ShEMP: A Mobile Framework for Shared Emotion, Music, and Physiology

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ABSTRACT

Categories and Subject Descriptors

H.5.3 [**Information Interfaces and Presentation**]: Group and Organization Interfaces—*Collaborative computing, Organizational design, Synchronous interaction*; H.5.2 [**Information Interfaces and Presentation**]: User Interfaces—*Input devices and strategies*; H.5.1 [**Information Interfaces and Presentation**]: Multimedia Information Systems—*Audio input/output*; H.5.5 [**Information Interfaces and Presentation**]: Sound and Music Computing; C.2.4 [**Computer-Communication Networks**]: Distributed Systems—*Client/server*; J.5 [**Arts and Humanities**]: [Performing arts]

General Terms

Algorithms, Design, Experimentation, Measurement

Keywords

Collaborative music, group emotion, mobile computing, physiological interfaces

1. INTRODUCTION

How can we measure the quality of a creative experience? In what ways do the emotions of participants affect or are affected by creative collaboration? Is the perception of a musical performance altered depending on whether it is experienced individually or as a member of a group?

These are among the questions under consideration by partners, including the authors, in the Social Interaction and Entrainment using Musical Performance Experimentation (SIEMPRE) project. Here we introduce ShEMP–a software framework through which we can explore these questions in greater depth. ShEMP, a mobile framework for Shared Emotion, Music, and Physiology, in conjunction with MobileMuse, an unobtrusive sensor package for mobile physiological signal acquisition, leverage the distributed yet locative properties of mobile devices to allow the design of ecological experiments outside of the laboratory to investigate collaborative creativity and shared experience of musical performances. This paper provides a brief introduction to several notable advances made in recent and current SIEMPRE experiments that have been particularly motivating to the development of ShEMP. This is followed by an overview of the design of ShEMP and a discussion of the suite of technologies it employs. We then elaborate on an initial battery of experiments to be executed presently, for which the framework was designed.

2. BACKGROUND

For the last two years, the Social Interaction and Entrainment using Music Performance Experimentation (SIEMPRE) project has focused on measuring interpersonal creative interaction on the backdrop of music performance. The experiments designed and executed thus far have focused on these the experience of musical performance and experience in the following interconnected areas ([4]):

- Musician/musician interactions

- Conductor/musicians interactions

- Music/listener interactions

- Musician/listener interactions

Within these scenarios, our attention is drawn to four different foci. The first of these, *entrainment* is described by

Clayton, Sager, and Will ([1]) as "a process whereby two rhythmic processes interact with each other in such a way that they adjust towards and eventually 'lock in' to a common phase and/or periodicity." This takes shape on multiple levels and in various situations: from a listener's foot tapping in tempo with music or their respiration and heart rates coming into synchronization (albeit often much more slowly) with the beat of the music, to an organisms internal physiological processes' entrainment to one another, or to those of another organism within a group. Indeed, as Clayton, Sager, and Will note, humans' internal rhythmic processes can and do entrain to both other internal rhythms as well as to those of other humans through music performance and shared experience of music. This potential for entrainment through social interaction by way of music is of particular interest to SIEMPRE.

Closely linked to entrainment is *emotional contagion*. In their seminal work on the subject, Hatfield, Cacioppo, and Rapson ([3]) describe the phenomenon of emotional contagion as one in which a particular emotional episode in one individual can evoke stimuli that act upon other individuals to bring about similar or complementary emotional responses. While the related phenomenon, empathy, requires cognitive and autonomic facility, Hatfield et al. argue that emotional contagion is an automatic and involuntary process. Converse to empathy, they further define contagion as a process in which humans automatically mimic and synchronize the behaviors of another, and as a result, converge emotionally ([2]). Emotional contagion not only strengthens emotional bonds between people, however; the presence and awareness of emotional contagion in interpersonal interaction affects meaning and significance in communication, aid in understanding social interaction, and facilitate empathy and sympathy, for instance. It is this significance that places emotional contagion as the second focus of SIEMPRE's research into interpersonal interaction.

3. RELATED WORK

4. RECENT RESULTS AND MOTIVATION

5. FRAMEWORK DESIGN

6. PROPOSED EXPERIMENT

7. POTENTIAL ISSUES

8. CONCLUSIONS

9. ACKNOWLEDGMENTS

10. REFERENCES

[1] M. Clayton, R. Sager, and U. Will. In time with the music: The concept of entrainment and its significance for ethnomusicology. *European Meetings in Ethnomusicology*, 11:3–142, 2005.

[2] E. Hatfield, J. T. Cacioppo, and R. L. Rapson. Emotional contagion. *Review of Personality and Social Psychology*, 14: Emotion and social behavior:151–177, July 1992.

[3] E. Hatfield, J. T. Cacioppo, and R. L. Rapson. *Emotional Contagion*. Studies in Emotion and Social Interaction. Cambridge University Press, Cambridge, England, July 1994.

[4] SIEMPRE Project Consortium. D1.1: Research Requirements. Technical report, Mar. 2011.