Design of an alternative controller from an industrial design perspective

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ABSTRACT

Industrial designers frequently deal with issues of how products are perceived and used in addition to their manufacture and production. This paper briefly discusses the application of a model of human-machine interaction to musical instruments and the design of an alternative MIDI controller.

1. INTRODUCTION

The first step in designing a product is to define the users' task. Clarke (1988), in a discussion of musical interpretation, states "If ...artistry is the primary aim [of music], then prescription [of performance issues] is both impossible and inappropriate", and "...while the expressive resources may be outlined, their precise disposition ...can be accounted for only in retrospect, not predicted." Clarke's comments indicate it is not only undesirable but impossible to precisely define the musicians' task. The designer's goal must then be to provide the "expressive resources" necessary for artistic interpretation.

Understanding the design issues presented by an alternative controller can be difficult, especially when the controller is not based on an existing instrument or a familiar metaphor. Designers can deal with some of the complexities of musical instruments by taking the view that instruments are machines for making musical sounds and using a model of human-machine interaction. An interaction model suitable for this purpose can be found in Rasmussen (1986). This model ties together human performance, information processing and human-machine interaction.

2. MODELLING MUSICAL INSTRUMENTS

Rasmussen classifies activities as skill-, rule- or knowledge-based behaviours. These behaviours form a continuum as knowledge is used to form rules and rules, in turn, are followed to develop skills. Associated with each behaviour is a corresponding manner of perceiving information. Signals, signs and symbols, respectively, are generally defined by the behaviour resulting from their perception. The same stimulus might act as a signal, sign or symbol, depending on the actions of the person perceiving the stimulus. Skill-based behaviour is a sensorimotor reaction to signals (sensory stimuli and feedback) where actions and adjustments take place without conscious effort. The rapid and coordinated movements required for musical performance are obviously skills. Rule-based behaviour is triggered by signs and consists of actions determined by stored rules or procedures. In music, a sign could be a conductor's gesture or a marking in a musical score. Knowledge-based behaviour uses symbols to represent complex ideas and occurs when rule- or skill-based behaviours are not applicable. Knowledge is used to reason about the operation of a system (such as an electronic instrument) as it responds to actions. The user develops knowledge through repeated goal-setting and testing. Electronic musical instruments and controllers usually require significant knowledge-based behaviour to realize their full range of musical expression.

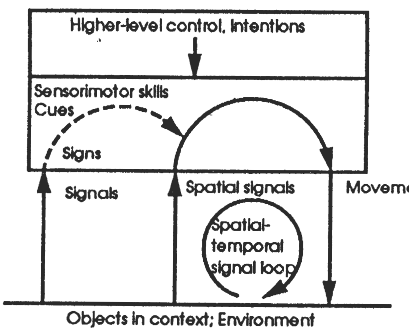

Figure 1. Direct manipulation (after Rasmussen, 1986)

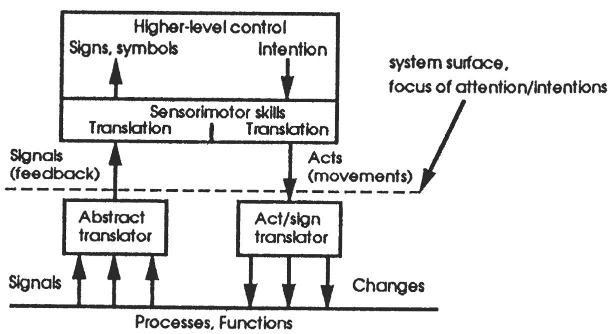

Figure 2. Remote process control (after Rasmussen, 1986)

Rasmussen gives four variations of a model for using tools or machines. Most acoustic instruments conform to his direct object manipulation (Fig. 1). The user manipulates the object (instrument) directly to produce a change in the environment (sounds). Objects are perceived in terms of their functional implications, and intentions toward objects are formed as acts to perform or goals to reach, not generally as movements. The action or pattern of movement released upon the object is affected by space-time signals. These signals are feedback used to modify the user's internal model. Electronic instruments can be considered a case of Rasmussen's remote process control (Fig. 2) in which a task is typically the manipulation of an invisible process. (We hear the results of an invisible sound synthesis process, not the process itself.) When the time-space signal loop is broken by a mediator in both the act and signal channels, the user focuses attention and expresses intention at the surface of the system. The manipulation of controls usually transmits coded information, not space-time signals. Skills are then devoted to translation tasks, sign recognition and interface manipulation. Other musical instruments, such as the pipe organ or electric guitar, follow Rasmussen's indirect or remote manipulation.

Rasmussen feels system control interfaces should aim at eliminating translation tasks so skills may be applied directly to the main task. Even though in remote process control the user is manipulating a representation of a process, it should 'feel' like direct manipulation. To accomplish this, the translators between the system surface and the process must make visible the invisible process. The translators in a sense become transparent, allowing users to feel as though they are in direct contact with the process.

3. CONTROLLER DESIGN

The primary goal of the controller design is to increase transparency between the user and the generation of sound in performance situations. One way of achieving this is to provide a system surface that will respond to a variety of gestures, and give musicians control over what effect their gestures have on the sounds produced. Musicians then have the power to design their own 'translators' for performance gestures, thereby becoming more physically involved with the expressive resources possible in the electronic generation of sound.

The controller consists of two elements: a control or system surface generating MIDI data and a Macintosh computer running *MAX* (Puckette, 1988). A *MAX* program allows users to design their own translator between the physical controls and the sound synthesis engine. The same physical gesture might have a different effect, depending on how it is translated. Currently, the controller drives a Korg Wavestation synthesizer. *MAX* is also used to supply visual feedback for the user as signals, signs or symbols (discussed above). The controller allows musicians to shape individual musical events (notes, sounds, musical phrases or sequences) through time. Events are triggered monophonically; however, several events can run simultaneously to permit forms of polyphony.

The design provides a different control surface with multiple dimensions of control for each hand. The left hand operates a specially designed joystick having four dimensions of control. Several switches located under the fingers of the left hand select a translator for the joystick. The right hand operates a five key chordic keyboard that generates note on/off, velocity, aftertouch and pitch-bend data. These devices were chosen because while their basic operation is easy to understand, each device has nuances of operation for the musician to explore and master.

Physically, the controller is designed so the performer's hands remain visible to an audience. The hands are maintained in a horizontal and relaxed position, and both finger movements and arm movements are used while playing. The controller is designed to be used in a comfortable standing or sitting position.

Future work will focus on providing tactile feedback from the sound engine to the musician. Such feedback is important for development of the motor skills associated with expert performance. Recent developments in providing digital signal processing capabilities within the *MAX* environment also presents exciting opportunities for musicians to participate more directly in the generation and shaping of musical sounds.

4. REFERENCES

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