Mesh Garden: A creative-based musical game for participatory musical performance

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ABSTRACT

Mesh Garden explores participatory music-making with smartphones using an audio sequencer game made up of a distributed smartphone speaker system. The piece allows a group of people in a relaxed situation to create a piece of ambient music using their smartphones networked through the internet. The players' interactions with the music are derived from the orientations of their phones. The work also has a gameplay aspect; if two players' phones match in orientation, one player has the option to take the other player's note, building up a bank of notes that will be used to form a melody.

Author Keywords

NIME, Web Audio, participatory music, music game

CCS Concepts

•**Applied computing** → **Sound and music computing;** Performing arts; •**Human-centered computing** → *Web-based interaction;*

1. INTRODUCTION

Figure 1: A performance of *Mesh Garden*.

Mesh Garden builds on my earlier works for distributed smartphone speaker systems, *A more perfect union* (2017) and *And the water receded* (2017). Looking at how the concepts for player interaction evolved from piece to piece, we can examine what makes *Mesh Garden* unique. In *And the water receded*, I use the audience's smartphones as playback devices for the composition being performed by live musicians on the stage; there is no audience interaction. In *A more perfect union*, the audience members are the performers;all the sound originates from smartphones and with a toggle switch, players can choose what sounds to listen to and for how long. The concept change that *Mesh Garden* introduces is two-fold. It moves the performance space from the concert hall to any location that includes a social activity, like someone's living room. It also grants the players more opportunities to affect the composition. Through intuitive interactions, I sought to create a distributed instrument that anyone can play and recreate the style of music making found in participatory folk music from around the world. Steve Jones also advocates for the use of the mobile device as a new folk instrument because of its ubiquity and possibility for giving us a sense of social connection [4].

2. RELATED WORKS

Many works exist that involve audience participation and the smartphone speaker array, best catalogued in Ben Taylor's *A History of the Audience as a Speaker Array* [11]. Like *Mesh Garden*, the catalogued works also use the Web Audio API, which allows participation without the need to download an app, easing the friction of joining the music-making experience. When examining these works, we must distinguish between the frameworks that allow participatory performance and the compositions themselves. Several frameworks have been developed that allow participatory performance with the smartphone speaker array. Notable examples are Nathan Weitzner and Jason Freeman's *massMobile* [13], Jesse Allison's *Nexus* [1], and Tim Shaw and Sebastien Piquemal's *Fields* [9]. Also, Sebastien Robaszkiewicz and Norbert Schnell's *Soundworks*[8] must be noted for its unique scenarios developed to work with the system *Drops* and *Paths*. These scenarios are important because they create a new language of possibilities for the smartphone speaker array. With Paths, Robaszkiewicz and Schnell describe a very similar interaction to the heading matching aspect of *Mesh Garden*. This heading matching method requires phones to be placed in a grid and allows a player to change the path of the sound by turning their phone and sending the sound to another player. Based on the details given, it is unclear whether Robaszkiewicz and Schnell's heading matching method is identical to *Mesh Garden*'s, but the concept is undoubtedly similar. *Mesh Garden* also bears a similarity to *Drops* in its ambient and participatory nature, wherein a player can play a sound on their phone and hear it echoed on other phones nearby.

Other notable compositions for smartphone speaker array and audience participation include *Crowd in C[loud]*[5], by Antonio Deusany de Carvalho Junior and Sang Won Lee

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and *echobo*[6] by Sang Won Lee and Jason Freeman. Smule provides many examples of unique smartphone based instruments meant for participatory performance [3]. These instruments are recreations or extensions of already existing instruments, such as an ocarina, fiddle, or trombone, which is where it differs from *Mesh Garden*.

3. PARTICIPATORY PERFORMANCE AS FOUND IN FOLK MUSIC

The most important aspect of the previously discussed works is their allowance for participatory performance. This type of performance has been found in folk music traditions from around the world and much can be learned by examining how music takes on an important social role when it is the most participatory. In *Music as Social Life* musicologist Thomas Turino defines participatory performance as "a special type of artistic practice in which there are no artist-audience distinctions, only participants and potential participants performing different roles, and the primary goal is to involve the maximum number of people in some performance role [12]." Participatory performance can be contrasted with other fields of performance practice, including "presentational performance" music for an audience, "high fidelity" recordings that are meant to be representations of live music, and "studio audio art" or tape music. These are not musical genres, but ways of making and consuming music. *Mesh Garden* was designed with Turino's definition of participatory performance in mind, so moving forward I will use the term "players" instead of "audience" to refer to performance participants.

Important to the success of participatory performance is the capacity for people with wide ranging abilities to participate. This ensures that new players feel like they have something to contribute while experienced players feel they have room to grow and improve. In future versions of *Mesh Garden*, a feeling of flow might be improved by adding a mechanism for testing the skill levels of some participants, musically or strategically though the game. The work is built with a distributed smartphone speaker system because many people have easy access to smartphones. The work's intention is to recreate in our culture a practice found in many smaller, tight-knit cultures in which everyone can participate regardless of their level of musical ability. The smartphones are an accessible platform for anyone to participate in creating music. Because the work is web-based, the player doesn't need an app to participate; players just go to the webpage and play. This accessibility and ease of use is reminiscent of folk music traditions.

Turino studied the indigenous Shona music of Zimbabwe, Peruvian Aymara music, and Midwestern Contra dance music and found that while their music sounds nothing alike, many of the "sound features, basic principles of organization, and performance practices" were shared. In addition to the shared musical property of rhythmic repetition, Turino found that the form was usually open, with sections able to be repeated as often as necessary for whatever activity the music was accompanying. He also found a commonality of feathered beginnings and endings; players can join and leave as they please.

Turino describes the social effect of participatory music as "social synchrony," a term first used by anthropologist Edward Hall to describe how everyday social interactions are driven by our unconscious synchrony of movement and body language. Social synchrony is difficult to accomplish in electronic music where effort has a different meaning than acoustic music. In *Mesh Garden*, no effort is needed to stay in sync; it's done by the computer and there is no specific predetermined musical goal. The indeterminate nature of this music makes it more difficult to imagine how a feeling of flow would emerge.

4. GAMEPLAY

Because one of the goals of *Mesh Garden* is to allow the greatest number of people to participate, a musical gameplay framework is adopted. This provides methods of interaction that allow any person to contribute regardless of their musical ability. Players can explore the musical space by changing the orientation of their phones and listening to the sonic result. If a player wishes, they can place their phone on a table, freezing the state of play, allowing them to listen to the results without having to interact with the other players.

There are many examples and types of musical games, separated by their level of musical control and skill. The gameplay mechanics of Mesh Garden are best described using Thomas Studley's definition of creative-based musical games:

> For 'music', 1) the core gameplay activity must be predicated on musical decision-making and 2) the player must be able to influence the production of music through the direct use of game mechanics. For 'creative-based', 3) the player must plausibly be able to mentally frame their use of the mechanics as having created new music in all instances of play. For 'game', 4) an 'unnecessary obstacle' must be enforced by an automated game mechanic, and 5) the player must 'exert effort' to achieve a self-imposed 'aesthetic goal', the value of which is mediated by their personal music bias, and for which the emotional 'consequences' are both self-negotiated and 'optional'. Finally, 6) the 'game' must be apprehended as an activity rather than an object[10].

Creative-based musical games are games where the primary purpose is to create original music. *Mesh Garden* differs from other musical games that fall into the categories of gameplay. *Guitar Hero*, for example, is considered musical "mimicry" in which the objective is recreating music as opposed creating something new and original. This definition of creative-based music games is important because there is a stronger social meaning of music when it is being created, rather than recreated, among a group of people. In Mesh Garden, there are no predefined rhythms or melodies that are unearthed by gameplay, making it different from a musical mimicry game.

Many music games exist that fulfill all or part of Studley's definition for creative-based music games. *Instant City*[1] is a music-building table game created by Sibylle Hauert and Daniel Reichmuth in collaboration with Volker Bohm. Players stack blocks on top of each other to create music. Mesh Garden is inspired by the ambient gameplay aspect of this work. *Instant City* has no specific gameplay or aesthetic goal; the gameplay mode is exploratory. While being an impressive project, it is not very accessible as it requires a unique light table to read where the blocks are positioned. The *reacTable*[7] is another inspiration for *Mesh Garden*. It is an instrument with a tabletop user interface that allows players to create music by moving physical objects on top of a screen to manipulate musical parameters. Again, the non-portability of the table interface renders this inaccessible to a large group of people. The intention with *Mesh Garden*

[1]http://www.hauert-reichmuth.ch/en/projekte/instant-city/

was to create something similar to these pieces, but using the all-pervasive and accessible smartphone.

5. MUSIC DESIGN

5.1 Orchestration

When a player joins Mesh Garden, they are given one of two types of sounds–a **long bowed sound** and a **short percussive sound**. The sounds are evenly distributed depending on the number of players connected. If a player leaves and another player joins, the parts are redistributed to keep the orchestration even.

The short percussive sounds comprise three possible samples. The sample is chosen at random when the player logs on via the webpage. These short sounds are played with Euclidian rhythms that are randomly generated. Ableton Link synchronizes these Euclidian rhythms. The longer bowed sounds play a predetermined melody.

5.2 Interactions

The interactions of *Mesh Garden* are designed to be intuitive for a non-musically trained player to use. Using the smartphone's compass, the piece allows the player to interact with the sounds. A player interacts by turning their phone, which affects two different parts of the work.

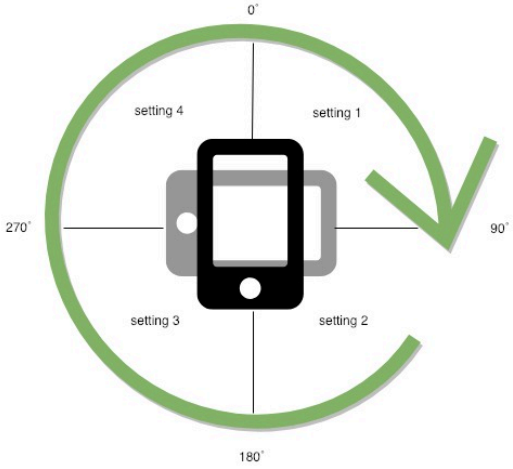

Figure 2: Relative axis compass interaction.

One aspect is turning on the relative axis. When the player logs on, their forward-facing position is registered to be zero degrees, which will produce the default sounds. Then, by turning the phone 90 degrees, 180 degrees, and 270 degrees, the player can pick between four different predetermined note options and rhythmic options made up of four different Euclidian rhythmic patterns. The rhythmic patterns are randomized for each player when they log on, but do not change after this point. Therefore, the player should be able to tell one pattern from another and use their musical intuition to choose the pattern that best fits musically.

To control the long bowed sound, the player can decide what order the line is played through. The choices are up, down, drunk, and random. The rhythm is based on the same Euclidian rhythms that determine onsets.

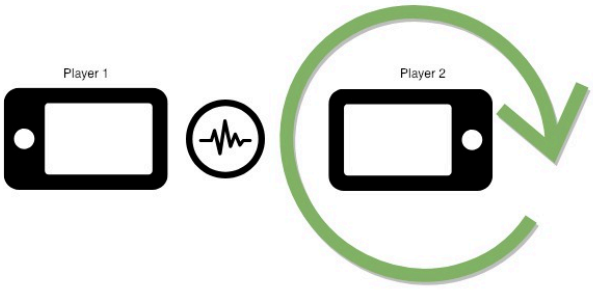

Figure 3: Compass heading matching.

Figure 4: Three versions of the player GUI

The more active game play aspect of *Mesh Garden* is the compass heading matching feature. When a player matches with the headings of another player, the player that was moving last plays an unsynchronized melody. To tell if two phones are facing towards each other, the compass headings are compared. The absolute compass values are used instead of the relative orientation data of the other section. Each phone's heading is determined using the kompas npm library, then each heading is sent to the server.

On the server, the headings are continually compared with each other. If the difference between one player's heading and another's is 180 degrees, then the phones are facing each other. Once a match is found between two phones, a sound plays on one of the phones. The sound is one note of a melody that comes from a bank of pre-selected notes. This player then has the chance to take the note of the phone it matched with and add that note to its bank of notes. The phone that lost its note can then try to match with other phones to add their notes and build up its own melody. Since notes only get traded back and forth between phones, they are never totally lost, rendering more of a creative orchestration between distributed devices.

6. TECHNICAL DESIGN

Mesh Garden uses a similar technology stack to my previously mentioned works. The sounds were created using the Web Audio API, aided by the Tone.js framework. Networking between devices is accomplished using the socket.io library, enabling real-time, bidirectional communication between the client and server. I use Zeit's Now for simple one command serverless deployments. The new technological aspect of *Mesh Garden*, that hasn't been used in previous smartphone speaker array works, is the implementation of Ableton's Link software in a distributed smartphone context

Link is a technology developed by Ableton that allows any computers running Live to play in sync with each other. Because Link is open sourced, it is possible to use it in non-Live applications [2]. The Link API is in C++, a language not suitable for the web; so, to run Link in the web, I had to use a Node.js port, node-abletonlink[2], created by GitHub user 2bbb. This project ports the C++ Link implementation to Node.js to allow its use in the browser. Because of platform specific installation issues, Docker was needed to deploy *Mesh Garden* to a Linux server. I used Docker to ensure that the development and deployment environment were identical.

By default, node-ableton link provides time based synchronization between devices but does not ensure that the synchronization is in metrical, musical time. Notes will all play at the same time, but the tempo will fluctuate due to network latency. To fix this problem, I use the Transport system in Tone.js. When a player joins *Mesh Garden*, their device's rhythmic transport starts, giving their device a musically metronomic time clock. When a new player logs on, the system stops each of the other players transports and then immediately restarts them, ensuring that all players stay in sync. I also use metrical quantization of time values in Tone.js to ensure that metronomic variation will be smoothed out by quantization on a synchronized clock. Used together, these methods create a successful distributed sequencer that works even with devices on separate networks.

7. PLAYER FEEDBACK

When asked if the gameplay elements make for an engaging experience in music making, one player stated, "The game was a new way of making music that I haven't experienced before! I enjoyed trying to figure out how the game works and its goals." Another question was asked about the feeling of control over the composition: "Did you feel like the options you were given for participation were tied enough to the sound outcome, while still allowing for a casual party atmosphere?" Responding, another player said, "for the most part, I felt in control of my own musical output. Once I realized how note taking worked, I tried more diligently to steal notes from where I heard them. It fit the casual environment well!" A final question was asked about the technique employed in gameplay: "What was your technique for playing? More exploratory searching for sounds or more aggressively trying to collect everyone's sounds?" A player responded that they were "definitely aggressive! I was frustrated at first when everyone kept stealing my notes until I realized I could steal them back!"

8. CONCLUSION AND FUTURE WORK

With *Mesh Garden*, I created a composition that allows a greater number of people to participate in music making. Through an examination of participatory music traits found in folk music, I found the compositional techniques that are designed to encourage participation. Using a gameplay paradigm of interaction, I was able to design a system that anyone can play regardless of their musical ability. My hope is that the democratic music making of *Mesh Garden* will translate to the player's life outside of the piece. To enhance the outcomes of participatory music making, I want to further realize Turino's criteria for participatory performance and Thomas Studley's definition of creative-based musical games. The primary component that I would like to improve is to add a greater sense of effort and skill for players who have existing musical ability, while leaving the easier supporting parts for those who have no prior musical experience. With this improvement, experienced players will have room to grow without excluding newcomers.

[2]https://github.com/2bbb/node-abletonlink

9. REFERENCES

[1] J. Allison, Y. Oh, and B. Taylor. NEXUS: Collaborative Performance for the Masses, Handling Instrument Interface Distribution Through the Web. In *Proceedings of the International Conference on New Interfaces for Musical Expression (NIME)*, pages 1–6, 2013.

[2] F. Goltz. Ableton Link–A technology to synchronize music software. In *Linux Audio Conference 2018*, page 39, 2018.

[3] R. Hamilton, J. Smith, and G. Wang. Social Composition: Musical Data Systems for Expressive Mobile Music. 21:57–64. 00019.

[4] S. Jones. The Mobile Device: A new folk instrument? *Organised Sound*, 18(3):299–305, 2013.

[5] S. W. Lee, A. Deusany de Carvalho Junior, and G. Essl. Crowd in C[loud] : Audience Participation Music with Online Dating Metaphor using Cloud Service. In *Web Audio Conference*, Atlanta, USA, 2016.

[6] S. W. Lee and J. Freeman. Echobo: A mobile music instrument designed for audience to play. In *Proceedings of the International Conference on New Interfaces for Musical Expression*, pages 450–455, Daejeon, Korea, 2013.

[7] M. Kaltenbrunner, S. Jorda, G. Geiger, and M. Alonso. The reacTable*: A Collaborative Musical Instrument. In *15th IEEE International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE'06)*, pages 406–411, June 2006.

[8] S. Robaszkiewicz and N. Schnell. Soundworks–A playground for artists and developers to create collaborative mobile web performances. In *WAC-1st Web Audio Conference*, 2015.

[9] T. Shaw, S. Piquemal, and J. Bowers. Fields: An exploration into the use of mobile devices as a medium for sound diffusion. In *Proceedings of the International Conference on New Interfaces for Musical Expression*, pages 281–284.

[10] T. Studley, R. Vella, N. Scott, and K. Nesbitt. A definition of creative-based music games. In *Proceedings of the Australasian Computer Science Week Multiconference*, page 42. ACM, 2018.

[11] B. Taylor. A history of the audience as a speaker array. In *Proceedings of the International Conference on New Interfaces for Musical Expression*, volume 481-486.

[12] T. Turino. *Music as Social Life: The Politics of Participation.* Chicago Studies in Ethnomusicology. University of Chicago Press, Chicago, 2008.

[13] N. Weitzner, J. Freeman, Y.-L. Chen, and S. Garrett. massMobile: Towards a flexible framework for large-scale participatory collaborations in live performances. *Organised Sound*, 18(1):30–42, 2013.