SONIC CROSSINGS WITH AUDIENCE PARTICIPA-
TION: THE EMBODIED ISOUND PERFORMANCE

Marcelo Gimenes
University of Plymouth
marcelo.gimenes@plymouth.ac.uk

ABSTRACT

This paper introduces how a participatory performance named *Embodied iSound* gathered a number of technologies, sound and music in order to explore the experience of sonic crossings. The main components of the experience are introduced, from the inception of design, inspired by contemporary social and political events, to the implementation of technical solutions. Among these, participants' gestures and movements are tracked in order to control sound generation and spatialization. The physicality of a performance space is used to enable an all-inclusive listening experience that activates all senses as well as personal and collective memories. The performance was evaluated by the audience who provided encouraging feedback, in particular regarding embodiment, interaction, and immersiveness.

1. INTRODUCTION

The current edition of the Sound & Music Computing Conference highlights the "ability of sound and music to cross boundaries, to eliminate borderlines and overcome physical and digital limitations". It also invites discussions about "what it means to cross a border and to explore physical, spiritual and conceptual correlations in terms of the acoustic experience". The context of this invitation is that of Cyprus, "a divided land where the sound of the church bells on one side, the muezzin's call to prayer on the other and the noise from military aircrafts are all filtered through sea and forest sounds from both sides and intertwine across its borders" [1].

This paper wholeheartedly accepts this invitation and presents how a performance entitled Embodied iSound [2] recently addressed these exact same issues. The performance was premiered in 2016 at the Peninsula Arts Contemporary Music Festival (PACMF), a yearly event that celebrates music innovation at the University of Plymouth (UK) [3]. In that occasion, the proposed discussion (and general theme) was "Frontiers: expanding musical imagination". This theme did not necessarily imply a particular social, political or cultural context. In fact, some of the PACMF's composers and performers decided to focus on other approaches to music creation,

including unconventional computing [4], and music opportunities for motor-disabled individuals with brain-computer music interfaces [5]. One can easily see some of the frontiers, difficult challenges and implications these issues raise in the context of technology, health and well-being.

However, Embodied iSound addresses a different kind of frontier, one that has many parallels with the context proposed by the SMC Conference. One year before the PACMF, in 2015, public awareness regarding the Syrian crisis seemed to be at its peak. After many waves of illegal immigration, governments around the world discussed humanitarian help and, in particular, how to grant asylum and financial support to people that fled the country as a last resource to preserve their own lives. Unfortunately, for many of those who faced bombardment and the waters of the Mediterranean this help never arrived. Today, this tragedy persists and images of distress are seen on the news almost on a daily basis.

Indeed, direct links between music and emotion, broadly explored in the literature [6], underlies the power of sound to cross boundaries and alleviate human hardship. The photograph of an old man listening to music in his destroyed bedroom in Aleppo clearly illustrates that [7]. Music is a remedy for sorrow. Even when perceived as sad, music can help to heal affliction and ease the pain of the soul [8].

On the one hand, music has strong cognitive and behavioural components, clearly reflecting the culture and surroundings of its peoples [9]. Yet, on the other hand, this does not necessarily mean that cultural or stylistic traits represent any border or obstacle for human understanding. Evans [10] believed that "all people are in possession of what might be called a universal musical mind" and "any true music speaks with this universal mind to the universal mind in all people". Music is a universal language. No translations or intermediaries are needed as music speaks directly from one mind to another. Perhaps, for these same reasons, autocrats try to use music to their advantage, as instruments of propaganda. Oddly in these cases, music, as many other means of communication, can be misleading.

The healing power of music, however, is at the heart and actions of many people. This applies, in particular, to an organisation the author met during the inception of *Embodied iSound*: Musicians Without Borders. Based in the Netherlands, since 1999 this organisation runs musical projects in places that have been hit by the storm of conflict. Teaming up with local institutions, they try to

use "the power of music for peace-building, connecting people, empowering musicians as social activists, and training local youth as change-makers" [11]. Several places around the world have already benefited from the program, from countries such as Tanzania and Rwanda to Kosovo, Northern Ireland and Palestine, to name a few. Musicians Without Borders kindly authorised the use of audio taken from some of its projects [12] as part of the *Embodied iSound* composition.

Given the political context of the moment and inspired by the work done by Musicians Without Borders, connections between political, social, ethnic and cultural frontiers became the main thread of the *Embodied iSound* performance. This was an opportunity for reflection. The performance should trigger connections between these issues within the context of an acoustic experience. After all, why should borderlines exist (other than an opportunity to be challenged)? The sentiment was that of indignation, resistance, rebellion.

In order to translate these ideas into sound, a series of resources were designed and implemented. One in particular symbolised an additional challenge (or frontier): the apparent divides between long established (and generally accepted) roles of composers, performers and audience. The SMC community, among other groups, often showcases the work of researchers that in many ways question (and provide alternatives to) these conventional roles. Reasons and approaches to this end are manifold, from entirely acoustic works to performances mediated by artificial intelligent interactive computer music systems. A wealth of solutions is continuously being proposed and documented in the literature [13].

This paper introduces the *Embodied iSound* performance from a creative perspective, or "what it means to cross a border and to explore physical, spiritual and conceptual correlations in terms of the acoustic experience" [1]. Specific details about technologies and implementation (in this and other related performances) that are outside this scope are introduced and discussed in [14]. The following section describes how the performance was designed and, in particular, how the performance space was conceived and technologies implemented to support the free movement of audiences and sounds in connection with the composition narrative.

2. THE PERFORMANCE

In a nutshell, *Embodied iSound* is a participatory music performance [15] in which leading elements are the focus on the exploration of sound spaces and the crossing of sonic borders through an embodied experience by the audience.

2.1 The performance space

The performance space is physically defined (Figure 1) in order to provide an environment where audience and sound are able to freely move. Sound movement is implemented via localisation within a quadraphonic surround system and is controlled by the participant's movements. Participants' movement is tracked with the support of six Bluetooth Low Energy beacons ('B1' to

'B6'). As shown in Figure 1, one beacon is installed next to each one of the speakers and, in addition, one beacon is installed in between two pairs of speakers. This setup helps to give more precision to the mapping of the space, divided into four sound regions ('R1' to 'R4') which have a particular meaning within the context of the performance, explained below.

A number of seats are provided in the centre of the space for those participants who decide not to take an active role in the performance, and just listen to and observe other participants to move around. Screen projection is also provided in order to give real-time visual feedback regarding the participants' movements.
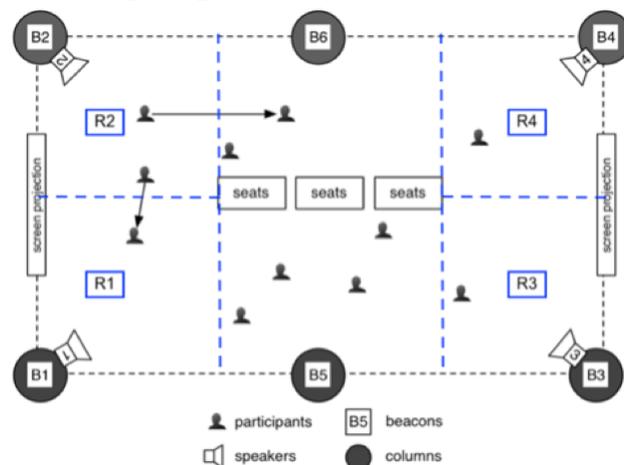

Figure 1: *Embodied iSound* performance space

2.2 Free movement of audiences

The *Embodied iSound* experience is similar to a guided tour that has been planned by a tourist adviser, but only in very generic terms. Initially, attractions, locations and routes are introduced. During the tour, however, visitors are allowed to make decisions, explore detours, and take 'escapades'. Along the way, at every new spot, they decide whether to move with the rest of the group or to go to different locations. In the end, all visitors will possibly have a good understanding about the environment as a whole. They will also have shared perspectives and, at the same time, their personal and unique points of view about the tour. Each experience has its own set of sensory and emotional triggers (lights, sounds, colours, and scents). Every time a new tour is undertaken by the same or by a different group, the exact terms of the route is individually and collectively determined.

The analogy between this type of guided tour and *Embodied iSound* is particularly appropriate. Before the performance, participants receive general instructions about the environment (the 'performance space', shown in Figure 1), how it is divided into regions (or 'sound territories'), how to move around these regions and how their movement influences the way they experience sound.

The main instruction is that participants should move towards those sounds they fell mostly attracted to. The experience resulting from that, however, is far from being limited to sound alone. In fact, the sound they experience is part of a series of interconnected events which sequentially activate different senses (other than audition) and

produce impressions that, at the same time, are particular to each one of them and commonly shared by the whole group.

Therefore, the free movement of the audience is essential in this context, especially with regard to embodiment and immersion. According to Leman [16], the "body of a person can be considered as the mediator between the person's environment and the person's subjective experience of that environment". Immersiveness translates into degrees of involvement, attention and engagement. As the body moves, the eyes focus on different places, different objects and shapes. Some of them will be familiar, others will captivate (or distract) the participant's attention. Meeting other people adds complexity to the experience. Some will be familiar, others strangers. Conversations may (or may not) occur about all sorts of subjects, from the participants' discoveries regarding the performance itself to the weather, emotions, or any other.

Given the above-mentioned number of (potentially complex) variables that influence the listening experience, it is not surprising that, throughout history, a series of conventions has been established with respect to social behaviour in performance settings. Typically, in order to preserve the 'integrity of the artwork', within a traditional classical music setting, audience members are shown to their seats and not allowed to (effectively) participate other than by applauding at the end of the performance.

In fact, these conventions entail a great loss in terms of experience. Contemporary and, in particular, experimental and participatory music very often try to breach this 'ceremonial approach'. Rather than focusing on the artwork itself, the emphasis shifts to the listening experience as an integrated whole, comprising all senses, activating listeners' personal and collective memories. The artwork is not limited to the sound alone but is enriched and expanded by the audience.

With respect to the *Embodied iSound* performance, movement has a specific and notable relevance. Crossing borders presupposes the physical movement from one place to another. Thus, the intrinsic correlation (or cognitive quality) between these ideas is used in the performance to reinforce the experience of crossing borders which are not only geographic but also cultural.

The performance space is divided into regions strongly related to specific and contrasting music styles (such as African, and electronic). Regions are mapped to sets of tracks (in Logic), each one containing stylistically-related sound material. During the performance, as the audience moves around the space, the number of participants varies within each region. This fact is interpreted as the audience is searching for their collective preferences in terms of music style. Preferences evolve as the performance progresses.

In practical terms, the number of participants within each sound region is used to control the relative importance of each music style (sets of tracks in Logic) according to a simple rule. The more participants are inside a region, the lower the volume of that region is. This apparently counter-intuitive rule has the (proposed) effect of making the audience's (collectively speaking) most desired sound 'disappear'. One could imagine a scenario where moving towards something makes this *something*

(sound, in this case) escape or fade away. When this happens, a new cycle initiates. People move around, looking for their new preferred spot which, again, fades away.

The above-mentioned dynamics regarding the 'free movement of audiences' has a direct correlation with how sound moves in the performance space. Sound is ubiquitous and, as such, everywhere, laws of Physics applied. In the *Embodied iSound* performance sounds respond to the audience's resolve. A completely (metaphorical) 'tax-free' policy is applied within the performance space.

Awareness about sound sources is a feature that has been addressed in many contemporary contexts [13]. Acousmatic sound and music, for instance, borrowing from the Pythagorean practice of concealing the sound source, happens behind the 'veil of the loudspeaker'. In the case of the *Embodied iSound*, as described below, sound is also reproduced by loudspeakers but, through the application of diffusion techniques (that respond to control data generated by the audience), its source becomes a distinguishable feature.

2.3 The composition

At the heart of the *Embodied iSound* performance is an acousmatic composition entirely reproduced through a quadraphonic surround sound system. The whole work has approximately 12 minutes of duration. Two main computer environments control sound reproduction: Logic and Pure Data. The former contains the core of the narrative, including an arrangement that has been craftily designed in order to support multiple real-time mixing possibilities. The later contains an algorithmic component. Both respond to control data generated by the audience. A stereo mix is available online (https://youtu.be/ZEM56I68oRo) for reference purposes only. Considering *Embodied iSound*'s very dynamic nature, however, this mix is far from what is achievable in an actual performance.

On the Logic side, the arrangement consists of a sequence of eight sections. Transitions between two consecutive sections are relatively clear as sections incorporate different sets of sound material. Layers of tracks containing fragments of audio files were combined with an original score written by the author. Many of these fragments were taken from recordings of Musicians Without Borders projects [12], including various rhythms (e.g., samba, rap, rock), and instrumentation (e.g., didgeridoo, hand clapping, voices, guitar). These projects contain strong, distinguishable, and contrasting cultural elements which are suitable for the ethos of the performance. A number of manipulation techniques are applied to the audio fragments, including slicing, pitch alteration, and audio stretching, among others. The main task is to define a sequence of sound elements that can be vertically aligned and support the narrative, whatever path the audience decides to take, consciously or unconsciously, during the performance.

The composition's consecutive sections use a combination of different sounds traversing a spectrum of distinct moods. From an initial mysterious and tense state (portrayed through sounds taken from Apollo 10 astronauts recordings [16]), the composition progressively moves

towards uplifting, melancholic and hopeful moments. Towards the end, a female voice repetitively says the word 'if', a simple message that summarizes the whole piece. An approximation map of these several moments and music materials is described in Table 1 below:

| #	Sounds and references	Mood
1	Apollo 10 recordings, deep pad sounds, women voices	mysterious, technological
2	Didgeridoo, women voices	curious
3	Samba, rap	uplifting
4	Sudden silences, women voices, flute and bassoon	melancholic
5	Deep sounds, rap, flute, sounds from space, group singing, algorithmic/synthetic sounds	uplifting
6	Pads, traditional harmonies, melodic	deep suffering, anguished
7	Chords, claps, electronic, bassoon, rock guitar	anguished
8	Flute and bassoon, shouts, group singing	gradually moves to relaxed atmosphere, hope

Table 1: Summary of the composition sections
(#: section)

Finally, in addition to the main arrangement in Logic, the composition contains an algorithmic element programmed in Pure Data. Specific members of the audience, chosen at regular time intervals, control some variables of the algorithm. The introduction of this type of design approach addresses the issue of having a good balance between collective and personal control in the context of participatory performances. Very often, in these cases, individual participants are not able to distinguish their personal commands because they are merged with the commands of other participants (through averages, etc.). Handling the command to particular individuals during the performance has the effect of turning them into soloists and, therefore, enhancing their sense of authorship and control.

The next section contains a summary of the technical details that help to understand how the ideas described above were implemented in the *Embodied iSound* performance.

2.4 Control data and mappings

Embodied iSound is supported by a distributed system named Levinsky Music which includes a smartphone app (the 'app') and a desktop server (the 'server'). Mobile devices, given their processing power, widespread use and availability, have been used in a number of ways in recent years to support audience participation [17-19]. Communication between server, app, Logic and Pure Data is done via MIDI and OSC. The app [20] (main screen shown in Figure 2) collects control data (position, gyroscope and button taps) from each participant and sends this data to the server which then maps it (the resulting calculation) to specific parameters in Logic and Pure Data.
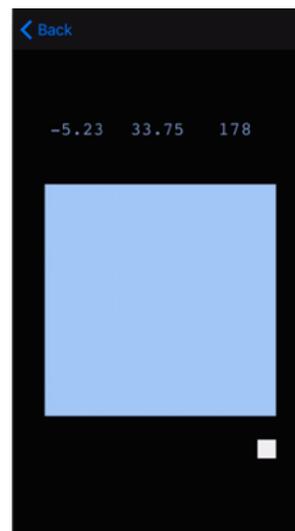
Figure 2: Levinsky app main screen

The server provides a real-time visual representation of the participant's movement in the space, used as feedback to the participants. In addition, throughout the performance, the server also randomly chooses the next leader (soloist) every number of seconds. The server then notifies the new leader he/she has been chosen with a text message, change of colour in the app background and vibration of the mobile device.

Figure 3: Questions regarding the app
(SD = strongly disagree; D = disagree; N = neutral; A = agree; SA = strongly agree)

A summary of the sound control mappings is shown in Table 2:

Control	Environment	Mapping	Part
gyro yaw	Logic	sur. panning	soloist
gyro pitch	Logic	synth par.	soloist
	Pure Data	algorithm	soloist
gyro roll	Logic	synth par.	soloist
	Pure Data	algorithm	soloist
app's button	Pure Data	on/off	soloist
positioning	Logic	volume	all

Table 2: Summary of mappings

Briefly, the participants' position inside each sound region is based on their distance relative to the beacons installed around the space. The server calculates the number of participants in each region and then defines the volume of sets of tracks (in Logic) associated with that region. The central area in the space is not considered a 'music territory' and remaining within it does not trigger any event in the server. As mentioned above, the higher the number of participants in a particular region, the lower the volume of the tracks associated with that region. Lower thresholds are also applied in order to completely silence particular regions.

Volume control considers the collective behaviour of all the participants. Data generated by soloists (or 'leaders') are also taken into account in order to control particular parameters in both Logic and Pure Data, as shown in Table 2. Gyroscope's 'yaw' controls surround panning of particular tracks in Logic; 'pitch' and 'roll' control software synth parameters in Logic and algorithm variables in Pure Data. Finally, a button on the app's main screen

gives to the soloist the ability to start or stop the generative algorithm in Pure Data.

3. PARTICIPANTS' FEEDBACK

Observation during (and recording of) the performance shows that the majority of participants fully engaged, moving around the space and controlling the sound with their smartphones. The remainder only walked or stayed in the central neutral area. After the performance, participants were invited to respond to a questionnaire using a Likert-type scale in order to evaluate their experience. Whilst 14 smartphones connected to the system, 13 participants responded to the survey.

Participants were asked about age, gender, music background, and their personal relation to the smartphone. Age of respondents ranged from 13 to 62. Table 3 contains a summary of this data:

	Count	%
Participation		
Listener:	4	30.77
Controller:	9	69.23
Gender		
Male:	6	46.15
Female:	7	53.85
Other		
is trained musician	10	76.92
listens to music on a daily basis	13	100.00
regularly listens to experimental music	11	84.62
smartphone plays a major role in daily routines	9	69.23

Table 3: Summary of participant's description
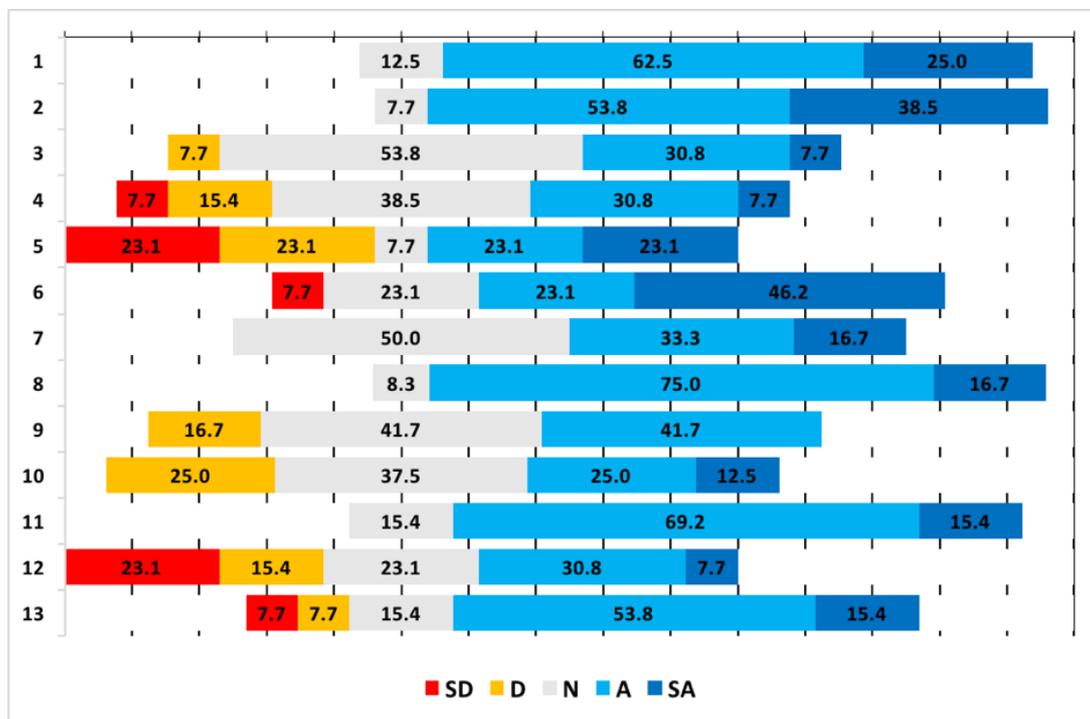
Figure 4: Questions regarding the performance
(SD = strongly disagree; D = disagree; N = neutral; A = agree; SA = strongly agree)

Participants were also asked about the app itself (Figure 3), whether (1) they felt they were able to control the sound output with their mobile device, and (2) whether it was easy to understand and use the app. With respect to the performance (Figure 4), the questions were: (1) Controlling the sound improved my listening experience; (2) I enjoyed the performance; (3) I felt connected to the music; (4) I felt connected to the other participants; (5) I felt I made a personal contribution to the overall result of the event; (6) It made me feel creative; (7) Moving around the space helped me understand the idea of embodiment; (8) Moving around the space improved my listening experience; (9) Moving around the space made me think about crossing musical frontiers; (10) The app provided a real interactive experience; (11) The installation was an immersive experience; (12) The installation would have been different without my participation; and (13) The presence of other people influenced the way I moved.

Graphs in Figure 3 and Figure 4 show the results in the form of diverging stacked bars where the neutral response is vertically aligned. This helps to visualise that, overall, results were positive. With regard to the app, the majority of respondents (Figure 3) felt it was easy to understand (Q2) and that they were able to control the sound output with their mobile devices (Q1).

With regard to the performance (Figure 4), the overwhelming majority responded they enjoyed it (Q2) and that controlling the sound (Q1) and moving around the space (Q8) improved their listening experience. The performance received good ratings regarding creativeness (Q6), embodiment (Q7), interaction (Q10) and immersiveness (Q11). In particular, the idea of (Q9) crossing musical frontiers conveyed by moving around the performance space was appreciated by a large number of participants (41% strongly agree). Connections (Q3) to the music and (Q4) to other participants was positive but not by a large margin, even though (Q13) most of the respondents said the presence of other people influenced the way they moved (69.2% agree and strongly agree). Finally, questions whether (Q5) participants felt they had made a personal contribution to the overall result of the event and (Q12) whether the performance would have been different without their participation were inconclusive. Further experiments and performances with larger numbers of participants will help to corroborate these evaluations in the future.

4. CONCLUSION

This paper addresses the general theme of this year's SMC Conference, 'sonic crossings', from the perspective of a participatory performance named *Embodied iSound*, which explores the idea of crossing borders and its "physical, spiritual and conceptual correlations in terms of the acoustic experience" [1]. The design of the performance is inspired by a troubled international scenario that led the way to the creation of several artistic and technological components which, together, helps to create an ambiance where a utopian argument is proposed: what if borderlines didn't exist? This question is raised by an acousmatic composition, the main component of the per-

formance's narrative, where, at the end, a female voice repetitively conspires: 'if'!

Technology, sound, and music are intertwined in *Embodied iSound*, allowing participants to explore a performance space where borderlines between music territories are freely crossed. The emphasis shifts from the artwork itself to a listening experience as an integrated whole comprising all senses, activating participants' personal and collective memories. Decisions about which route to take is theirs, not the composer's. The personal voice is heard as much as the collective voice. Embodiment and immersion are key ingredients and convey the message that different music traditions, however different they are, can peacefully coexist.

5. REFERENCES

[1] "SMC 2018". (2018, 19/03/2018). *SMC2018 Conference Homepage*. Available: https://goo.gl/feuBSK

[2] M. Gimenes, "Embodied iSound," ed. Plymouth: Peninsula Arts Contemporary Music Festival, 2016.

[3] Peninsula Arts. (2016, 19/03/2018). *Peninsula Arts Contemporary Music Festival 2016*. Available: https://goo.gl/krgaar

[4] E. Braund and E. Miranda, "Music with Unconventional Computing: Towards a Step Sequencer from Plasmodium of Physarum Polycephalum," in *Evolutionary and Biologically Inspired Music, Sound, Art and Design*: Springer, 2015, pp. 15-26.

[5] E. R. Miranda and J. Castet, *Guide to Brain-Computer Music Interfacing*. Springer, 2014.

[6] Y. E. Kim *et al.*, "Music emotion recognition: A state of the art review," in *Proc. ISMIR*, 2010, pp. 255-266.

[7] B. McKernan. (2017, 19/03/2018). *Aleppo man: The story behind the viral photograph symbolising six years of Syrian civil war*. Available: https://goo.gl/awqjpi

[8] D. Huron, "Why is sad music pleasurable? A possible role for prolactin," *Musicae Scientiae,* vol. 15, no. 2, pp. 146-158, 2011.

[9] L. Meyer, *Style and Music: Theory, History, and Ideology*. Philadelphia: University of Pennsylvania Press, 1989.

[10] B. Evans, "The Universal Mind Of Bill Evans (DVD)," D. Records, Ed., ed, 2005.

[11] Musicians Without Borders. (2018, 19/03/2018). *Musicians Without Borders Homepage*. Available: https://goo.gl/woYCSn

[12] Musicians Without Borders. (2016, 19/03/2018). *YouTube Website*. Available: https://goo.gl/LJKHnL

[13] G. E. Garnett, "The Aesthetics of Interactive Computer Music," *Computer Music Journal,* vol. 25, no. 1, pp. 21-33, 2001.

[14] M. Gimenes, "Experiments on collective decision-making and musical metacreative performances with audience participation," in *Proceedings of the International Workshop on Musical Metacreation, International Conference on Computational Creativity*, Salamanca, Spain, 2018.

[15] O. Hödl, G. Fitzpatrick, F. Kayali, and S. Holland, "Design Implications for Technology-Mediated Audience Participation in Live Music," in *Proceedings of the 14th Sound and Music Computing Conference, July 5-8 2017, Aalto University, Espoo, Finland*, 2017, pp. 28-34.

[16] J. Griffiths. (2016). *NASA releases recording of 'outer-space type music' from far side of the moon*. Available: https://goo.gl/8YwfdP

[17] A. Hindle, "Swarmed: Captive portals, mobile devices, and audience participation in multi-user music performance," in *13th International Conference on New Interfaces for Musical Expression*, 2013, pp. 174-179.

[18] J. Oh and G. Wang, *Audience-participation techniques based on social mobile computing*. Ann Arbor, MI: MPublishing, University of Michigan Library, 2011.

[19] O. Hödl, F. Kayali, and G. Fitzpatrick, "Designing interactive audience participation using smart phones in a musical performance," presented at the International Computer Music Conference, Ljubljana, Slovenia, 2012.

[20] M. Gimenes, "Levinsky Music (iOS app)," ed. Apple App Store: Apple Inc., 2016.