The Smartphone Ensemble. Exploring mobile computer mediation in collaborative musical performance

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ABSTRACT

This paper reports the goals, procedures and recent activities of the Smartphone Ensemble, an academic group of musicians and designers exploring mobile phones social mediation in musical contexts. The SE was created in the Design and Creation program at the Caldas University in Manizales, Colombia and includes six regular members. The group intends to enhance links among musicians, and between the musicians and their audience, by leveraging the network capabilities and mobility of smart phones, and exploring the expressivity of urban space. Through the creation of pieces and interventions that are related to urban experiences, the Smartphone Ensemble envisions alternatives to the standard musical performance space. In this regard, the performances intend to be urban interventions, not traditional concerts, they progress according to previously defined tours around the city that the group embarks while playing

Author Keywords

Mobile Music, Smartphone Ensemble, Sound Design

ACM Classification

H.5.5 [Information Interfaces and Presentation] Sound and Music Computing.

1. INTRODUCTION

Smartphone Ensemble (SE) activities described in this paper could be affiliated with a kind of collective phenomenon acknowledged as *Computer Mediated Musical Collaboration* (CMMC), specifically where participants interact in a co-located and real-time environment. We adopt the concept of mediation from Brazilian composer and researcher Fernando Iazzetta, [18] who claims that the mode of association between music and technology ought to be objective as well as synergetic, regarding the intense roll that technological objects play in our culture. Accordingly, we develop music applications for smartphones thinking in the interactions that they will inspire in the urban public space, taking into account that musicians and non-musicians have different approaches.

Computer mediation in musical collaboration contexts has been a regular practice since the launch of personal computers. In this regard, we initially go over some procedures and principles of The League of Automatic Composers and The HUB, as well as laptop orchestras. Some recent musical projects developed in Latin America are reported. Other works that adopt mobile phones as musical instruments, such as Stanford Mopho orchestra by Ge Wang, are also recognized as inspiring projects to develop our work.

NIME'16, July 11-15, 2016, Griffith University, Brisbane, Australia.

The second section of the text discusses SE purposes and methodologies. SE creates musical pieces and structured improvisations using custom-built apps that have been designed and adjusted to specific needs. Each app consists of two modules. On the one hand, a processing device where computer music techniques are being implemented, on the other, a graphic user interface (GUI) where different input methods are being tested. We have deployed development tools for ease of use because several SE members are not programming experts. Moreover, we have designed a mobile wearable speaker and tested it in a recent public intervention carried out a round a park in Manizales city.

Lastly the paper reports some results from an exploratory study conducted with SE members. Following some Design theory methodologies, the study observes collaboration, intuition and interdependency phenomena, and examines which components and qualities of smartphones are more propitious for implementation on a musical environment. Our study includes the creation of software to confront smartphone input methods, such as, the touchscreen, the tilt sensors and the microphone. Furthermore, the study produced unexpected results rating sense of reciprocity in different interdependent configuration and musical content disposition over the touchscreen.

2. RELATED WORK. COMPUTER MEDIATED MUSICAL COLLABORATION

CMMC has been in the computer music agenda since the release of personal computers. Collaboration strategies among performers were developed by San Francisco Bay Area League of Automatic Composers (1978-1982) and The HUB (1985-1995). Through a number of pieces and concerts, these bands pointed out the origin of a practice in which computers assist the musical ensemble as social mediators. Coordination, communication and cooperation among performers help the product to be greater than the sum of its parts. The League and The Hub introduced distributed parametrization of computer music methods, such as amplitude and frequency modulation and wavetable synthesis. Through interconnected configurations, band members shared generation and processing settings in real time with each other. Moreover, other musical collaboration strategies included shared materials, chats and unexpected MIDI connections [9]. It is a matter of fact that fluid interactions were achieved by the Hub in a co-located environment, not a remote one: "... although the group performed at separate locations a few times, it creates its strongest and most interesting work with all the participants in the same room, interacting directly with each other and with the emergent algorithmic behavior of each new piece" [16]. Since co-located versus remote CMMC has been discussed in the context of Network Music by Barbosa [5] and Arango [3], our practice in Brazil [1] and Colombia [4] has revealed

that they are very different activities and each one has its particular aesthetics, goals and procedures.

Laptop orchestras brought in new directions for co-located CMMC. Music production studio portability, novel MIDI controllers, and OSC based network utilities embedded in Max/Msp, Pure Data, Supercollider or Chuck extended the computer collaborative musician toolbox. Laptop orchestras such as Stanford based Slork [39] or Columbia-Princeton based Plork [37] traced a path that has been followed in other north-american and european institutions [29]. Although computer music is still an emergent field in Latin America, regular laptop orchestra projects have been initiated in Sao Paulo [32], Buenos Aires [22], Morelia [21] and Mexico city [24] with sporadic institutional support. As it has been discussed by CMMC enthusiasts [36], [41], laptop orchestras merge music, technology and pedagogy in a collaborative laboratory environment where musicians, non-musicians, programmers and non-programmers can participate. In our context this aspect is important for engaging new computer music practitioners.

A natural next step in CMMC has been achieved by recent projects that use mobile phones as musical instruments. Pioneer projects in the field of mobile music such as Golan Levin's Dialtones -A Telesymphony- (2001) [23] or Radio Concert for 144 mobile phones (2003) [34] by german collective Ligna and composer Jens Rohm took advantage of basic audio features embedded in early mobile phone models (ringtones, alarms, notification sounds, radio) to create interactive musical experiences. Other projects such as NetDérive (2006) by Petra Gemeinboeck and Atau Tanaka [15] or game-oriented apps such as Zombies, Run! [43] or Oterp [33] used smartphones context-awareness properties to create musical compositions and sonic fictional narratives related to the urban experience. In contrast to these projects, mobile phone orchestras such as Mopho [31], [40] and others [11], [26], place particular emphasis in sound synthesis, musical expressiveness, instrument building process and collective coordination. They can be seen as a contemporary manifestation of CMMC that has emerged from the evolution of laptop orchestras. According to the Frauke Bhernerdt's mobile music framework, mobile phone orchestras such as SE could be considered in her "musical instrument" category [6].

3. UNIVERSIDAD DE CALDAS SMARTPHONE ENSEMBLE

The Smartphone Ensemble was created in July, 2015 at the Universidad de Caldas (UDC) Design Program, in Manizales, Colombia. It includes six regular members coming from the Master in Design and the Music School. The project was established within a postdoctoral research called "Sound Design for Urban Spaces" [2] that focuses on the design process of novel audio devices and studies listening strategies for people in transit through the city. The SE main purpose is to incorporate smartphones as social mediators in mobile musical contexts. Mobility of smartphones is taken as an opportunity to envision alternatives to the standard performance space, supporting the idea of a musical ensemble of non-traditional musical devices that travels while playing [35] and focusing on the contingencies brought about by performing in a urban environment. SE public presentations intend to be urban interventions, not traditional concerts. As musicians, we would like to propose that spontaneity of the urban space can be taken as the score, or at least, as a path to compose mobile music pieces. In this regard, SE improvisation based performances are structured according to short and defined tours around a specific public place (the university campus, a neighborhood, a park, a building, a shopping mall, a market). In this spirit, atypical places can become a suitable performance space for SE musical interventions and smartphones can become mediators in the exploration of urban settings.

Since additional amplification is required in (noisy) urban environments, we designed a wearable speaker system for SE outdoor interventions and rehearsals. Because of the size, weight, price and local availability, we chose Nokia Coloud portable speaker with a built-in rechargeable Li-ion battery and fixed it in the wearable. Different designs shown in Figure 1 (hood, glove, armband, belt, scarf, vest) were sketched, tested and evaluated based on sound projection, proximity to the GUI device (the smartphone) and comfort, being the armband the most suitable solution for our goals. Unlike other solutions such as the glove-speaker by Mopho [40] or the whristband by the Michigan University mobile phone ensemble [11], the armband keeps sound projection independent from forearm and hand motion (that is needed in tilt manipulation) and is located close enough to the GUI device. Each SE member wears a speaker band in each arm in order to handle stereo parametrization.

Figure 1. Smartphone Ensemble wearable speaker prototypes.

For the purpose of mobility, GUI and processing devices are embedded in a single app and our approach to software design has been instrument-oriented. We have designed custom-made apps implementing FM, wavetable and waveshape synthesis, bandpass filters and arpeggiators among other methods. We have created audio processing software using Peter Brinkmann libpd library [8] that allows sketching audio applications in the Pure Data Vanilla distribution. The GUI devices have been created with Daniel Iglesia's MobMuPlat [19] that provides a series of standard input methods. We have also implemented Landini protocol [30] to build interconnected setups. Since other systems and procedures allow similar results [7], [12], Pure Data MobMuPlat ease of use has been useful for our collaborative environment of musicians and designers.

Figure 2. University Campus rehearsal.

SE laboratory embraces an ongoing cyclic design process where development, test and evaluation phases are constantly

being accomplished. University campus has been the test-field where experiments and rehearsals have taken place, allowing us to try with different musical ideas, improvisation criteria, app sketches, collaborative setups, choreographic dispositions and walking trajectories. We have found surprising comments and unexpected reactions from outside observers during open rehearsals and test sessions.

The first SE performance was carried out in the Manizales Gotera park on November 13 within the "electronic picnic", a regular event organized by governmental institutions Vivelab [38] and Clusterlab [10]. A reduced version of the ensemble with only four smartphone players made the performance. The group walked through the park following a trajectory while improvising over four different musical ideas. Along the intervention some curious spectators approached to SE members asking for available versions of the musical instrument apps in order to join the smartphone parade. It strongly suggests that we may include the audience as an active participant in future events.

Figure 3. The electronic Picnic, the first SE Public intervention at Gotera Park in Manizales, Colombia.

4. EXPLORING THE TOOL. SMARTPHONES AS MUSICAL INSTRUMENTS

As part of a Master dissertation about interactive design for mobile sonic creation, [25] we carried out an experimental study examining which components and qualities of smartphones are more propitious for implementation on a musical environment. In the process we could observe collaboration, intuition and interdependency phenomena. While recent studies discuss smartphone capabilities for music making from an instrumental perspective [13], [27], we have adopted the "about design" user-centered methodology following Allain Findeli [14] and other design research procedures [28], [20]. The embraced methodology led to a four phase process: (1) information and research where relevant data were gathered, (2) analysis where user needs were observed and identified, (3) synthesis in which possible solutions were proposed and (4) evaluation where proposals were valued.

Two sets of semi-structured surveys were conducted, the first one over a population of 21 non-experts (music performers, composers and creators from Manizales city) and the second one over the 6 SE members. The Study addressed the concept of expressivity, defined as the index among precision degree, action-response correspondence and visual feedback quality. On this basis it rates expressivity level on different smartphone input methods such as the tilt sensors, the multi touch display and the microphone. The study conducted with SE members included some exercises where respondents followed a rhythmic pattern and played sustained notes with different input methods as is shown in Figure 4. Musical interdependence interpreted from Weinberg [42] as the reciprocal interaction on collaborative contexts was also examined interconnecting the smartphone apps. A "centralized-monarchic" control setup, with a single participant acting as a conductor, was compared with a "decentralized-democratic" one, where each participant influenced a fellow member instrument. This confrontation allowed us to observe group behavior and members adaptation to interconnected setups. Other factors were tested such as on screen tonal content disposition over the touch screen vs. musical expressivity with expert and non-expert volunteers.

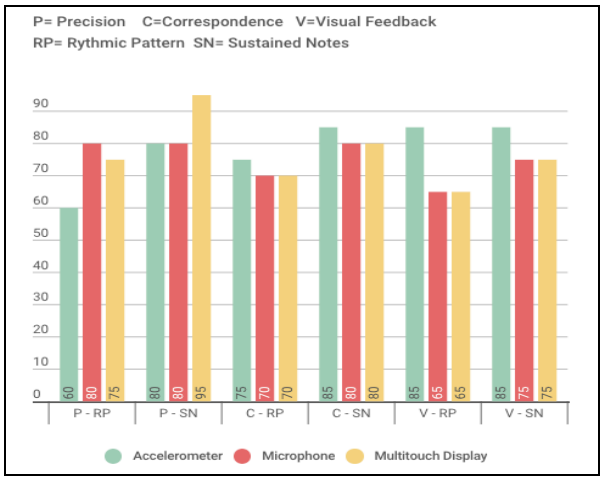

Figure 4. Rating musical expressivity in different smartphone input methods over a population of six experts.

Among the results we have found it is worth mentioning that comparatively tilt sensors seem to be less precise than the touch screen and the microphone. However, they are better rated in action-response correspondence and are preferable than other input methods to stress performer actions. The microphone had similar results than the touch screen in expressivity terms, being chosen by respondents to repeat a rhythmic pattern. However, the touch screen was consistently better rated to input unambiguous control data. It was a surprise that almost opposed interconnected configurations were similarly valued in terms of reciprocity perception. Concerning the disposition of notes over the touch screen, SE members preferred harmonic contiguity (4th, 5th and 8th relations) rather than a chromatic piano like disposition.

5. FUTURE WORK

The first SE public performance left some lessons and challenges for future concerts and interventions. On the one hand, there is an opportunity to experiment in the future with audience engagement through available apps that spontaneous spectators may install in their own smartphone and join the tour. Smartphones software standardization simplifies the creation of interactive setups where the audience can get seamless integration. On the other, the exploration of novel and unprecedented venues for public musical performances will continue to be an important SE goal. Since pedestrians, walkers, passers-by and people in transit through the city are the main SE performances recipients, Manizales city suggests an ideal testing arena for creating new musical experiences associated with technology. In this regard, local public transportation provides a series of challenging mobile stages to carry out SE performances. Context-aware processes are also being implemented in current app sketching for new pieces, associating local territory GPS data with interactive musical content. Concerning the study results, they are still in the user needs identification phase. The results are being processed and implemented in new SE app design prototypes that, in turn, will be tested and evaluated in future SE performances.

6. ACKNOWLEDGMENTS

This work is a result of a research funded by Departamento Administrativo de Ciencia, Tecnología e Innovación (COLCIENCIAS), Grant 656.

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