitat Politècnica de València. The work was designed to explore the possibilities of real-time, remote collaboration using Soundcool as the central multimedia system. The performance was a response to the challenges posed by the COVID-19 pandemic, which required artists and performers to adapt to new ways of working in isolation while maintaining the potential for creative collaboration.

The main objective of “Poliacordes Audiovisuales” was to create a live, interactive audiovisual experience that could be controlled remotely by musicians and visual artists located in different places. While some musicians were together with the central computer running Soundcool, many artists controlled the audio and visual elements of the performance from remote locations in France, the United States, the United Kingdom, and Spain using mobile devices (iOS or Android) with the Soundcool OSC app.

The connection between participants was made possible through the use of the Soundcool OSC app, available on both Android and iOS, which operates over the internet using the Open Sound Control (OSC) protocol. OSC allows for the transmission of simple control messages, such as button presses and slider movements, which contain minimal information and can be transmitted quickly, even over varying internet speeds. This lightweight communication system ensured a smooth, real-time collaboration between participants for evocative pieces like this one.

While “Poliacordes Audiovisuales” did not require tight synchronization of elements, the design of the system allows for such synchronization when necessary. In other projects, participants with the lowest network latencies can control more critical elements that require precise timing, while other elements—such as video textures or effects—can tolerate higher latencies without disrupting the performance. This flexibility demonstrates how Soundcool can adapt to different synchronization needs in a distributed performance setting, providing a smooth and creative experience regardless of network conditions.

Soundcool played a central role in facilitating the remote collaboration. The system allowed for easy configuration of

audio and video modules, and the resulting sound and images were transmitted to participants using an off-the-shelf video conferencing platform (Zoom). Participants could interact and control the performance remotely through the Soundcool OSC app running on smart phones connected back to the Soundcool host computer via the internet. This made it possible for the director and performers to communicate and collaborate effectively despite being physically separated. The project demonstrated the power of Soundcool's simplicity and flexibility, enabling non-technical users—such as musicians and visual artists—to engage in sophisticated multimedia performances without needing specialized training in technology or network configurations.

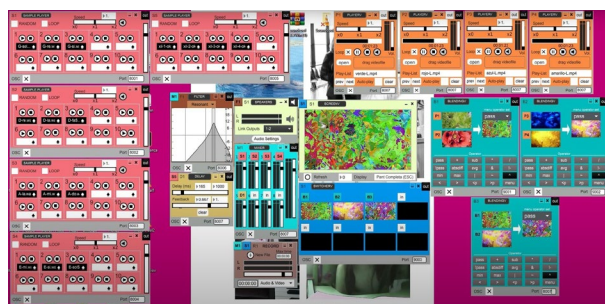


Figure 2. Soundcool configuration for “Poliacordes Audiovisuales” with audio modules (left) and video modules (right).

In terms of technical setup, the performance utilized several Soundcool modules, including audio processing for live music manipulation, video control for visual effects. Fig. 2 presents the Soundcool configuration with audio modules (left) and video modules (right). Concretely, from top to bottom and from left to right: 6 sampleplayers (red) with different samples for the piece, a resonant filter (brown), a delay (yellow), Speakers module (audio output, yellow), a mixer (blue), an audio record module (brown) to record the performance audio. For the video modules, the piece had 4 video players (orange), screen module to visualize the result (yellow), a video switcher (blue) to select between the video output of the 3 video blending modules (blue) (bottom right). These video blending modules have 20 possibilities for creative video blending, and blend video from the video players. All the modules were controlled in real time from multiple countries. The seamless integration of music and video was key to the success of “Poliacordes Audiovisuales,” as the audiovisual components were intricately linked, with live music influencing the visual projections and vice versa. The performance is available at <https://youtu.be/QyCYa71SGtc?t=366>.



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The success of the project was not only in the innovative use of Soundcool for remote collaboration but also in the impact it had on the performers and online audience. Despite the limitations imposed by the pandemic, the project enabled a high level of artistic expression and creative collaboration, proving that remote performances can be a powerful alternative to traditional in-person events. The flexibility of Soundcool allowed for a dynamic and interactive performance that would have been difficult to achieve with other systems or without the simplicity of Soundcool's modular approach.

"Poliacordes Audiovisuales" also highlighted the value of Soundcool in educational settings. As a tool designed initially for educational purposes, the system showed its potential for integrating the arts with technology in a way that is accessible to both students and educators. The ease of use and remote capabilities also demonstrated how Soundcool can be applied in online learning environments, providing a platform for students to engage in creative, multimedia projects without needing advanced technical knowledge.

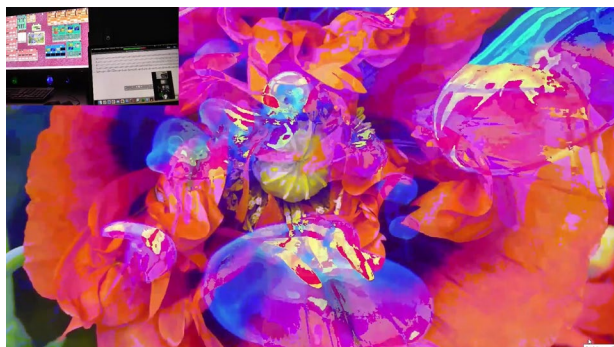


Figure 3. Snapshot from the live video creation for "Poliacordes Audiovisuales".

This case study not only illustrates the potential of Soundcool for remote collaborative performances but also serves as a foundation for further developments in distributed performances. Moving forward, projects like "Poliacordes Audiovisuales" will benefit from the new features in Soundcool 5.1, particularly the addition of videomapping capabilities, which will allow for even more complex and immersive multimedia experiences with minimal technical requirements. With the introduction of the videomapping module (MappingV) in Soundcool 5.1, users can now project video onto physical objects with minimal hardware requirements. The module supports up to six video inputs, which can be deformed, resized, or masked to fit the contours of objects. Users can control

these projections remotely via the Soundcool OSC app on mobile devices. Key features include:

- Video deformation and masking to align projections with objects.
- Multiple layers of video for complex projections.
- Real-time adjustments using keyboard shortcuts and remote control.

This feature enables immersive audiovisual experiences and can be easily used for live performances, interactive installations, and educational projects, with only a computer and projector needed.

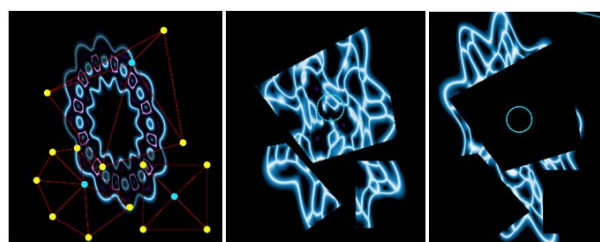


Figure 4. From left to right: mask editing mode, the same mask applied in Add mode, and finally applied in Subtract mode.

5. APPLICATIONS AND IMPACT OF SOUNDCOOL FOR NETWORKED PERFORMANCES AND EDUCATION

The introduction of remote-controlled modules, such as the videomapping feature in Soundcool 5.1, opens new possibilities for both networked performances and interactive education. This section highlights several examples of how these capabilities have been applied in professional music and audiovisual performances, educational projects, and neurocognitive stimulation.

5.1 Networked Performances

The flexibility and user-friendliness of Soundcool make it an ideal tool for live networked performances. As demonstrated in the Poliacordes Audiovisuales project, artists and performers from different countries were able to collaborate remotely, transcending geographical boundaries to produce a seamless live performance.

While more performances and remote interactive workshops can be explored at <https://bit.ly/3r1qFwO>, it's important to emphasize that Poliacordes Audiovisuales was created without technical training. One of Soundcool's key advantages is its minimal technical setup for networked performances. Unlike traditional NMP systems that often require specialized hardware or complex software,



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Soundcool's modular design allows for intuitive configuration and control, making it accessible even to non-technical users. This accessibility fosters collaboration across a wide range of participants, including those with little or no technical background.

5.2 Educational Impact

In the realm of education, Soundcool has proven to be a powerful tool for interactive learning. With its Project-Based Learning (PBL) approach, students can engage with technology creatively, working in groups to develop multimedia projects that integrate music, video, and performance. The system has been recognized by Spain's Ministry of Education, Training, and Sports for its innovative approach to STEAM (Science, Technology, Engineering, Arts, and Mathematics) education, particularly in creating collaborative projects across international borders [6].

The recent launch of Soundcool 5.1 has been instrumental in expanding its use in international educational settings, where students and teachers can now collaborate across borders in real time. For example, Soundcool's capacity to support live videomapping, as mentioned earlier, has proven invaluable for creative projects that combine visual effects and performance. In addition, Soundcool's ability to integrate easily with other digital tools, such as video conferencing platforms, ensures that it can be incorporated into online education and remote workshops.

5.3 Applications for Neurocognitive Stimulation

Beyond its impact on education and performance, Soundcool has shown great potential in the field of neurocognitive stimulation [7]. Its interactive, creative features have been applied in therapy sessions for patients with Alzheimer's disease and other neurodegenerative conditions [8][9][10]. By allowing individuals to control video, audio, and performance elements remotely, Soundcool provides a dynamic and engaging way to support cognitive functions such as memory, attention, and sensory processing.

One notable example is the Soundcool-based concert held in July 2024 at New York University, where patients with Alzheimer's, located in Spain, controlled video creation parameters using tablets and the Soundcool OSC app. This remote control setup enabled these patients to actively participate in the creative process, highlighting the potential of Soundcool as a tool for therapeutic activities. This concert was part of a series of similar concerts featuring video creation performed remotely by people with Alzheimer's and other neurodegenerative diseases in Spain, Mexico and the USA, which can be explored at this YouTube playlist: <https://bit.ly/nyu-sc-2024>.

A significant innovation introduced during this performance was the use of Artificial Intelligence (AI) for creating videos. This made the video creation process much easier and more engaging, as it eliminated the need to record videos ad-hoc or search for free-use videos, edit them, and create a cohesive story. Instead, AI-generated videos became the base material for performances, adding an exciting and new layer to the creative process.

We are also collaborating with New York University (NYU) for the application of AI acceleration in matrix function computations for generative flows in AI for images [11], further enhancing the possibilities for AI-driven video creation.

This application highlights Soundcool's versatility, providing an innovative and accessible way to engage individuals with neurodegenerative conditions in meaningful and stimulating activities. At the same time, it pushes the boundaries of AI-driven creative therapies. We are currently working on a publication to present the results of this application.

6. CONCLUSION

Soundcool represents a significant contribution to the field of networked music performance, offering an intuitive and highly flexible tool that allows for seamless collaboration across geographical boundaries. By combining audio, video, and now videomapping capabilities, it empowers both professional artists and non-technical users to engage in live performances and collaborative multimedia projects with minimal technical knowledge.

The ability to perform remotely, as demonstrated in the "Poliacordes Audiovisuales" project, has proven invaluable, not only for artistic collaborations but also for educational and therapeutic applications. The use of Soundcool for remote workshops and projects, such as the concert held at New York University with Alzheimer's patients controlling video parameters remotely from Spain, highlights its potential to democratize access to multimedia creation and extend its benefits beyond traditional performance contexts. Soundcool's modular design, combined with the Soundcool OSC app, simplifies the process of configuring and controlling performances, enabling individuals from various locations to participate and contribute in real time. This accessibility has made Soundcool an essential tool for collaborative projects in a wide range of settings, from live performances to educational initiatives and even therapeutic practices.

Looking forward, the ongoing development of Soundcool—particularly with features like videomapping in version 5.1—presents exciting new possibilities for interactive





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and immersive performances. As it continues to evolve, Soundcool will likely play an even greater role in facilitating cross-cultural, multidisciplinary collaboration, both in professional settings and educational environments. With its capacity to foster creativity and connection, Soundcool stands at the forefront of a new era in networked multimedia performance.

7. ACKNOWLEDGMENTS

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