Squidback: a decentralized generative experience, based on audio feedback from a smartphone app distributed to the audience

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ABSTRACT

Squidback is a participatory and contemplative experience, a collective generative soundscape without a central preferred point of view, whose sound sources are the audience's smartphones working as audio feedback generators.

The sound experience can also be coupled with a visual system that films the room to compose lights emitted from the devices into a collective digital painting.

The work aims at creating a ritual space to explore fields of play between being performer and audience, situating control, affection and listening in between human/machine and machine/environment ecosystemic interactions.

Author Keywords

participative, smartphone, feedback, performative installation, ecosystemic interaction

CCS Concepts

•Applied computing → Sound and music computing; •Human-centered computing → Smartphones; *Auditory feedback;*

1. GENERAL CONCEPT

Squidback is a smartphone application and a concept for a participatory performative installation. Its generative process is based on audio feedback (Larsen Effect) so to be naturally responsive to everything that surrounds the device (from the room's shape to the objects and people in it). It features an adaptive filter that adjusts itself autonomously, exposing no control interface, to invite the participants to a contemplative attitude and to find other ways to affect the process - for example by moving in the room, by creating shapes with their hands around the device, or by approaching other participants' devices.

No centralized control strategy is implemented: the devices become an ensemble of independent instances of the same process, each giving different results and thus composing a collective, generative, spatialized and moving soundscape without a preferred center.

To further enhance the collective generative experience, a visual program is provided, to be run by a computer with a camera and a projector. It films the room from the ceiling with a long exposure effect in order to compose a collective digital painting with lights emitted from audience's devices. This generative artifact is thus affected by the sound process (as the latter changes the color of devices' screens) and by people's positions and movements in the room, and it's meant to be projected in real-time on the ceiling.

The experience is meant as a collective exploration of a mysterious space: the room as the space in between people and a non-linear technological process, a space of mutual affections and contemplation, ritualized by the collective generative process, between individualities and the environment, where everyone is performer and spectator at the same time.

2. BACKGROUND

The application was developed as part of the author's practice-based research project *Becoming Program, Becoming Performance* at the Rytmisk Musikkonservatorium, Copenhagen (Aug 2017-Jun 2019), which focused on designing and performing with different systems (computer programs, machines, ensembles of musicians and directions for improvisation) in compositional, improvisational and production settings.

Squidback derived from a feedback generator written in SuperCollider for a previously composed piece called *Interstitium*, which also featured an adaptive filter and a four channel spatialization system.

It binds together the main topics that informed the author's general research frame: generative music, decentralized systems, sound in space, and relation between performing and listening. An adaptive feedback filter that runs on multiple independent instances on the participants' devices is a spatialized, decentralized generative system, with no predefined boundaries between performers and audience. Furthermore, spatialization and audio feedback are in mutual affection through the decentralization of the system: participants' movements affect the generative process, which in turn affects the spatialized soundscape even if the participants are still; by moving, participants change what they hear (which region of the collective soundscape) and what sound they produce, realizing another mutual affection between collective and individual dimensions.

3. RELATED WORKS

The present work closely relates to three categories of past works: feedback-based resonant assemblages[1][2], smartphone-based participatory techniques[3][8] and ecosystemic works[6].

3.1 Feedback generation

NIME'19, June 3-6, 2019, Federal University of Rio Grande do Sul, Porto Alegre, Brazil.

As a system and performative installation concept, Squidback fits into the description of *Hybrid Resonant Assemblages* coined by Bowers and Haas[1], which features: involvement of different materials and media (sound, lights and objects/textures in the room); *immanent* sound generation (feedback); *transient* performative gestures (i.e. the room-system's construction, deconstruction and exploration) inviting to a gathering and to rethink wider notions of touch and instrumentality.

Squidback's sound process is based on the Feedback Destroyer concept, where the technical process of listening for feedbacks to turn them down is exploited as a frequency generator. With the piece *Pea Soup* [2] Nicolas Collins was doing this already in 1974, using at first dedicated hardware, and then moving to software emulations. The piece is closely related as it produced both concerts and installations. The difference with Squidback is obviously the audience-owned devices array that the latter exploits as a spatialized sound system, bringing the process closer to the participants and breaking down the boundary between performers, audience and even installation as a completely autonomous and self-standing entity.

3.2 Smartphone-based participation

Among works for smartphone, we can distinguish between implementations which envision devices as instruments for performers to play (like much of the works from *Stanford Mobile Phone Orchestra* [8]) and others that are meant to be run by the audience, almost always including some form of centralized orchestration, or networked operations (like Tate Carson's *A More Perfect Union* or Andrey Bundin's *Concert For Smarphones*). A survey of smartphone-based audience participation strategies is provided by Oh and Wang[3], focusing on the relationship between audience and a "master performer", with audience-audience communication as an emergent property.

Compared to these works, Squidback stands for a decentralized aesthetics, whose unifying force and compositional effort is the development of a singular system that will be run by independent instances, these affecting each other only by sending and receiving sounds through the room.

3.3 Ecosystemic organization

In his inspiring article "Sound is the Interface", Agostino Di Scipio [6] defined an ecosystemic approach to interaction which differs from the most widely implemented paradigm, turning compositional attention from *interactive composing* to *composing interactions*, and from a question of exerting the proper control over a separate sound generator to the interrelationship between system and environment.

Fitting in Di Scipio's definition, Squidback is an ecosystemic work as much as it is "a dynamical system exhibiting an adaptive behaviour to the surrounding external conditions, and capable to interfere with the external conditions themselves", where man/machine interactions are situated in a system of machine/environment ones. In avoiding centralized control and control interfaces, Squidback reduces the predominance of humans as control agents, allowing the participants for more explorative and contemplative roles. However, human activity is still a central component in this work's performative concept, as it is left to the participants to decide both their degree and mode of activity and listening while exploring the performative space.

4. TECHNICAL IMPLEMENTATION

The application is developed for both Android and iOS devices, sharing DSP code written in C++ to reduce latency, based on the SuperPowered API[7]. The choice of DSP solutions was influenced by the tools available in the API, expecially the choice of using a bandpass filter bank instead of FFT analysis, a typical bias from SuperPowered.

The ideation process, when it comes to the actual DSP parameters and control strategies, is mostly empirical, directed and refined through several testings on different devices.

In this paper I will mostly avoid to present detailed technical solutions, privileging instead their concepts, aims and general structure.

4.1 Filter

The adaptive filter is the main actor of the sound process. It is a bandpass filter bank tuned to a scale, which, after trying a choice of different octave divisions (from tritones to 8ths of a tone), I set to a Just Intonation scale from Harry Partch[5], dividing each octave in seven unequal parts.

The bands are used only to dampen the signal, as I found out empirically that avoiding to gain the individual bands (together with a not so fine grained octave division) helps reducing the sound feeling too digital, preserving some roughness of the Larsen effect.

Each band is given negative gain if the incoming signal is louder than a threshold set by the controller. At every cycle, the new gain is calculated and the difference is applied, after multiplying it by a dynamic factor, which is also set by the controller.

Naturally, putting a filter bank in between a feedback chain is adding feedback to feedback, thus affecting the generative process. In other words, the system becomes an important part of the room, and it's impossible to tell apart the instrument (squidback and the device itself) from the "measured" phenomenon (the room and its resonances).

4.2 Controller

The filter's bands are adjusted automatically both at a pseudo-istantaneous time scale (buffer-size time) and using longer-term trackings. The controller keeps a register of different parameter values over time and compute running averages to inform the control process.

4.2.1 Peak Threshold

The filter's dampening threshold is set dynamically to the incoming signal's average level, as measured by the filter bank and averaged over periods of ten seconds.

4.2.2 Master Gain

The gain applied to the signal at the end of the chain is controlled by listening to the signal's amplitude, so that the average output volume approximates a set threshold.

4.2.3 Persistent corrections

At every cycle, the most frequently appearing peak during the last second gets a little persistent correction: a negative gain value that increases that filter band's minimum dampening. Over time, frequently appearing peaks get dampened more and more, affecting the feedback chain and opening up a space for other frequencies to appear, thus promoting variation and development over the course of a performance.

4.2.4 Plasticity

By the term plasticity I refer to how resistent to change are the non-persistent filter corrections. By working with the filter's resistance to change, its affection on the chain is limited to a slower, less intrusive process, allowing external actions on the device and changes of environmental conditions to be more effective. Plasticity decreases with the

increase of the sum of all filter bands' corrections, and with their variation over time. In other words, a more present, active and changing filter will influence the controller to make it less active, and conversely, a static filter activity will prompt the controller to increase it.

4.3 Visualization

The app's only screen scene visualizes the incoming spectrum in white, raising from the bottom of the screen. The filter's correction are visualized as descending from the top of the screen, in a dark color: black for persistent corrections and dark gray for pseudo-instantanous ones. The space in between corrections and the bottom is colored according to the pitch and chroma of the spectrum's most prominent peak at every screen refresh.

$$hue = pitchToMidi(peakFrequency)\%12/12 * 360$$

An additional layer is added to the colored area, making more opaque and bright a vertical portion of it, proportional to how much gain is given to the sound compared to the maximum gain defined as possible.

4.4 Visual Program

The visual program is written in openFrameworks [4] and it requires a camera and a screen or projector. It mimics a long exposure effect, giving persistency to a certain range of pixels' intensity values. In a dark room, it is designed to capture trails of devices' screen lights' movements, composing a collective digital painting with traces of people's movements in the room and colors from the sound app's process.

5. PERFORMANCE

A typical performance starts with lights getting low and the author explaining how the app works and how to download it. It is important to briefly inform the participant of what feedback is, for them to get a minimum knowledge of what it is going to happen in their hands and understand the possibility to affect it by changing the phone's physical environment. If there are strict requirements about the performance's duration, the participants are told to find a moment to stop the app when lights will be gradually turned on in the room; otherwise the participant are told that they can stop whenever they want. After the spoken introduction the apps can be started by the participants while lights are being turned down.

If the visual system is installed, it will work from when lights are shut off to just before they're turned on again.

6. INSTALLATION

As a standalone installation, Squidback is just an empty, dark room, with written indications (distributed as program notes, or present as the installation's description) functioning as the initial speech does for the performance. People can come and go, in any number, and start and stop the app on their devices as they want.

If the visual system is installed, it works continuously, so people enter a room that already present traces of past activity, adding to what's already there.

7. TESTING AND OBSERVATIONS

Several testings have been performed by organizing a private event with selected people. Involvement and curiosity are always high, as people try to figure out what their devices are doing and how they can affect them, exploring the performance's space of possibilities.

Participants exhibit different ways to relate to the devices, to each other and to the space, and different degrees of activity, energy, mobility, sociality, collaborativeness and individuality.

A typical session starts with very busy activity and participants engaging at first with their devices, then with other people, with the space, its surfaces and eventual objects. It is usually after around thirty minutes that the performance becomes calmer and more meditative, as people often lay down to listen to their device and the environment, sometimes changing position. I find forty-five minutes to be an optimal duration, allowing for enough time to explore curiosity, excitement, boredom, relax and contemplation.

Every participant's own device is most often kept close to its owner, acting as a 'soloist' voice, being the most perceptible sound source against the environment's background. Leaving their devices alone somewhere in the room is not something most participants have been spontaneously willing to do.

A short video edit from one testing session is available online here: `https://vimeo.com/312155346`

8. CONCLUSIONS

Squidback succeeds in creating an engaging explorative and contemplative experience for the participants. The performative space is ritualized by the presence of a collective system, opening different fields of play and relations across interconnected dimensions.

The absence of control interfaces puts the controller paradigm into question, inviting for a more fluid relationship between individuals, the adaptive technological process and the environment. A flow through exploration and contemplation, curiosity and experimentation, affection and inspiration, activity and passivity.

Each participant can choose a different mix between being more of a performer or an audience at any time, blending these two roles in lack of a clearly defined separation, opening up for a diversity of singular approaches to unfold and communicate.

The decentralized setting also contributes to these dynamic relations by making each participant a creative agent on the collective soundscape in two ways, inasmuch the singular position and movement state of each agent in the room affect sound contributions and perceptions at the same time. Just by being scattered in the room, participants create a multi-faced soundscape and inevitably listen to a singular selection and mix of it, thus constituting an ecosystem between individuality and interdependence across affections and perceptions.

A final note about smartphone apps deploying platforms. Other than a complication in writing the same code for different systems, developing native apps presents an amount of centralized control exerted by companies' official deployment platforms, with no alternative way being available for iOS devices. Considering this point as particularly dissonant with decentralized aesthetics, future Squidback versions and other projects by the author will migrate away from native app development to adopt web-application techniques.

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