Enhancing Musicality In Computer Music Interfaces With Reality-Based Interaction Techniques

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ABSTRACT
Post-WIMP interfaces have the potential to help improve musicality in computer music systems. This paper describes a research project that explores the use of reality-based interaction techniques for musical interaction, and examines HCI methodology for evaluating this style of interactivity.

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Computer Music, Interfaces, Interaction, Computer Vision, Evaluation

ACM Classification Keywords
H.5.2 User Interfaces: Evaluation/Methodology, Interaction Styles, User-centered design; H.5.5 Sound and Music Computing: Methodologies and Techniques, Systems; I.2.6 Learning: Connectionism and neural nets; I.5.4 Applications: Computer Vision

INTRODUCTION

A fundamental quality of a musical system is its musicality: the degree to which the system is, in itself, actually musical. Musicality is taken for granted in acoustic instruments which have typically evolved over generations to suit musicians' needs, however this is not the case with modern computer music systems, which bring with them new sets of issues: redefinitions of the concept of musical instruments, extra levels of abstraction, and new challenges to solve in interactivity.

Interactivity and musicality are inextricably connected; to play an acoustic instrument is to engage in an embodied interaction where boundaries between the musician and instrument are blurred, the instrument becoming an extension of the player. Interaction like this, between musician and instrument, can be seen as natural and intuitive, and potentially also as a flow experience [4, 6]. These terms do not so often describe the interaction with computer music systems; for example Armstrong [2] describes a 'disconnect' between performers and digital instruments, where instruments fail to provide the potential for an involved and engaged experience and therefore limit musical interaction.

This paper presents a research project which explores musicality in computer music systems; it focuses on three themes concerned with enhancing musicality: the nature of interaction between musicians and computer music systems, the use of novel interaction techniques to improve musicality, and methodology for evaluating musical interaction.

In order to ground this research project, it's important to define the concept of musical instruments in the context of computer music. With digital instruments it's possible to separate the sound source and controller. While some view a musical controller itself as an instrument, for this project it's more relevant to take Jorda's [8] holistic view of digital instruments as being the sum of all parts. In the context of computer music this might include multiple controllers and multiple modes of control, for example a software instrument might be operated in design time from a mouse and keyboard and in performance time from a piano style controller. These boundaries between performance and design time are often blurred [3] so it's important to consider musicality in terms of the complete system rather than just the performance controller. While numerous research projects (e.g. from the NIME community [1]) have examined musical interaction for performance, there are fewer that look at digital instruments in this holistic sense. To emphasise this, Serra et. al.'s [12] 2007 roadmap for future computer music research comments on the weakness of current musical interfaces and identifies interactivity and controllability as key areas that the next generation needs to focus on.

A key cause of this weakness is the reliance on mouse and keyboard for control. These prohibit any sense of embodied interaction, something that is so fundamental to musicality. Jacob et. al. [7] proposed the term Reality-Based Interaction (RBI) to describe post-WIMP interfaces that go beyond the mouse and keyboard. This is an area that is already proving to be fruitful for musical interaction, and is the area where this project focuses: how can RBI control techniques be employed to enhance musicality in computer music systems?

Complementary to interaction design is evaluation method-

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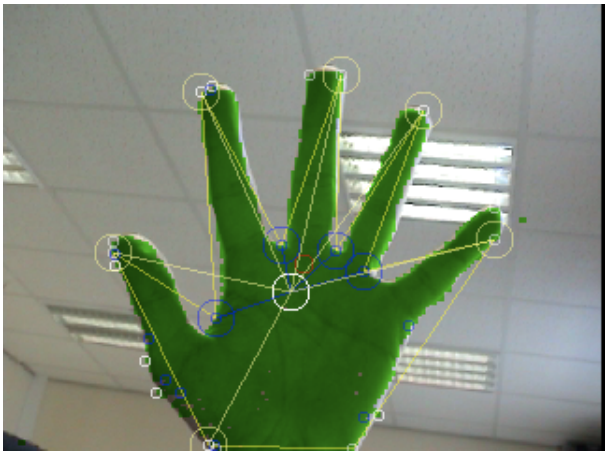

Figure 1. A hand tracking software analysing a hand shape

ology, and this is the second area of research in this project. Musical interaction involves a rich set of dynamics between player and instrument, and to evaluate this complex interchange we need to look beyond functionality. There is a growing body of research [9] investigating this area though little of it focuses on music. A key aim for this project is to look at how evaluation tools and methods can be adapted and improved for use in the specific case of evaluating musical interaction.

APPROACH AND PROGRESS

With a view to effectively evaluating future designs, the topic of evaluation of musical interfaces was addressed as an initial step; the first experiment was a usability evaluation of Nintendo's Wiimote as a musical controller. The results provided some methodological and practical insights into running a musical usability study [11], and also some useful usability advice for musicians wishing to employ the Wiimote in their own projects [10]. A key issue that this study highlighted was the need for more research into evaluation methodology for musical systems.

The current phase of research involves two interconnected projects, firstly the design of a new prototype gestural interaction system for the control of musical interfaces, and secondly an exploratory study to examine musicians relationship with the interfaces they use.

The gestural control system is a hand movement recognition system that uses a combination of computer vision and artificial intelligence techniques to enable a musician to control music software. Hand movement was chosen for it's potential for intuitive feel and possibilities for complex interaction, something which could mirror the interface of an acoustic instrument in it's ease of use and yet potential for virtuosity.

The system works in two stages. First, the user's hand is presented to the video camera. It uses a neural network to learn their skin colour so as to pick out their hand from the background. The next step is to analyse hand shape and movement; Andy Clark [5] argues that artificial intelligence systems work well when presented with realistic perceptual representations as parameters rather than raw data, and the system follows these guidelines. Computer vision algorithms make a set of observations about the hand and these are used to train a Support Vector Machine classifier to recognise hand shapes. The combination of hand shape data along with variables that track hand position, hand depth and finger tip positions can then be used to control music software.

With the prototype system now working, the next stage is to investigate mappings between the hand tracking system and music software, and look at ways in which software can by enhanced by this modality of interaction in order to improve musicality. This process raises questions about merging new control interfaces with existing software; can good results be obtained from mapping gestural interaction onto a GUI originally designed for mouse and keyboard use, or does the GUI need to be redesigned from the ground up to take full advantage?

The second project is an exploratory study to examine the nature of computer musicians' relationships with the systems they use. This study is currently in its initial stages, and involves a combination of informal interviews and an examination of the experiential aspects of musical interaction inspired by cultural probes. During the session, participants are interviewed to gather information about the musical interfaces they use, what they like and dislike about interacting with computer music instruments in general, and what they perceive as being ideal qualities of interfaces. They also try out the hand tracking software, and are asked to discuss aspects of this mode of interaction. Participants are asked to bring in photos and audio from the environment in which they make music, and are also requested to keep a diary of their music work. The study is an attempt to obtain some generalized data about computer musicians and the interfaces they use in order to inform more formal research later on. The results should provide a basis for next stage of the research project, and also provide some valuable initial feedback for the hand gesture system.

FUTURE WORK

The overall aim of the project is to continue to use RBI interfaces to investigate the nature of musical interaction and in turn to see how these types of interfaces might be used to enhance musicality. In the near future, the results from the exploratory study will be used to enhance the hand gesture system, preceding a full formal evaluation. One possible extension to the hand gesture system is to introduce some physical feedback; the results of the Wiimote experiment showed that users would like feedback to help make limits of control areas more tangible, and to this end a prototype system for tactile feedback is under construction, using small scale vibrating motors. To continue the second branch of research into evaluation methodology, an experiment is planned to test out *third wave* HCI user experience oriented evaluation techniques in musical contexts, to see which are best suited for this type of study, and to see how they might be modified

to work more effectively for evaluating musical interaction.

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