Interactive Installation

Fidjam

Sistemas Digitais Interativos - MM0027

Group 6

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1. Context of the Work

Interactive art represents a type of artistic expression, where it involves the audience in the art piece, therefore the artwork finds its purpose through participation. Some interactive installations achieve this by making people walk thru, over, or around them, while others invite the audience to be a part of the artwork itself. Our project, **Fidjam**, is one of those that follow this tradition by providing an immersive and participatory experience that blends music, technology, and creativity working on the same level.

The installation offers an intuitive and engaging way for participants to interact with music through the use of physical cubes and an interactive surface. Using the reacTIVision framework, which tracks fiducial markers on physical objects, the installation allows users to control different aspects of music creation in a hands-on manner.

The installation features five cubes, each representing a different element of music composition. One cube is used to select the genre, with three faces corresponding to pop, hip-hop, and rock. Users can place the genre cube in any position to choose the musical style they want to explore. The other four cubes represent drums, lead, vox, and bass. Each of these cubes has three faces, each representing a different sample of that particular instrument. By positioning the cube with the desired face facing up, the corresponding sound sample is activated.

Figure 1 - Fidjam Cubes (2025)

The surface serves as the control interface for adjusting volume and sound filtering. Users can adjust the volume by placing the cubes higher or lower on the surface – higher positions increase the volume, while lower positions reduce it. Similarly, the horizontal placement of the cubes controls the filter frequency between low-pass and high-pass. The further to the right a cube is placed, the stronger the high-pass filter applied to the sound, while placing the cube further left applies a stronger low-pass effect.

Figure 2 - Fidjam Surface (2025)

Through the manipulation of the cubes, users can control the volume and apply dynamic filtering to different elements of the music, shaping the composition in real-time. This interactive experience is designed to be hands-on and accessible, allowing users to experiment and explore music creation without needing prior knowledge or training. The installation is particularly engaging for children but is also enjoyable for a wide range of audiences, offering an innovative and fun way to understand the components that make up a musical track.

The versatility of Fidjam makes it ideal for various settings. It could be a highlight at music festivals, where attendees can create their own music in a fun and creative way. Museums and galleries focused on art and technology would also be a perfect venue, showcasing how interactive design mixes with artistic expression. In schools or workshops, it can teach children and adults about music structure and sound engineering in an intuitive manner. Additionally, it suits corporate events or team-building activities, fostering collaboration and creativity in a unique and engaging way.

The **Fidjam** installation transforms music creation into a tangible, playful experience where anyone can compose by simply arranging and moving cubes on a surface. As participants position these physical objects, they naturally discover how musical elements like bass, drums, lead, and vocals blend together, making music composition an intuitive journey of exploration rather than a technical challenge.

2. Bongers Interaction Diagram

The diagram illustrates how **Fidjam's** interaction process aligns closely with **Bongers'** model of interaction, where the user interacts with the system through various sensory channels, such as vision and hearing, to control the music generation process. Accordingly, the user places cubes with fiducial markers on an interactive surface and the system, using the reacTIVision framework, tracks the position and orientation of these markers in real time, mapping each cube and its face to a specific genre, instrument, or sample. As users move the cubes vertically and horizontally, the system adjusts the volume and frequency (from low-pass to high-pass). The system provides immediate auditory feedback, dynamically generating music based on these interactions. This interactive loop encourages users to explore different combinations of genres, instruments, and effects, adopting an artistic and engaging musical experience.

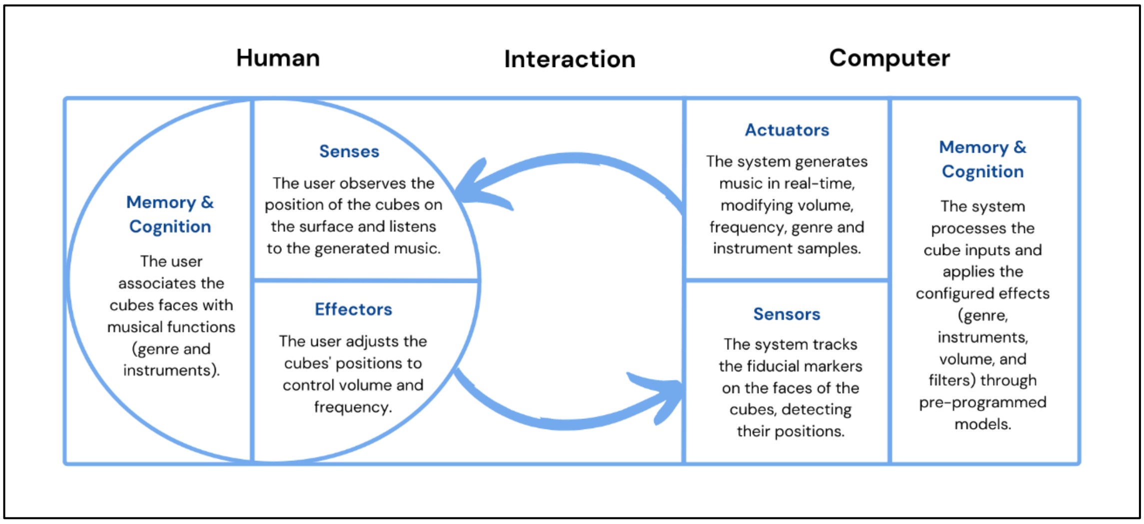

Figure 3 - Bongers Interaction Diagram of Project (2025)

3. Related Work and Artists

3.1. Reactable

Figure 4 - Reactable by Sergi Jordà, Marcos Alonso, Martin Kaltenbrunner, and Günter Geiger (2003)

Reactable, created by Sergi Jordà, Marcos Alonso, Martin Kaltenbrunner, and Günter Geiger, served as a major inspiration for our project. Reactable is an interactive music system in which the sounds are produced through placing tangible objects on a tabletop user interface. It uses real-time sound synthesis and visual feedback to make musical composition simple and intuitive. The user can move items representing sound modules around, controlling musical elements such as oscillators and effects to provide an intuitive and collaborative way of performing.

The Reactable uses a translucent round table where users place and manipulate blocks, known as tangibles, to control sound. Each tangible corresponds to a module in a synthesizer, such as oscillators, filters, or sequencers. These are identified and tracked in real-time using **fiducial symbols** and the computer vision software **reacTIVision**, which processes their positions, rotations, and relationships on the table surface. The table itself acts both as interface and display, showing immediate visual feedback of the relations established by modules, which can further be manipulated by touch.

One of Reactable’s key contributions is its ability to bridge physical interaction with digital sound creation, making music production more accessible and intuitive. The use of fiducial symbols as a recognition system and multi-touch tracking really shows how tangible interaction can redefine how users interact with sound synthesis. This innovative approach aligns well with our interest in exploring similar technologies, such as reacTIVision, for the creation of dynamic and immersive musical experiences.

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3.2. Audiopad

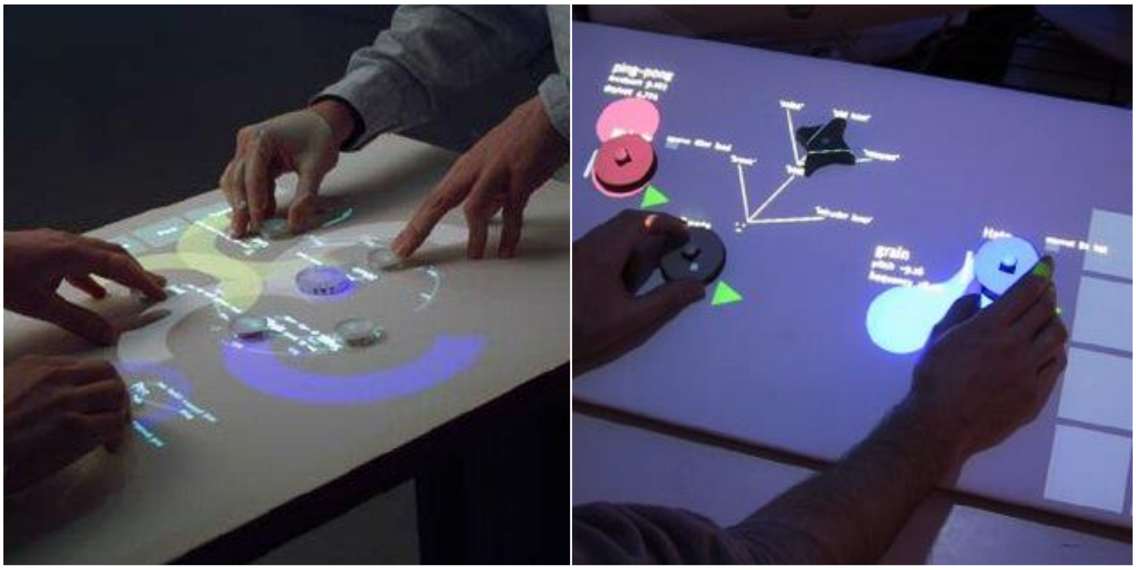

Figure 5 - Audiopad (2003)

The interactive experience **Audiopad** also served as inspiration for the development of our project. It is an electronic music composition and performance instrument, developed by James Patten, Ben Recht and Professor Hiroshi Ishii. The interaction essentially makes use of a tabletop interface for tracking electronically tagged objects on it, translating the information from the positions into music and visual feedback. Objects on Audiopad symbolize the tracks or the microphone elements with which one interacts to play, manipulate sounds, add recordings over one another, and process sound through applying digital audio effects. Audiopad is unique in the sense that it merges physical interaction, visual feedback, and sound synthesis into one dynamic relationship between the performer, the system, and the audience. Like our project, it uses tangible interaction and graphical feedback to make the creation of music intuitive and engaging, placing great emphasis on exploration and improvisation.

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3.3. BeatBearing

Figure 6 - BeatBearing (2007)

The **BeatBearing** is a musical instrument, designed by Peter Bennett, that enables users to manipulate rhythmic patterns by placing ball bearings on a grid. As an explorative design case, the BeatBearing investigates how embodied interaction can inform the creation of new digital musical instruments. The system offers users haptic interaction and visual-auditory feedback, allowing for real-time composition of music by physically interacting with the grid. One of the areas where the BeatBearing closely connects with our project is in its ability to hear separate parts of sounds. By placing the ball bearings in specific positions, users activate different sounds, such as kick drums, snares, or hi-hats, allowing them to clearly hear and understand how each musical element contributes to the composition. This feature gives an idea of how different parts of a song are combined, similar to what we aim for in our project by allowing users to experiment with isolated pieces of a composition and understand how they combine to form a complete piece of music.

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4. Technical Architecture

The development of this project was implemented using **Processing**, with the **TUIO library** for marker tracking, **Minim** for audio processing, and **ReacTIVision** to enable interaction through fiducial markers on physical objects. These tools work together to detect user input, manipulate musical tracks, and provide an active and interactive audio environment.

At its core, the system uses TUIO (open framework that defines a common protocol and API for tangible multi touch surfaces) to detect and track the positions of fiducial markers placed on the cubes. Each marker corresponds to either a genre or an instrument/sample, and their real-time positioning on the interactive surface determines the active audio configurations. Minim handles the playback, volume, and filtering of audio tracks, ensuring uniform adjustments.

The setup includes three main genres - hip-hop, pop, and rock – each represented by unique markers. For instruments (bass, drums, lead, and vocals), three distinct samples are available for each, corresponding to additional markers. The system dynamically switches between genres and samples based on the markers detected.

The audio samples for each genre and instrument are preloaded during the initialization phase and all the samples for the instruments across genres play continuously in the background at a muted volume. This approach allows the system to instantly adjust the sound of specific tracks when the user interacts with the cubes, creating an experience without delays in audio output.

The interactive surface acts as the control interface for manipulating the audio. The vertical position of a cube determines the volume of the corresponding instrument sample, with higher placements resulting in increased volume and lower placements reducing it. The horizontal position controls the filter effect applied to the sample, dynamically shifting between a low-pass filter on the left and a high-pass filter on the right. These effects are applied in real-time, allowing auditory feedback for users as they move the cubes.

A key feature of the system is its real-time feedback loop. When a cube is placed or moved, the system identifies the associated marker, tracks its position, and adjusts the audio accordingly. The detected instrument or genre samples are unmuted and their volumes increased, while applying the corresponding filter effect based on the cube's placement. This technical design ensures a fluid and immersive musical experience by applying continuous playback and audio adjustment in response to user input.

4.1. Technical Architecture Diagram

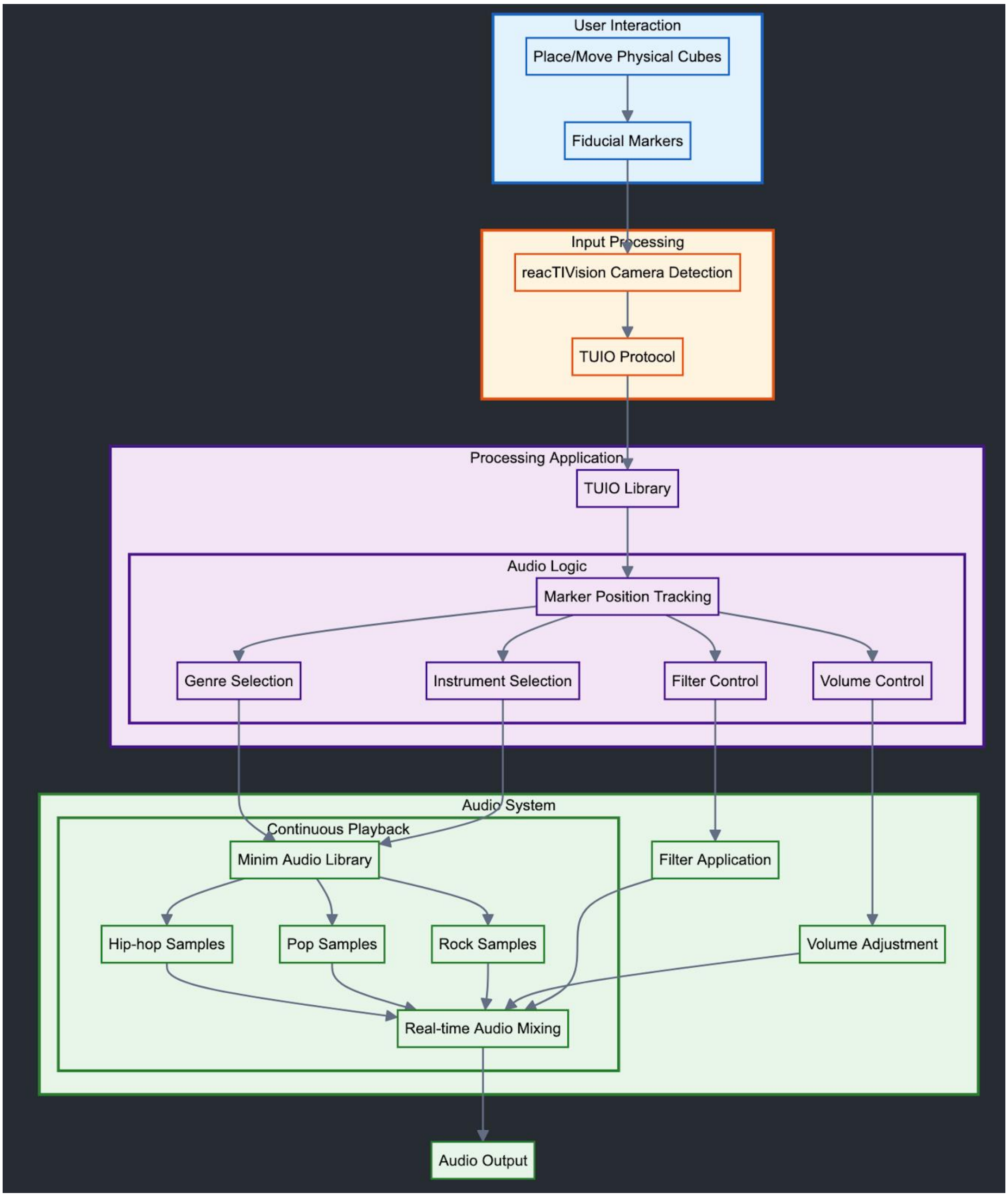

Figure 7 - Fidjam's Technical Architecture Diagram (2025)

5. Areas for Improvement

This project successfully delivered an engaging and interactive music-generating system; however, there is room for improvement to further enhance its scalability, performance, and user experience.

One key limitation lies in the current implementation, where all audio samples continuously play in a muted state until activated. While effective for a smaller number of genres, instruments, and samples, this approach becomes increasingly complex as the library grows. Expanding the number of genres, instruments, or samples could strain the system, potentially causing performance issues or audio desynchronization. To address this, the code would need to be optimized, initiating samples only when needed while ensuring that transitions are synchronized.

Another potential improvement is the introduction of a transparent surface with a camera placed underneath. This design would prevent the user's hands or other objects from interfering with cube placement, ensuring more accurate marker tracking and a smoother interaction experience. Such a surface could also improve the system's aesthetic appeal and usability, making it more intuitive for users.

Additionally, the installation could benefit from more smooth transitions between genres, instruments, and samples. Currently, switching between these elements can result in sudden changes that disrupt the flow of the music. Implementing techniques such as crossfading or gradual parameter adjustments could create smoother transitions, making interactions more polished and enjoyable.

By addressing these areas, the system could evolve into a more robust, scalable, and immersive platform, capable of handling a wider range of musical possibilities while maintaining a fluid and entertaining user experience.

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