Keseh Gong: Augmented Balinese Gamelan "Gong" for Interactive Music Performance

I PUTU ARYA DEVA SURYANEGARA, Université de Montréal, Canada
NI NYOMAN SRAYAMURTIKANTI, Independent Composer, Canada

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1 Program Notes

Keseh Gong is a mixed acoustic and electronic performance that explores the central role of gesture in Balinese gamelan practice. The title Keseh Gong comes from the Balinese word "keseh", meaning “to shift” or “to move,” referring to the moving gong at the center of this performance. The piece introduces a newly designed instrument system called the Gong Machine, where a traditional Balinese gong becomes an augmented instrument that maps a performer’s gestures to electronic sound in real time. In this way, the traditionally gestural nature of communal gamelan practice is extended into an interactive electronic context.

Fig. 1. The Gong Machine for Keseh Gong

In contemporary gamelan practice, the gong is often played while moving or mounted on a wheeled frame, creating swinging motions even when it is not struck. Usually, these swinging motions are unintentional and incidental to playing

Authors’ Contact Information: I Putu Arya Deva Suryanegara, Université de Montréal, Montreal, Canada; Ni Nyoman Srayamurtikanti, Independent Composer, Montreal, Canada.

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the gong. By contrast, in Keseh Gong, the musician strikes, rubs, swings, and moves the gong intentionally in order to realize the piece. Sound comes not only from the acoustic instrument, but also from its movement through space. Small and wide swings, and movement across the stage are all sonified, or shape the electronic sound in real time. Light and shadow also interact with the instrument, becoming part of both the sonic and visual performance. Two additional instruments, *gender wayang* and *gangsa* from the Gong Kebyar ensemble, are included to reflect how the gong traditionally functions within a larger ensemble setting.

Musical form emerges dynamically from the interplay between gesture, instrument, and computer, broadening the possibilities for traditional instruments in contemporary Balinese music while remaining firmly connected to community-rooted practices. The gong can be understood both as a traditional instrument and as a digital interactive interface. Each gesture, such as swinging, lifting, or moving, changes the texture and spatial position of the sound. The performance becomes a dialogue between body, instrument, electronics, and space.

Although performed by a single musician, the work remains grounded in the communal spirit of Balinese gamelan. In gamelan practice, gestures are essential for shaping musical form and coordination between musicians. In Keseh Gong, these embodied gestures shape electronic sound, bringing collective tradition into contemporary interactive performance. In this way, Keseh Gong becomes a dialogue between historical and contemporary Balinese musical practices—those rooted in place and community in Bali. Through physical gesture, which is normally dance-like and used to synchronize musicians, the performer of Keseh Gong instead synchronizes electronic and acoustic sound and reconstitutes what it means to be a performer embedded within a tradition, while simultaneously extending the possibilities of that tradition.

2 Project Description

Keseh Gong situates the performer's gestures in dialogue with the Balinese gamelan tradition, amplifying their central role in musical and community practice rather than treating them as incidental. In contemporary practice, the gong is often swung or moved on a wheeled frame, creating natural motions even when not struck. These gestures form the conceptual basis of the Gong Machine, an augmented instrument system developed for this project using a traditional Balinese gong with attached sensors. In the performance of Keseh Gong, the Gong Machine transforms the instrument into an augmented instrument that functions as a real-time interface for electronic processes.

Artistically, the project asks: what happens when the communal, embodied gestures of gamelan become a way to control electronic sound? How can a traditional instrument interact with electronic systems without losing its cultural and practical context? For example, in the Gong Kebyar ensemble, gestures play a crucial role in shaping dynamics, structure, and transitions, especially since written scores are rarely used. Musical communication relies on bodily cues and collective listening, with gestures guiding how other musicians respond [1, pp.2–3]. A musical gesture can be understood as a movement of the body, such as hand or head motion, which expresses an idea or meaning, whether to control an instrument, coordinate with other musicians or convey expression to the audience [3, pp.3-11].

This project continues a methodological approach that prioritizes community-based gamelan practice rather than solely considering the sonic aspects of creating electronic sounds [4, pp.23-25]. Drawing on our artistic backgrounds as conservatory-trained gamelan composers and musicians, we worked together to refine both the system and the composition through an iterative process, including both development and rehearsal phases. Recognizing that gamelan musicians communicate and shape musical form through gestures, listening, and interaction, the project extends the instrument so that performers can directly control electronic processes through their playing. Therefore, musicians' years of training and knowledge remain central to interacting with the system.

Movements and gestures are captured using ultrasonic and accelerometer sensors, while a Light Dependent Resistor (LDR) sensor maps stage lighting to synthesis parameters for visual performance impact. We use Max/MSP to process sensor data and map it to sound synthesis, spatialization, corpus-based manipulation, and algorithmic processes. Machine learning tools from the Fluid Corpus Manipulation (FluCoMa) library [5] estimate hand position in real time, making gesture an integral part of sound processing.

Keseh Gong explores gestures not only as communication tools, but as data for triggering and shaping electronic sound. The gong, rarely struck but structurally significant, contains many moments of listening, movement, and sensitivity to other instruments. The project draws inspiration from the spaces between gong strikes, translating swinging, body movements, and surrounding gamelan sounds into real-time electronic processes. Gestures typically used to interact with other musicians now interface with electronics, allowing the performer to maintain an active role throughout the piece. In this way, the project opens new possibilities for traditional instruments in contemporary and electronic music while preserving strong connections to Balinese gamelan practices and embodied knowledge.

3 Technical Notes

The Gong Machine is an augmented instrument that allows the musician to directly control the electronic sounds in a Max/MSP patch. It can still be played acoustically by striking or rubbing, while electronic parameters are controlled by swinging, lifting, or moving the gong on the wheeled frame.

3.1 Sensors and System Setup

Nine ultrasonic sensors are placed inside the gong to track the performer's hand movements. Eight of these sensors are positioned around the back of the gong at different angles to cover most of the playing area. Sensors 1 to 4 are placed closer to the center at angles of 0°, 45°, 90°, and 135°, while sensors 5 to 8 are placed slightly further out to cover 180°, 225°, 270°, and 315°. The ninth sensor is located at the center of the gong, facing outward, to detect how close or far the musician is from the instrument. This central sensor can trigger effects depending on the performer's distance from the gong.

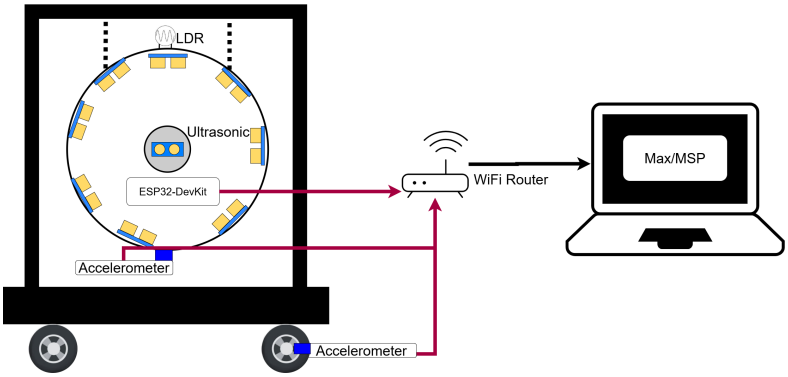

Fig. 2. The system diagram

Two accelerometers are used to detect the gong's motion. The first is installed under the gong to capture swinging movements in XYZ directions. The second is attached to a wheel on the gong's frame to detect when the gong is being moved across the performance space. These sensors allow the performer to control different synths in real time through swinging or moving gestures. A light-dependent resistor (LDR) sensor is placed above the gong to activate the system and allow interactive control of lights. This lets the musician change presets, control visual effects, and link the lights directly to the music. All sensor data is sent via Wi-Fi using the OSC protocol and processed in Max/MSP. The software uses this data to control electronic sound parameters and effects, providing a responsive and interactive performance environment.

3.2 Mapping

To detect hand position inside the gong, we use FluCoMa's [fluid.mlpregressor] object, a supervised machine-learning model [5]. Eight ultrasonic sensors arranged in a circle provide real-time input data. We trained the model by capturing approximately 50 data snapshots for each position: eight points around the edges, the center of the gong, and absence of the hand (acting as a system gate). The model learned to relate patterns across all sensor values to a continuous XY representation of hand location inside the gong. This use of regression had the added benefit of managing the sometimes 'noisy' data produced by low-cost sensors, helping the system recognize clear patterns from the sensor readings. We validated our model through live testing in both the studio and in rehearsal, verifying that the predicted XY positions accurately aligned with our performances and intentions and that the model could track hand positions in real-time, meeting the creative requirements of this piece. Our regression model is specific to the 80 cm gong and the current sensor placement; any changes in gong size or sensor positions would require new training.

In the performance system, the regression model's predicted XY positions are mapped to a collection of pre-analyzed sound files, arranged in a two-dimensional space using a corpus analysis patch from SPTools (now Data Knot) [2]. Each sound occupies a virtual spatial position inside the gong. When the hand moves toward the center, sounds near the center are selected; when it shifts toward the edges, corresponding sounds are chosen. If no hand is detected, the system remains inactive. Using this XY data, the musician can directly control the sound spatialization on a multichannel speaker. This creates an interaction between pre-composed material and the performer's real-time decisions, reflecting the traditional communication between composer and musicians and the gestural nature of gamelan practice within a live electronic context.

3.3 Additional Instrumentation

While the Gong Machine is the main focus of the piece, *gender wayang* and *gangsa* are added as additional instrumentation, played alternately by the same solo performer to enrich the sonic texture of the composition. These act as a musical bridge, showcasing how the sonic outputs of the Gong Machine blend with the acoustic instruments in a traditional gamelan setup. In our performance, we also use microphones to capture the live sound of these instruments for additional electronic processing, for two purposes. First, a drone texture is created by time-stretching the acoustic strikes into sustained sounds via a buffer in Max/MSP. Second, we apply amplitude detection to trigger a collection of sound files when the signals from these instruments exceed a predefined threshold. Through these techniques, the *gender wayang* and *gangsa* are integrated into the sonic landscape and performance of the piece both acoustically and electronically.

3.4 Affordable Materials

One of our main motivations in designing the system was to make an instrument that is easily replicable by others, especially the gamelan community in Indonesia. Therefore, we used only easily accessible and affordable materials. Based on our most recent build in Indonesia, the entire microcontroller and sensor array costs approximately 1 million Indonesian Rupiah (around 60 USD). This approach provides a viable alternative to commercial motion sensors, which, in our experience, are often difficult to purchase and inaccessible to composers in Bali.

Our long-term goal through this approach is to encourage contemporary gamelan composers in Bali to experiment with simple, affordable technology to expand their creative boundaries. In our future work, we plan to develop a shareable toolkit to assist others in experimenting with these approaches, distributed through online repositories, future publications, and community workshops.

4 Performance Techniques

The musician plays the gong by striking or rubbing its surface to produce acoustic and electronic sounds. Playing in different areas of the gong produces different timbre and hand position data, which are captured by the ultrasonic sensors. When a hand is detected inside the gong, sounds are triggered, and when no hand is present, no sounds are selected.

The swinging motion of the suspended gong is captured using an accelerometer, which provides XYZ data. The musician activates and deactivates the pre-made synth by quickly swinging the gong, while lifting or further swinging the lower part of the gong to control the envelope and pitch. The movement of the gong's frame is captured by a second accelerometer attached to one of its wheels. XYZ data from this sensor triggers a separate synthesizer, enabling the musician to activate, deactivate, and control pitch parameters in real time by moving the gong across the performance space. Together, these systems allow the performer to shape electronic sound through swinging and spatial movement.

An LDR sensor placed above the gong is used to activate one or two synthesizers simultaneously in predefined sections. The sensor can also switch between presets and control both the structure of the piece and electronic parameters in real time. By pointing lights at the gong, blocking them, or positioning the gong opposite the light, the performer can influence which sensors are active. This approach offers a creative alternative use of lights to many public gamelan performances, which often rely on large and expensive lighting systems.

5 Performance and Staging Notes

Performance Setup

- Minimum performance space: 3 m × 2.5 m
- 1 musician
- Gong on a wheeled frame (movable)
- *Gender wayang* and *gangsa* instruments from a Gong Kebyar ensemble
- Speakers: stereo or multichannel if possible
- 1 movable light placed in front of the musician

Duration

- 14 minutes

Requirements from the Venue

- A table for a laptop, interface, and other equipment
- 1 microphone for *gender wayang* and *gangsa* instruments
- 1 movable LED stage light
- Stereo or multichannel speakers

Performance Options

- Live performance or distance (pre-recorded)

6 Work in Progress

Our long-term goal is to develop an extended gamelan ensemble in which all instruments act as interfaces for real-time electronics. The current focus on the gong, traditionally the most structurally central instrument, allows for a detailed investigation of its possible functions, playing techniques, gestures, and underlying philosophies, which could inform electronic interactive music. Future projects will expand this approach to include other instruments in the ensemble.

7 Media Links

- Video: https://youtube.com/playlist?list=PL66fj0YkZ7-L7FRYsZOFwYMdb3gO2FVJA&si=9yS6Rix1m9jMu0_C

8 Ethical Standards

The authors are unaware of any conflicts of interest related to this project. This work does not involve research with human or animal subjects as data subjects. No personal data was collected, stored, or shared. The system operates solely through real-time sensor data from the instruments and the players' movements. All collaborators voluntarily participated in the development and realization of this work and are listed as co-authors.

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