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Incorporating Affective Computing Into an Interactive System With MakeyMakey:
An Emotional Human-Computer Interaction Design

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ABSTRACT

People's emotions or behaviors often ensue from positive or negative emotions. Whether set off subconsciously or intentionally, these fragmentary responses also represent people's emotional vacillations at different times, albeit rarely noted or discovered. This paper presents a system that incorporates affective computing into an interactive installation. While a user is performing a task, the system instantaneously and randomly generates corresponding musical-instrument sound effects and special effects. The system is intended to enable users to interact with emotions through the interactive installation to yield a personalized digital artwork while learning how emotions affect the causative factors of consciousness and personal behaviors. At the end of the process, three questionnaires are presented for users to fill in as a means to enhance the integrity and richness of the system and its stability and precision through progressive modifications aligned with user suggestions.

KEYWORDS

Affective Computing, Digital Art, Facial Recognition, Interactive Installation, MakeyMakey, Musical Art

INTRODUCTION

The history of music is very long, and the genres and constituent elements of music vary across countries. With its ubiquitous presence, music enriches human life and affects human emotions (Arjmand, Hohagen, Paton, & Rickard, 2017). In the past, the musical expression of emotions could only be conveyed by using physical instruments or by singing. However, with the advancement of information technology, the manifestation of musical art should break free of a musician's constraints and reach out to the general public while returning to music's original intent. A system that offers simple operations and interfaces without compromising its accuracy can hopefully instantaneously present a user's most authentic feelings, thus generating a personalized digital artwork (Geng & Cao, 2019). Combining an interactive installation with emotional-recognition technology, this system allows users to manipulate sound shadows; furthermore, it randomly generates corresponding sound effects to raise users' sense of participation in the operation and to facilitate their emotional release to some

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degree. Combined with augmented reality (AR) experiences, this system promotes the embodiment of musical performances, bringing users a brand new visual and auditory feast (Coulton, Smith, Murphy, Pucihar, & Lochrie, 2014).

Facial recognition is chosen as the distinguishing criterion for affective computing rather than other elements. Compared with other decision elements such as heart rhythm, body temperature, and skin conductance, facial recognition offers immediate, precise numerical variations and considerably high accuracy (Wegrzyn, Vogt, Kireclioglu, Schneider, & Kissler, 2017). Therefore, this technique is considered more suitable for the present study's support and augmentation. However, merely digitizing the aforementioned physiological data and movements seem rather dull. This system materializes feelings from the mental level. It allows users to control the variation of sound shadows through an interactive installation, thereby heightening their sense of participation in operating the system and making it more stimulating and interesting to use (Duarte, Gonçalves, & Baranauskas, 2018).

Our ultimate objective is to bring digital art closer to people's lives using the abovementioned information technology and to eradicate further misunderstandings resulting from differences between research fields, shortages of knowledge and technology, or even age barriers. It stands to reason that digital art should go beyond specific ethnic groups and become integrated into daily life. Hopefully, a system that runs with simple operations and interfaces without losing its accuracy can instantaneously present a user's most authentic feelings and further generate personalized digital artwork.

Therefore, our research focus addresses the following questions:

1. How to automatically generate a tune corresponding to users' mindset based on computing the emotional data they enter at will?
2. How to convert the musical attributes of the input from the installation to a value that is calculable by the computer?
3. How to judge the emotionality of music? What musical attributes can be used as a basis for such judgment?
4. Can this system offer users a deeper understanding of and familiarity with digital art?
5. Can this system promote users' willingness and propensity for artistic creation?

RELATED WORK

Human-Computer Interaction

To understand the meaning of human-computer interaction, we must first define what a human-computer interface is. Namely, it is the front across which humans and computers communicate, and this communication is the most important factor besides the humans and computers themselves (Siricharoen, 2019). This communication is called interaction; Preece et al., (1994) postulated that human–computer interaction helps users achieve high efficiency and safety, making operation more convenient. In other words, it takes adequate, appropriate communication between users and the information system to efficiently complete work. Human-computer interaction studies the interactive relationship between a user and a system, which can be composed of various machines or computerized systems and software; the category is broad enough to include everything from computers to interactive installations. It is a design for enjoyment and experience, and all interfaces should consider bringing the experience as close as possible to humanity, nature, and intuition. Thus, two principles for designing human-computer interaction are proposed: direct manipulation and direct engagement, enabling users to interact with the system more directly (Bachmann, Weichert, & Rinkenauer, 2018).

Most early research on human-computer interaction cited theories of cognitive psychology (Brave & Nass, 2009; Card, Moran, & Newell, 1983), such as users' information-processing behaviors. The bases of such theories were constructed through cognitive studies of users interacting with computers. However, cognitive psychological research that leaves out relevant systems and situational factors